Canadian
Transportation
Research
Forum

CTRF

24th Annual Meeting
Halifax, Nova Scotia

Transportation Strategies for Success

Les stratégies de transport conduisant au succès

24ième Conférence
Annuelle
Halifax, Nouvelle-Écosse

GRTC

Groupe de
Recherches sur les
Transports au
Canada

Canadian
Transportation
Research
Forum

CTRF

24th Annual Meeting
Halifax, Nova Scotia

Transportation Strategies for Success

Les stratégies de transport conduisant au succès

24ième Conférence Annuelle
Halifax, Nouvelle-Écosse

GRTC

Groupe de
Recherches sur les
Transports au
Canada

Proceedings Printed by

University of Saskatchewan
Printing Services

PRESIDENT'S MESSAGE

Welcome to the 24th annual meeting of the Canadian Transportation Research Forum.

This year's theme is "Transportation Strategies for Success." One of the strategies for successful conferences is to choose effective organizers and let them get on with the job. CTRF has been highly successful again this year. Mary Brooks took on the frustrating but crucial task of organizing the program. I don't know what strategies she followed but they appear to have worked. Patricia McDermott has succeeded in lining up sponsors, meeting rooms and entertainment for us. We all are grateful for their effort.

This year's meeting continues our tradition of providing a platform for the presentation of specific research results and a forum where research and analysis is extended to practical management and public policy issues. The papers and panel discussions indicate that we have lively and worthwhile sessions ahead. Research, analysis and informed debate are crucial elements in "Strategies for Success."

In addition to the many specific transportation topics on the program, there are a couple broad transportation developments which warrant attention and which need some "strategies for success." Although data and hard facts are difficult to come by, it appears that there is a decline in research and educational activity in Canadian transportation. This is a worrisome trend. CTRF has launched a scholarship program as one means of stimulating interest in graduate study in transportation. But more must be done if the intellectual infrastructure for transportation is to be preserved and upgraded. Please give some thought to this during your deliberations.

In addition to the program and conference organizers, I wish to thank the members of the CTRF Board for all their efforts and encouragement during the past year. It has been a privilege to serve as President for such a distinguished organization. My best wishes for our 24th annual meeting.

W.G. Waters II
President

The Canadian Transportation Research Forum assumes no responsibility for the content of the papers published herein nor for any errors or omissions in the printing of this volume. These papers are published by CTRF as a means to disseminate transportation research and to encourage discussion on a broad range of issues during the CTRF Annual Conference.

CANADIAN TRANSPORTATION RESEARCH FORUM

EXECUTIVE - EXECUTIF

PRESIDENT
Wm, G. Waters II, University of British Columbia

EXECUTIVE VICE PRESIDENT
Eugene M. Ludwick, E.M. Ludwick and Associates Ltd.

SECRETARY
Frank Trotter, The Trade and Transportation Group

TREASURER
Richard Wansbutter, Grain Transportation Agency

VICE-PRESIDENT, EXTERNAL AFFAIRS
Andrew Elliott, PCS Sales

VICE-PRESIDENT, MEETINGS
Patricia McDermott, Halifax-Dartmouth Port Development Commission

VICE-PRESIDENT, ORGANIZATION & DEVELOPMENT
T.W. Phillips, CP Rail

VICE-PRESIDENT, PROGRAM & PUBLICATION
Mary Brooks, Dalhousie University

IMMEDIATE PAST-PRESIDENT
Craig S. Dickson, National Transportation Agency

CHAIRMAN, STUDENT PAPER COMPETITION
Andre Pageot, Transport Canada

COUNCILLORS
Lloyd Ash, Trimac Consulting Services Ltd.
B.G. Bisson, University of New Brunswick
Michael Boucher, Universite du Quebec
T.E. Culham, Council of Forest Industries of British Columbia
Julien Dupont, Ministere des Transports, Province of Quebec
Donal A. Hall, Misener Shipping
J. David Long, Canadian Industrial Transportation League
Roger Roy, National Transportation Agency
Peter Schwartz, CN Rail
Gordon A. Sparks, University of Saskatchewan
Rod B. Taylor, Ministry of Transportation, Province of Ontario

THE 24th ANNUAL CONFERENCE OF THE CANADIAN TRANSPORTATION RESEARCH FORUM

TABLE OF CONTENTS

Monday, May 29, 1989		Page
08:45-10:15	Session 1: Opening Plenary - Nova Scotia "C"	
10:30-12:00	Session 2: Regulatory Reform - Nova Scotia "C"	
	"Western Grain Transportation Act: Ideals versus Performance" Henry R. Ropertz, Western Economic Diversification Office	1
	" The Early Results of Transportation Regulation Reform in Canada - Revisited" F.E. Collins and J.M. Bowland, Peat Marwick Consulting Group	21
	"Regulatory Change in Transport to the Year 2000" John Heads, University of Manitoba Transport Institute	29
10:30-12:00	Session 3: Maintenance of Roadbed Integrity - Nova Scotia "D"	
	"A Game Theory Approach to Truck Weight Regulation Enforcement" Marvin D. Hildebrand and Barry E. Prentice, University of Manitoba Transport Institute	43
	"Aspects of Overweight Trucking in Manitoba" A. Clayton and R. Girling, Dept. of Civil Engineering, University of Manitoba	57
10:30-12:00	Panel 4: Port Marketing - Annapolis	
	"Transportational System Analysis in the New Environment: A Case Study" M.C. Ircha, F.R. Wilson, J. Christie and G. Hogg, UNB Transportation Group	68

13:45-15:15 Session 5: Highway Safety Issues - Annapolis

"An Analysis of the Use of Daytime Running Lights in the CVA Fleet in Saskatchewan" 82
Gordon A. Sparks, Russell D. Neudorf, Anne E. Smith, and Glen Parker; Clayton, Sparks & Associates Ltd., Decision Focus Inc., SaskAuto

"Testing and Safety/Monitoring Devices in the U.S.: Driver and Industry Perspectives" 96
Russell B. Capelle Jr.and Richard Beilock, Institute of Food and Agricultural Sciences, University of Florida

13:45-15:15 Panel 6: Technological Developments in the Rail Industry- Nova Scotia "D"

13:45-15:15 Session 7: Privatization - Nova Scotia "C"

"A Model for the Privatization of Rail Passenger Services in Canada" 111
R. Soberman and A. Cubukgil, University of Toronto/York University Joint Program in Transportation/Transmode Consultants

"Maritime Privatization" 124
John L. Eyre and Dimitri Plionis, Arthur Young International

"Establishment of Airport Authorities in Canada" 141
Ron Gilbertson, Regional Airports Task Force Association

15:30-17:00 Session 8: LTL Trucking - Nova Scotia "C"

"The LTL Market in Quebec: A Sectorial Approach" 151
Yvon Bigras and Jacques Roy, Groupe de recherche en gestion des transports, Universite du Quebec a Montreal

"Relationship between Costs and Rates in the Less-than-truckload Market" 163
Bill Raney, Goods Distribution System Office, Ministry of Transportation, Ontario

"The Role and Contribution of the Trucking Industry in Ontario" 178
John Farrow, Bill Empey, Paul Inglis, Anthony Koh, Jerry Brown and David Bradley, Coopers and Lybrand Consulting Group/ Ontario Trucking Association

15:30-17:00 Session 9: Technological Innovation and Strategic Decision-Making - Nova Scotia "D"

"Increasing the Rate of Technological Innovation within the Transportation Industry" 201
L. B. Ayers, Dept. of Civil Engineering, University of Saskatchewan

"Strategic Choice of Transportation Technology" 212
E. Frankel, Massachusetts Institute of Technology

15:30-17:00 Panel 10: Canadian Tax Policy and Ship Ownership and Management in Canada - Annapolis

Tuesday, May 30, 1989

08:45-10:15 Session 11: Price Indices/Trucking Statistics - Acadia A/B

"Indices de prix du camionnage pour compte d'autrui au Canada" 225
Bruno Jacques, Transports Canada

"Price Indices for the Quebec Trucking Industry: An Exploratory Investigation" 240
Michel Boucher, Ecole nationale d'administration publique, Universite du Quebec

"A Model for an Integrated Motor-Carrier Statistical System" 250
S.L. Mozes and B. Bekooy, Statistics Canada

08:45-10:15 Panel 12: Cost Allocation - Nova Scotia "A"

"Recovering the Costs of Transport Infrastructure: Canada's Proposed New Policy" 270
J. A. A. Lovink, Cost Recovery and Economic Evaluation, Transport Canada

"The Role of Benefit-Cost Analysis in Public Investment Decisions: Transport Canada's Experience" 272
E. K. Culley, Economic Evaluation, Transport Canada

10:30-12:00 Session 13: Routing and Operations Planning - Acadia A/B

"Computer-Aided Algorithmic Design in the Vehicle Routing Domain" 273
Jean-Yves Potvin, Guy Lapalme and Jean-Marc Rousseau, Centre of Rechechre sur les Transports, Universite de Montreal

"Slot Values and Market Entry in a Single Hub Airport System" 288
John Brander, B.A. Cook and John E. Rowcroft, Dept. of Economics, University of New Brunswick

"Micro-Economics of Freight Car Supply and Demand" 304
Douglass W. List, Catherine S. Cook and George F. List; Management Consultant, Planning Associates, Rensselaer Polytechnic Institute

10:30-12:00 Session 14: Cost Recovery in Surface Transport - Nova Scotia "A"

"Road-User Costs: Report on Exploratory Research" 314
Fred Nix, University of Toronto/York University Joint Program in Transportation

"Modal Competitive Balance in Canadian Surface Transportation" 318
Mr. Paul Kerry, CP Rail

"Road Cost Recovery Issues in Australia" 333
George Docwra and Garland Chow, University of Queensland/University of British Columbia

10:30-12:00 Session 15: Logistics - Annapolis

"A Logistical Analysis of Table Potato Marketing in Manitoba" 360
Barry E. Prentice and Jock Langford, University of Manitoba

"Potential Savings Through the Elimination of Empty Truck Movements" 375
W. Raney and K. Siwak, Ontario Ministry of Transportation

"Slow but Sure: Responsibility for Delay in the Delivery of Multimodal Cargoes" 390
Hugh M. Kindred, Faculty of Law, Dalhousie University

13:45-15:15 Session 16: Financing Issues- Annapolis

"Public/Private Sector Financing Techniques for Urban Transit in Canada" 403
R.G. Rice and Torill Kove, School of Urban Planning, McGill University

"Highway Finance - Theories, Principles, Controversies" 419
B.G. Bisson and E. Hildebrand, UNB Transportation Group

13:45-15:15 Special Panel 17: EDI for the Transport Industry - Acadia A/B

13:45-15:15 Session 18: Air Issues - Nova Scotia "A"

"Frequent-Flyer Programs: Marketing Bonanza or Anticompetitive Tool?" 433
Michael W. Tretheway, Faculty of Commerce and Business Administration, University of British Columbia

"Applying the New Competition Legislation to the Deregulated Airline Industry: The Case of Computer Reservation Systems" 447
W.B. Jankowski, Dept. of Economics, Lakehead University

"A Methodology for Airport Economic Impact Studies" 462
T.M. Mazerolle and B.G. Bisson, UNB Transportation Group

Wednesday, May 31, 1989

8:45-10:15 Session 19: Human Resource Development and Management - Annapolis

"Employment Trends and Wage Rates in the Trucking Industry" 475
Adil Cubukgil and Maryann Lovicsek, Transmode Consultants Inc.

"Executive MBA Program for Transportation Managers" 488
William D. Taylor, Concordia University

8:45-10:15 Session 20: Transborder Issues - Acadia A/B

"Petroleum Pipelines: The Dimensions of the U.S. Industry and its Relationship to Canada" 496
Leonard L. Coburn, Division of Competition, US Dept. of Energy

"Scheduled Air Services Between the United States and Canada" 510
Ira Gesser and David B. Vellenga, Arizona State University

"Transportation Rates and Seaway Competitiveness for Exporting U.S. Grain" 523
Hazem Ghonima, TAF Consultants

10:30-12:00 Session 21: Forum -- Transportation Education - Acadia A/B

Western Grain Transportation Act: Ideals versus Performance

Henry R. Ropertz[1]

On November 23, 1983 the Western Grain Transportation Act (WGTA) became law. The new legislation replaced the Crow's Nest Pass freight rates for moving grain with statutory rates which were intended to "adequately" compensate the railways for moving grain, in return for performance and investment guarantees. It was also intended that the cost for moving grain by rail would be shared by the federal government and the 140,000 prairie producers. In other words, the freight rate paid by grain producers was expected to gradually increase on an annual basis depending on the volume of grain moved.

It was further intended that the legislation would lay the ground work toward the development of a more cost-effective and efficient transport system in western Canada. This development in turn was to be part of a comprehensive solution to the recurring problems of inefficiency and high cost in the grain handling and transportation system (GHTS). Finally, the annual rate increases were expected, over time, to remove the distortions to the western livestock and processing industries created by maintaining low transport rates for raw grains.

---

[1] Manager, Transportation Policy and Planning, Western Economic Diversification Office, Vancouver, British Columbia. The views expressed in this paper are those of the author and do not necessarily reflect those of the Western Economic Diversifications Office. The author wishes to acknowledge Dr. Art Wilson who reviewed the paper and provided helpful suggestions.

This paper examined the impact of the WGTA on the grain handling and transport system over the last five years. The conclusions are:

1. The GHTS remains a high-cost and over-regulated system. Rather than facilitating the reduction of regulation, the WGTA continues to represent stringent regulation.

2. There have been no significant efficiency measures introduced into the system since passage of the WGTA. The institutions created by the legislation have not been successful in creating efficiency opportunities.

3. Changes to the system continue to be made on a piece-meal basis rather than part of a comprehensive program as expected by planners of the WGTA.

4. In real terms, grain producers are paying less today to move grain than they did in 1983-84.

5. The low grain rates continue to favour the movement of bulk grain and oilseed exports. These distortions continue to undermine the diversification of agriculture on the Prairies.

6. The railways are being "adequately" compensated for moving grain.

7. The last five years has seen direct government intervention on the level of freight rates. However, under the WGTA freight rates will automatically increase unless they are offset by direct intervention in either the rate setting process itself or in the form of subsidy as was the case in 1987-88 and 1988-89.

It should be pointed out that not all of the above conclusions can be blamed on the legislation. Indeed, a significant proportion of intended rate increases in the 1987-88 and 1988-89 crop years were offset by government intervention and many system improvements were not realized because of the inability or unwillingness of system participants to

reach consensus. This inaction locks grain producers into an unnecessary high cost system.

Western Grain Transportation Act

The Western Grain Transportation Act (Bill-155) was introduced in the House of Commons on May 09, 1983 by then Transport Minister, the Honourable Jean-Luc Pepin. Approximately 2 1/2 years of intensive negotiation, consultation, argument, bickering, lobbying and compromise had produced a document which still lacked a broad base of support. For nearly three years, Transport Minister Pepin had tackled one of the country's largest standing problems, mastering its technical difficulties with passion, dedication and diligence. In this period he gained the confidence if not the support, of producers, elevator companies and the railways. It is to his credit that the Bill although fraught with problems still contained significant clauses which were designed to lead the Prairie grain industry out of the 19th Century.[1]

Bill C-155 had tied-up business in the House of Commons for two months. The Opposition had introduced 170 amendments. The Speaker had ruled nearly half of them out of order. Parliament was debating the level of freight rates that western grain producers paid to move their grain by rail to port for export. The rates were so low that it cost more to ship a one ounce letter from Moose Jaw, Saskatchewan to Vancouver than it did a 60 pound bushel of Number 1 Canadian Western Spring Wheat.

On November 15, 1983 by a vote of 141 to 114, the House of Commons passed Bill C-155 undoing legislation which had been put in place 58 years earlier by another Parliament. The debate over the Crow Rate was arguably the angriest since the flag debate in June, 1964. On November 23, 1983, the legislation was formally proclaimed law. It was 9 years to the day that former Transport Minister Otto Lang first petitioned cabinet to change the Crow Rate.

Main Features of the Act[2]

The first 34 sections of the Act (Part I) are devoted to administrative measures. This part establishes the Senior Grain Transportation Committee (SGTC) and defines its membership and responsibilities, and establishes in law the Grain Transportation Agency Administrator, his office and staff and defines his responsibilities. The Act enables the SGTC (comprised of grain industry representatives) to advise the Minister of Transport on any matter affecting the transportation, shipping or handling of grain including capacity and efficiency measures and allocation of available railway cars. Unfortunately the Act is difficult to comprehend by the layman.

There is no longer a fixed rate on grain as established in 1899 and which lasted for 84 years. However statutory protection continues to ensure that the railways are not in a position to overcharge producers. Nevertheless, the railways are "adequately" compensated for moving grain. The second part of this paper examines to what degree the freight rate paid by the producer reflects the cost.

Government and Producer Financial Contributions

Every year the federal government pays directly to the railways the Crow Benefit (the difference between the real cost of moving grain in 1981-82 and what the producers paid under the Crow Rate). Between 1984 and 1988 this represented a total payment of $2.4 billion.

The WGTA also provides the western grain producers with two unique forms of protection from both inflation and low grain prices. The grain producer will never face an annual cost increase above six percentage points. Since the WGTA was passed, inflation rates have not as yet reached 6 percentage points. In addition to this cost-sharing provision, freight rates will not be allowed to exceed 10 per cent of a "basket" price of grain or an average of the six major grains. This is in recognition that grain producers have little control over international grain prices.

Railway Guarantees and Obligations

In return for being adequately compensated for moving grain, the railways are required to ensure an adequate, reliable and efficient railway system for the movement of grain. If this is not done the legislation provides for financial holdbacks. As well, the railways are providing annual information on capital investments related to grain movements.

The legislation contains a number of other provisions including payments to BC Rail for movement of statutory grain out of the Peace River Region of North-East British Columbia and for agreements to provide for the movement of grain by truck where interests of grain producers can be realized. Interestingly, the legislation also provided for application from shippers to the railways for variable or incentive rates at specific delivery points.

Purpose of the Act

It was anticipated that legislative changes to the Crow Rate would eventually lead to a more cost-effective and efficient grain handling and transport system.

It was further expected that based on the rate-setting formula in the WGTA that grain producers would be paying approximately 60 per cent of the cost of moving by grain by 1995 as compared to the 20 per cent level represented by the Crow Rate.

As a result of these rate increases, the distortion now faced by the western livestock sector would be diminished.

Finally, the opportunity provided to the SGTC and to the Grain Transportation Agency was expected to result in a lower cost grain transport system. These two institutions were expected to initiate major efficiency changes as part of an overall comprehensive solution to grain transport problems.

The second part of this paper examines to what degree these expectations were realized.

Impact of Western Grain Transportation Act

The current grain handling and transport system is huge and dynamic (See Table One) and concomitantly costly and inefficient. This is critical given that western Canadian producers must compete in a highly competitive world market and are forced to ship their products through two mountain ranges over longer distances than any of their competitors.

Not only is the prairie grain producer being ill-served by a high cost inefficient grain handling and transport system but also the grain sector remains one of the most regulated industries in the country. For example, entry of grain into the system is rigidly controlled by the Canadian Wheat Board. Movement within the system is controlled by no less than three agencies (the Wheat Board, Canada Grain Commission and the Grain Transportation Agency). Grain represents approximately 20 per cent of traffic moved by both CN Rail and CP Rail yet neither railway has any operational control of the grain in the collection and delivery system. This prevents the introduction of lower cost alternatives such as unit trains, a concept utilized by the railways for the last 25 years in moving other commodities.

The Prairie rail line network is still comprised of 75 per cent of the trackage in place in 1930 when grain was delivered by horse and wagon. Most of this trackage is protected by Order-In-Council from any abandonment consideration before the year 2000.

This large rail network has not prevented either the decline in the number of farm units nor the consolidation of elevator and delivery points (See Table Two). Approximately 1/5 of existing prairie delivery points account for 50 per cent of grain receipts and about 30 per cent of grain producers currently account for 80 per cent of grain production.

The net result is an inefficient and high cost grain handling and transport system which, while serving grain producers, contributes little to their competitiveness in the world market. In addition, the existence of a significant grain transport subsidy paid annually to the railways removes the geographical advantage of the Prairies as being a major supplier of feed grains. This distortion discourages the diversification of agriculture on the Prairies.

To test the impact of WGTA in meeting its intended objectives four areas are examined: Grain Volumes; Grain Freight Rates; System Efficiencies and Method of Payment.

Grain Volumes

One of the most significant events which triggered changes to the Crow Rate was experienced during the period between 1977-79 when it was estimated that western grain producers had either to lose or defer approximately one billion dollars in grain sales due to transportation problems. As a result, a series of costly ad hoc programs to purchase hopper cars and repair branch lines were undertaken by the federal government with assistance from the three Prairie Provinces. As indicated in Figure One grain movements increased dramatically in the late 1970's and early 1980's. There is no doubt that those high volumes helped to create a favourable environment during the negotiation phase of Crow Rate reform. The WGTA ensures that the railways are "adequately" compensated for moving grain. This addressed the problem which saw railway grain-related losses reach $300 million per annum in 1982-83. Under WGTA railway costs are determined on a system-wide basis ensuring that the railways are reimbursed regardless of inefficiencies in the system. This in turn, imposes these higher system costs on the federal government and grain producers with the result that all grain producers share the cost of providing service to high cost routes such as the line to the Port of Churchill and numerous branchlines on the prairies.

As a result of the WGTA grain companies have become major customers of the railways. Grain traffic is currently as attractive to the railways as other bulk commodities such as coal, sulphur, potash and lumber.

Grain Freight Rates

The average freight rate to ship grain by rail remained fixed at approximately $5.00/tonne between 1899 and 1983. The first rate increase came into effect on January 01, 1984. A second rate increase came into effect on August 01, 1984 and subsequent increases/decreases are set annually on August 01 and are in effect for the entire crop year. It was predicted that by 1995 Canada would be exporting 41 million tonnes and based on this volume, grain producers would be paying about 60 per cent of the cost. As indicated by Figure Two this does not appear likely. Increases in the rates for the first two years appear to be setting a trend line but by 1985/86, the rates actually decreased from $7.70/tonne to $6.00/tonne.

Under the WGTA grain freight rates must be determined in advance of the crop year in which they will apply. Projections must be made as to volumes and railway cost indices must also be determined in advance. This, as discussed by Tyrchniewicz and Wansbutter[3] (1987), is a difficult if not impossible task and if forecasts are too high - this can result in grain producers paying too much and require an adjustment to be made in the following year.

Although the Grain Transportation Agency is responsible for the volume forecasts, these projections can be influenced by either the federal government or the National Transportation Agency which is responsible for the final rate determination.

In 1987-88 the rate projection was set at $8.32/tonne but in late 1986 the federal government announced a $2.4 billion relief package primarily for Western Canadian producers. Included in that program was a $2.00/tonne subsidy to reduce most of the intended rate increase. In the following year, the federal government announced a further

$1.11/tonne subsidy to keep the freight rate at $7.27/tonne. In other words since 1983-84 the freight rate level initially set in 1899 had only increased about $2.27/tonne.

The Western Grain Transportation Act was supposed to gradually increase the grain shipper's share of the cost of moving grain but this has not happened, partly because of the rate-setting formula but also partly because of intervention. In fact, the shippers' share of the costs based on average freight rates are currently lower than when the Act was established in 1983.

System Efficiencies

In 1987, the federal government made significant changes to the National Transportation Act. Many of those changes were intended to reduce government regulation. Paradoxically, the railways were expected to operate with more regulations under this new Act than they did under the 1967 version. Even more significant was the situation where grain, despite representing 20 per cent of railway traffic, was not de-regulated at all. As a result grain movement continues under the rigid regulation imposed by the WGTA, the Canadian Wheat Board Act and the Canada Grain Act.

Despite this regulation, railways have made some improvements. For example, average train weight has increased by 12 per cent and car switching time has been reduced by 20 per cent[4]. In 1972, it took 9,600 boxcars to move 450,000 tonnes of grain. Today 9,600 boxcars can move 680,000 tonnes of grain in one week. No doubt, government(s) programs to purchase 19,000 hopper cars are the main reason of this improvement. The question is however, can the system be operated more efficiently with less cars?[5]

Under the WGTA future car purchases are to be made by the railways but paid for by the producers through increased rates. For this reason the WGTA provides an opportunity for the Senior Grain Transportation Committee to advise the Minister on ways to lower transport costs.

The Senior Grain Transportation Committee is comprised of representative from all the grain and transportation industry sectors including as of 1989, elected producers representatives (See Table Three).

The Committee meets on a regular basis but has been unable to reach consensus on any major policy issue which would result in significant cost efficiencies to the system. The SGTC has conducted extensive studies and has documented the cost of moving grain on high-cost branch lines. This study shows that the cost to provide rail service on prairie branch lines can range from as low as .04/tonne-mile to $1.03/tonne-mile.[6]

In 1977, the federal government announced a $700 million program to repair prairie branch lines. It is anticipated that the program will cost over $1.0 billion at its conclusion. In recognition of the high cost of rehabilitating/upgrading these lines, the federal government as part of the follow-up program to WGTA established a $50 million System Improvement Fund (SIR Fund). The SIR Fund was to be used to finance demonstration projects which could improve system efficiency. The SGTC was requested by former Transport Minister Crosbie in the Fall of 1986 to recommend proposals to improve efficiency. Prior to making this request, the federal government had already approved spending $13 million from the SIR Fund.

The SGTC recommended only one project at a cost of $500,000. In the Fall of 1987, the federal government announced a $4.7 million project to construct an off-track elevator at Valleyview, Alberta. Valleyview was never connected by a rail line. In fact, the SGTC itself had considered the Valleyview project but had concluded that the facility was too costly particularly when compared to direct trucking assistance.

Approximately 40 per cent of the SIR Fund has been committed and the future role of the SGTC in recommending further projects is obscure. No overall assessment of the various projects has been undertaken but at

best, the projects can only have a marginal impact on lowering transport costs.

As demonstrated by the work of the SGTC, real significant reductions can only come with further rationalization of the Prairie rail network and that has not happened. Branch line abandonment remains the responsibility of the National Transportation Agency.

The other area where significant efficiency gains can be made is making extensive use of unit-trains. However, car allocation remains under control of the Canadian Wheat Board and the Grain Transportation Agency. Though research in this area has been initiated by the SGTC it has not as yet recommended any changes in this arrangement.

Method of Payment

Throughout the Crow Rate debate, the most contentious issue was whether or not the grain producer should pay higher freight rates. However, by the Spring of 1982, it was possible to state that a general consensus existed that the railways lost money moving export grain and that the rate should be changed. The federal government had also committed itself to providing a grain transport subsidy. The debate then shifted to who should receive the federal government's subsidy, the railways or the grain producers. Table Four explains the differences between the two options.

The difference between federal payments to the railways or to producers is both contentious and complex. The main argument for payments to producers is to eliminate current distortions in the western agricultural economy arising out of the Crow Rate which work to the disadvantage of the production of livestock and other agricultural products. The price of feed-grains, oilseeds and other raw products on the prairies is the international price minus transportation costs. Since the Crow Rate keeps transportation costs at very low levels, farm gate prices for feed grains are kept artificially high. The pay-the-railway approach does not resolve the distortion, as grain

transportation costs (e.g. freight rates) paid by producers would remain at low levels, and thus feed grain prices on the prairies remain artificially high. The argument in favour of pay-the-railway is that the subsidy supports the movement of export grain and that as long as the subsidy goes to the railways, the federal government will not remove it. This is a comfortable position for all those who benefit from maintenance of the status quo.

Many compromises were attempted prior to the passage of the WGTA. In 1982 Dr. Clay Gilson, the federal government's Crow Rate negotiator proposed paying 81 per cent of the Crow Benefit to producers. This level would be phased in over an eight year period. This proposal was strongly opposed by the three Prairie Wheat Pools and the governments of Manitoba, Quebec and Saskatchewan. In 1983, Mr. Pepin attempted to sell a 50/50 proposal but eventually he was forced to withdraw this compromise. Under the WGTA the entire Crow Benefit is paid to the railways.

However, it was expected that under the WGTA, grain producers would eventually pay an ever increasing share of the cost of moving grain and as such, as the freight rate increased, the distortion against the western livestock sector would decrease. Traditionally Canada's agricultural policies have favoured bulk grain and oilseed exports. According to the Economic Council of Canada report on Handling the Risks: A Report on the Prairie Grain Economy[7], the value-added contents of Canada's agricultural exports is the lowest of any developed country with the exception of the United States.

As indicated in the section on grain freight rates, the anticipated increases have not been realized and the price of feed grains and processed grains on the Prairies remain artificially higher ($22.00/tonne in 1988) than they would be otherwise.

Conclusions

The purpose of this paper was to review the objectives of the WGTA and to examine what effect this legislation has had on the Prairie grain handling and transport system.

Four specific tests were examined. These included the impact of the WGTA: on the movement of record volumes of grain; on intended freight rate increases; on introduction of efficiency programs and on the development of further processing and livestock production.

The conclusions are:

1. The GHTS remains both a high-cost and over-regulated system. Rather than facilitating the reduction of regulation, the WGTA continues to represent stringent regulation.

2. There have been no significant efficiency measures introduced into the system since passage of the WGTA. The institutions created by the legislation have not been successful in creating either more efficiency or more cost-effective opportunities.

3. Changes to the system continue to be made on a piece-meal basis rather than part of a comprehensive program as expected by planners of the WGTA.

4. In real terms, grain producers are paying less today to move grain than they did in 1983-84.

5. The low grain rates continue to favour the movement of bulk grain and oilseed exports. These distortions continue to undermine the diversification of agriculture on the Prairies.

6. The railways are being "adequately" compensated for moving grain.

7. The last five years has seen direct government intervention in the determination of the level of freight rates. However, under the WGTA freight rates will automatically increase unless they are offset by direct intervention in either the rate setting process itself or in the form of subsidy as was the case in 1987-88 and 1988-89.

References

1. Ropertz, Henry "Canadian Federalism: A Major Constraint on the Development of National Transportation Policy: Lessons From Changes to the Crow Rate", Unpublished Ph.D. Thesis, University of British Columbia, 1989, Vancouver

2. Symposium on Management Under Contrasting Public Policies, "Western Grain Transportation Act" Paper presented by Henry Ropertz, March 2, 3, 1984, Vancouver

3. Wansbutter, E.R. and E.W. Tyrchniewicz, Forecasting for Subsidy Purposes: Idiosyncrasies in the Western Grain Transportation Act, Proceedings of the 22nd Annual Meeting of the Canadian Transportation Research Forum, June 7-10, 1987, St. John's

4. Grain Transportation Research: Proceedings of a Workshop, A.G. Wilson, Editor, "Grain Transportation and Railway Efficiency Gains", by R.B. Boyd, November, 1986, Winnipeg

5. Kruger, J., Grain Unit Trains - Estimated Potential Savings on a System Basis, Canadian Transport Commission, Ottawa/Hull, 1986. This report documents the benefits of unit-train configuration for grain movement. It indicates potential savings for producers of up to $5.00/tonne

6. Senior Grain Transportation Committee, "Straight Talk About Grain Transportation", March, 1987, Winnipeg. For further explanation of these numbers see the paper by David J. Craig, "Recent and Potential Efficiency Gains in Grain Related Rail Operations: Focus on Branch Lines in Grain Transportation Research" in Grain Transportation Research op cit pp. 22-29

7. Economic Council of Canada, "Handling the Risks: A Report on the Prairie Grain Economy", Minister of Supply and Services, 1988, Ottawa

TABLE ONE: GRAIN HANDLING AND TRANSPORTATION SYSTEM (1987)

Number of grain cars	-	19,000
Number of elevators	-	1,700
Number of delivery points	-	1,000
Railway mileage	-	17,000
Road mileage (Prairie Provinces)	-	200,000
Number of grain producers	-	132,000
Tonnes of grain production	-	56.9 million
Tonnes of grain exported	-	27.5 million
Production area	-	150,000 sq. miles

TABLE TWO: GRAIN HANDLING SYSTEM 1974-75, 1984-85, 1994-95

	1974-75	1984-85	1994-95*
		Millions of Tonnes	
Receipts	19.3	27.2 (+41%)	38.0
Capacity	9.6	8.0 (-17%)	6.6
Operating units	2,814	1,885 (-33%)	1,260
Turner rates	2.0	3.4 (+70%)	5.8
Volume per Operating unit	6,850	14,420 (+110%)	30,200

* Projection

Source: Grain Transportation Research: Proceedings of a Workshop, A.G. Wilson, Editor, "Recent and Potential Efficiency Gains in the Grain Handling System, by Ron Weik, November, 1986, Winnipeg

TABLE THREE

MEMBERSHIP OF SENIOR GRAIN TRANSPORTATION COMMITTEE - 1987

NAME	OFFICE HELD	ADDRESS or ASSOCIATION	REPRE-SENTING
Ron Leonhardt	Producer Rep.	Drumheller, Alta	Alta. Farmers
Guy Beatty	Producer Rep.	Watrous, Sask.	Sask. Farmers
Dick Lewis	Producer Rep.	Birch Hills, Sask.	Sask. Farmers
Jim Deveson	Producer Rep.	Arden, Man.	Man. Farmers
Stan Price	User Rep.	Acme, Alta	Feed Grain Users
Esmond Jarvis	Chief Commissioner	Can. Wheat Board	CWB
George Leith	Chief Commissioner	Can Grain Comm.	CGC
Jack Horner	Administrator	Grain Trans. Agency	GTA
Wally Madill	Chief Exec. Officer	Alberta Wheat Pool	AWP
Milt Fair	Chief Exec. Officer	Sask. Wheat Pool	SWP
Murray Cormack	Chief Exec. Officer	Man. Pool Elevators	MPE
Gerry Moore	General Manager	United Grain Growers	UGG
Otto Lang	Exec. Vice-Pres.	Pioneer Grain Co.Ltd	Pioneer
Kerry Hawkins	President & C.E.O.	Cargill Limited	Cargill
Cliff Swartz	President	Norther Sales Co.Ltd	Primary Elevator Licensees
Cecil Werner	General Manager	Western Alfalfa	Special Crops
Al Huffman	Chief Exec. Officer	CSP Foods Ltd.	Process Elevator Licensees
Doug Campbell	Asst. Vice-Pres.	CN Rail	CN Rail
Charlie Pike	Regional Vice-Pres.	CP Rail	CP Rail
Norman Hall	President	Dom. Marine Assoc.	Great Lake Carriers
Tom Jensen	Vice-President	Kleysen Transport Ltd.	Canadian Trucking Assoc.
Gus Sonneveld	Vice-Chairman	Canadian Livestock Feed Board	CLFB
Jim Hunter	Nat'l. President	CBRT	Organized Labor
Nick Mulder	Assistant Deputy Minister	Transport Canada	(Observer)

Note: Dr. Murray Cormack served as the Chairman between 1984-87. Otto Lang was the Chairman in 1987-88 and Wally Madill is the current Chairman. Secretarial duties are provided by officials from the Grain Transportation Agency.

TABLE FOUR: CROW BENEFIT and PAYMENT OPTION

Pay the Railway

- current system
- federal support paid to railways
- railways keep freight charges down

Example ($ tonne)

Feed barley at Vancouver	$110.00
Crow Rate	5.00
Price of feed barley on the prairies	$105.00
Average freight rate	$ 27.00
Farmer pays (Crow Rate)	$ 5.00
Government pays to railways	$ 22.00
	$ 27.00

Pay the Producer

- proposed by Gilson
- farmers pay full cost of hauling grain
- federal support paid to farmers

Example ($ tonne)

Feed barley at Vancouver	$110.00
Commercial Rail Rate	27.00
Price of feed barley on the prairies	$ 81.00
Average freight rate	$ 27.00
Farmer pays	$ 27.00
Government pays to farmer	$ 22.00
	$ 27.00

Bulk Exports of Grain (1956–86)

Figure 1

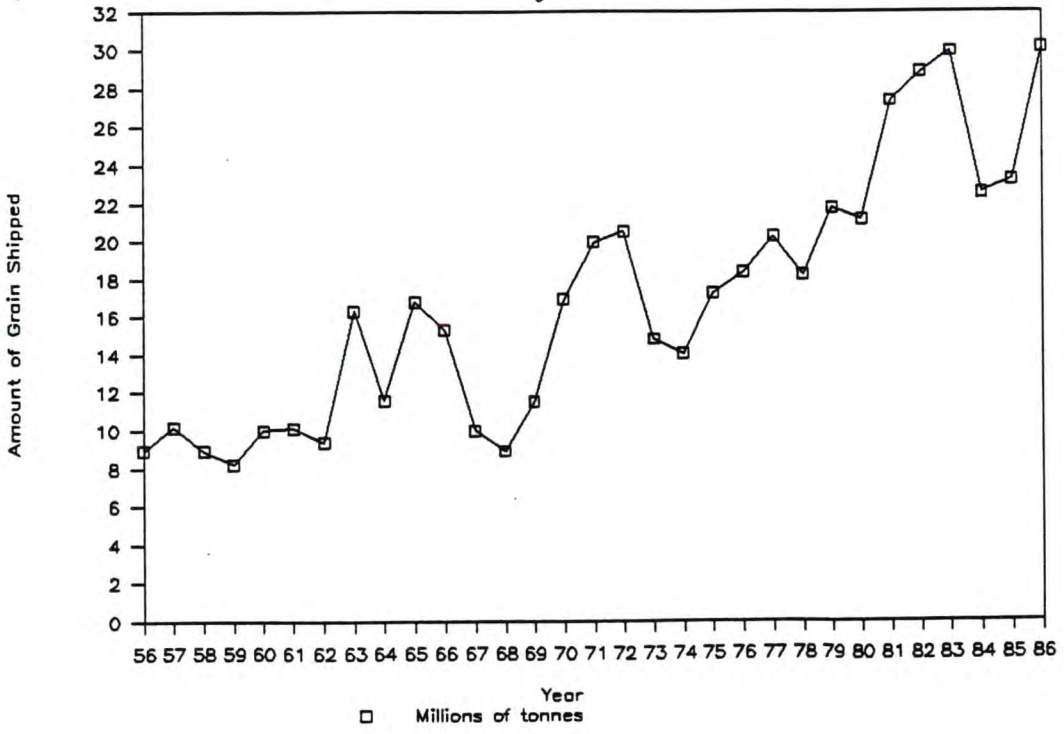
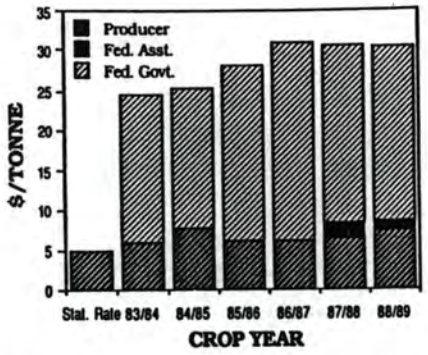


FIGURE TWO: GRAIN FREIGHT RATES 1983-84 TO 1988-89



Source: Grain Transportation Agency

Note: The actual freight rate to be paid by the producer for the 1988/89 crop year will be $8.38/tonne. The rates vary (with exceptions) according to the distance the grain is transported to ports by rail. The rates are based on system wide costs.

THE EARLY RESULTS OF TRANSPORTATION REGULATORY REFORM IN CANADA — REVISITED

by

F.E. Collins and J.M. Bowland
Peat Marwick Consulting Group

INTRODUCTION

Peat Marwick investigated the results of Canadian transportation regulatory reform at an early stage of its implementation (about eight months after the legislation became effective). The study findings were published widely across Canada and generated a degree of interest far beyond our initial expectations.

The Canadian transportation scene continues to change as the new régime unfolds. This paper revisits the early results about six months following our initial survey. We begin with a summary of the initial findings, with some of the facts updated to December 31, 1988.

THE EARLY RESULTS

The "Early Results" report is based upon a reasonably extensive survey of shippers, motor carriers, and railways. Survey participants were highly forthcoming and enthusiastic in their responses. As a result 174 companies, representing a wide cross section of industries, carriers, and geographic locations responded to our carefully planned survey.

Rates

The impact of regulatory reform has been beneficial to shippers. Almost half of the rail shippers and one third of motor carrier shippers reported that their rates had decreased since the introduction of regulatory reform. Only a very small minority of shippers reported increased rates.

The railways' general responses on the issue of rates resembled those of shippers. The railways claimed that in many instances the 1988 rates were held constant at 1987 levels. Based on general railway cost increases and the cost of living, a 4 to 5 percent increase in rates would have been reasonable. The railways claim that to remain financially viable the reduction in rates, or at least the foregoing of rate increases, must be offset by reductions in costs. Branchline abandonment and caboose less trains were cited by the railways as areas where cost savings are needed.

One third of the truckers surveyed felt that rates would decrease in the short-term, but then increase in the longer term. Another one third of trucker respondents indicated that any changes in rates would largely depend upon the location of a shipper. For those shippers located in high volume areas, rates would likely be lower. For shippers in low volume areas, rates would likely remain stable, or possibly increase slightly.

Confidential Contracts

The popularity of confidential contracts is the most impressive evidence of the new shipper/carrier relationships which are evolving. Moreover, the adoption of shipper/carrier contracts is the most visible early effect of Canada's new transportation laws — at least for rail shippers.

Of the shipper respondents who use rail as a means of transport 82% had entered or anticipated entering into confidential contracts. The hope of obtaining better rates was by far the most important motivation for those shippers entering into confidential contracts. 59% cited rates as the primary reason for entering confidential contracts, while 24% felt that better service was the major benefit.

One year into the new régime (i.e., as at December 31, 1988) the number of confidential contracts filed by railways was as follows:

CONFIDENTIAL CONTRACTS FILED

Railways	*Number of Contracts*
CP Rail	887
CN Rail	506
CSXT	205
Burlington Northern	124
Norfolk and Western	18
Conrail	10
Algoma Central	6
Others	16
Total	1,772

Based on the number of contracts (not the volume of traffic), 30% of the contracts were in the petrochemical industry, 20% in forest products, 18% in farm and food products, 10% in steel and manufacturing, 6% in mining, and the remaining in other general categories.

Service

In addition to reduced freight rates, shippers are demanding higher quality service. Shippers, railways and motor carriers therefore have to consider trade offs in rates and service. Generally, truckers can offer superior service to time sensitive traffic, and railways can offer better combinations of rates and service for large volume bulk movements.

The Peat Marwick survey indicated that service levels have not suffered as a result of decreased rates. Most shippers (83%) felt that service levels had not changed, and some (15%) reported improved service.

The carriers emphasized the trade offs in rates and services. Higher quality service could be guaranteed at a price. The railways felt that confidential contracts gave railways and shippers the opportunity to discuss service needs.

Competition

A stated objective of the new legislation was to increase competition. This has certainly been achieved within the trucking industry, as a majority of both shippers and truckers interviewed stated that there is now more competition. The effect on competition between the trucking industry and the railways has been less noticeable. While many truckers indicated that they had been affected by the rail legislation, shippers felt that the market shares of both modes had not changed significantly.

The introduction of rail competitive line rates (CLR's) was by far the most controversial issue when Canada's new transportation law was being formulated. However, to date this provision has seen little direct use. Nevertheless, nearly one third of rail shippers stated an intention to make future use of competitive line rates.

CLR's were introduced to help captive shippers. The mining industry has the greatest percentage of shippers who might be classified as captive. However, 72% of the mining companies' surveys stated that they did not intend to use CLR's. When asked why they would not use CLR's, 62% said that CLR's were not applicable to them, 23% said that they were satisfied with the present service, and 15% gave other reasons.

Railways continue to be unenthusiastic about CLR's. They stated a preference to negotiate joint line rates rather than being forced into using CLR's.

Dispute Resolution

Shippers have yet to use to any degree the dispute resolution provisions of the new legislation. This may be because there has been no need to do so. So far the railways and shippers appear to have found other means to resolve disputes. Another possible reason is some sense of apprehension on the part of shippers about using these mechanisms, particularly concerning the cost and effort involved. The survey results suggest both reasons help to explain the relative lack of interest in, and knowledge of Final Offer Arbitration and Public Interest Appeals.

Carrier Impacts

There is no evidence, as yet, that the railways' financial viability has been eroded. According to the survey, shippers have increased their use of rail service. It appears that increased rail traffic has been offset to some degree by lower rates. At the same time, the 1988 Financial Results of CN and CP are better than in many previous years. However, other economic factors have undoubtedly contributed to these results, including 1988's buoyant economic conditions.

Shippers also reported a slight increase in the use of truck transport. However, the stated increased competitiveness of trucking, together with decreased truck rates, may be causing financial difficulty for some carriers. The survey results are not conclusive on this point. Some trucking companies are making changes to their operations, while mergers and acquisitions are continuing to occur.

Overview

We concluded that the early results of transportation regulatory reform are, for the most part, positive. In passing the new legislation, Canadian law makers hoped that market forces and competition would determine rates and service levels. Given the widespread and anticipated increased use of confidential contracts, it appears that this has in fact

occurred. While other sections have not been as widely used as confidential contracts, this may change as shippers become more familiar with the new transportation legislation.

THE RESULTS REVISITED

Since the "Early Results" report was published in October 1988, many representatives of shippers, carriers, and governmental agencies have been in touch with us concerning our findings. This has encouraged us to keep our ear to the ground in an organized fashion in an effort to take the pulse of the industry. We supplemented these informal information gathering processes with a number of telephone calls to the shippers and carriers who were interviewed in our initial survey. The more recent results are reported below.

Railway

Confidential Contracts

Confidential contracts continue to be the most popular and successful aspect of the new régime. Both shippers and railways seem pleased with the results. The large majority of shippers are reporting either rate reductions or no rate increases. For their part, the railways must be gaining worthwhile considerations, such as locking in traffic volume, and/or service features which facilitate their operations.

For some reason CP appears to have moved more quickly than CN in securing contracts, although both Class I railways have clearly been highly active on this front.

Western forest products traffic presents an anomaly. Responses to our initial survey, as well as the follow up, led us to believe that western producers are making extensive use of confidential contracts, by virtue of which their share of rail shipments has increased, although the absolute total volume of their shipments has decreased (particularly in the case of lumber). However, information reported by the railways suggests the opposite: the the trend of shippers to truck their products to U.S. railway reload centres (especially Burlington Northern) has continued, and possibly accelerated. For this paradox we have no explanation.

Competitive Access

Comparatively little has evolved on the competitive access front.

At the time of this writing (late February 1989) the NTA has made five decisions on extended interswitching, four of which were settled in favour of the applicant. At least one of these decisions was controversial (i.e., the Domtar Donacona Mill case). Three applications are currently active, and two applications have been withdrawn prior to an NTA decision.

The NTA has established interswitching rates for 1989, representing an increase of about $5 for the lower two rates, and $10 for the higher two rates.

To date, only one competitive line rate (CLR) has been filed — an Alberta Gas Chemical movement from Medicine Hat to Coutts involving CP (the local

carrier) and Burlington Northern (the competitive carrier). No other CLR actions have been reported by the NTA.

In spite of the paucity of CLR activity, shippers continue to be very interested in CLR's. About one third of the rail shippers originally interviewed expressed the intention of using CLR's, and the interest in CLR's remained high in our follow up inquiries. In seems likely, therefore, that shippers are using CLR's to gain leverage in negotiations with the railways, and that the results to date have been sufficiently productive in the shipper's view to obviate the need to force CLR's on the carriers.

Dispute Resolution

The dispute resolution front appears to be comparatively quiet. The NTA has yet to receive a formal application for final offer arbitration. Since shippers must give carriers fifteen days notice of their intent to inter into final offer arbitration, it may be that shippers and carriers are resolving their differences during the fifteen-day period without the NTA having to be involved.

Rationalization

The railways have been highly vocal concerning the need to rationalize their plant and operations. They have expressed disappointment in the overall results achieved during 1988.

CN obtained abandonment orders for about 290 miles of branch line plant (approximately 1.4% of CN's total route mileage), while CP was permitted to abandon about 165 miles (approximately 1.2% of its total route mileage). In both cases the abandonments permitted were substantially below the 4% ceiling established in Section 159(4) of the Act. However, 1988 was a federal election year, which may account for slow progress on this front. Perhaps the 1989 results will be more favorable to the railways, although it seems unlikely that the legislation can be interpreted to permit the 4% ceiling to be treated cumulatively, as desired by some railway spokesman.

Apart from the above, the railways have expressed disappointment that the abandonment proceedings have not occurred within the time limits prescribed in the Act. Moreover, some railway representatives claim that the procedures are not simpler that before. Again, these problems may be corrected in time as the regulatory agency and all of the participants in the process gain experience in the new modus operandi.

The arbitration decision on removal of cabooses, while not directly tied to the new legislation, was clearly a disappointment to the railways, and they have appealed it.

For their own part, the railways are pushing ahead with internal streamlining and downsizing. An allegedly "leaked" memorandum, cited CN plans to eliminate some 17,000 jobs over the next five to ten years. CN's president denied this, but estimated approximately 4,000 jobs would be eliminated over the next five years. We are unaware of any comparable forecasts for employment at CP. However, it is reported that a major management and administrative review has been underway within CP Rail, which may lead to some streamlining of CP's organization.

In sum, the railways continue to stress the need to rationalize their plant and operations, and are actively pursuing initiatives on this front.

Trucking

The results in the motor carrier mode are somewhat confused. This is partly because implementation of the Motor Vehicle Transport Act, 1987 is essentially in the hands of provincial authorities. It is also due to concurrent developments, including the 1988 decision on vehicle weights and dimensions, and regulation in the safety area, particularly in respect of drivers' hours of service.

There has been little uniformity in the approach of individual provinces to the liberalization of market entry. Saskatchewan, Alberta and British Columbia appear to be approving new authorities fairly readily, while Manitoba seems to be moving slowly. The Nova Scotia regulators granted the province's first new extraprovincial authority in September 1988, but in so doing set a precedent which facilitates the approval of future applications.

Much attention has been focused on Ontario — a province which appears determined to liberalize entry at both the extra- and intraprovincial levels. In much publicized litigation between the Ontario Trucking Association and Ontario's Minister of Transport (Mr. Fulton), Ontario's granting of new extraprovincial authorities was truncated — at least temporarily.

The Ontario legislature eventually passed the Truck Transportation Act (Bill 88) in 1989, the first new initiative to deregulate trucking at the intraprovincial level. Ontario truckers had vigorously fought this development for a number of years claiming, inter alia, that it would give an unfair advantage to U.S. carriers, as it remains difficult for Canadian carriers to obtain intrastate authorities in many states.

Although formal, publicly available data is largely lacking, evidence is mounting that many truckers are experiencing profitability difficulties. For example, the Canadian Transport Tariff Bureau announced that a sampling of its 141 members showed many carriers were effectively operating at a loss. Other information reported in the press indicates that very few carriers (especially the larger carriers) are making money, with this situation being attributed to over-capacity caused by new entrants.

Perhaps as a result of the above difficulties there has been a number of new mergers and buy-outs. Notable among these are Federal Industries' acquisition of C.F. Kingsway, and Purolator's acquisition of Gelco.

Meanwhile, the railways (particularly CP) have launched a campaign aimed at forcing truckers to pay a greater share of roadway costs. A vehicle weight-distance tax is being promoted for this purpose. In the railways' view, this would contribute to a "level playing field", and perhaps prevent further erosion of the railways' truck competitive traffic.

Shippers

Our follow up interviews with shippers revealed continued contentment with the new régime. This should not be surprising in view of the shipper-oriented character of the new legislation.

Shippers continue to report that rail and truck rates have either dropped or have not increased. Service levels have not deteriorated, and in some cases have improved.

The Canadian Industrial Traffic League reports that *"since the passing of the Act, many shippers have found carriers eager to discuss service innovations and to be generally quicker and more flexible in responding to shipper initiatives, other than CLR's. The actions of the National Transportation Agency have so far been positive and helpful in progress on some potentially divisive issues (e.g., the extension of switching limits)."*

The ability to negotiate confidential contracts has been particularly attractive to most shippers. This is due partly to improved rates and/or service which may be achieved, and partly due to having more scope for negotiating than was previously possible. Some shippers stated that they were pleased to see collective rate-making ended.

Perhaps due to the success of confidential contracts, shippers generally indicated that they have not needed to use either CLR's or final offer arbitration. Nevertheless, at least some shippers continued to express considerable interest in CLR's, and indicated that they may use CLR's in the future. One shipper stated that the CLR provision was the most important aspect of the new Act, and expressed concern that it might be removed if not utilized by shippers.

CONCLUSIONS

Our investigations continue to indicate that the early results of transportation regulatory reform are generally positive. However, there are a number of issues which warrant attention.

Carrier financial viability gives us cause for concern. The difficulties being experienced by some motor carriers is perhaps the most immediate problem. However, the very nature of the trucking industry should enable carriers to adjust to the new circumstances, although not without some pain. The railways enjoyed improved financial results in 1988, and CN's balance sheet was substantially strengthened through the sale of non-rail enterprises and retirement of debt. However, the railways reported a decreased yield on rates, and appear to have achieved the profit improvements largely through increased volume. Economic conditions were particularly buoyant in 1988, and were reflected in high rail traffic levels. Unfortunately, 1989 has not started out well for the railways: traffic levels are down significantly from 1988. This underscores the need for railways to rationalize their operations and reduce costs.

The future use of the competitive access provisions of the Act represents another unknown quantity. To date, most shippers have been content to use these instruments as bargaining chips or last resort measures. It is a reasonable conjecture that this may have been the intent of the architects of the new legislation. Reminiscent of Fredrick the Great of Prussia — whose policy was to maintain a huge military establishment, but never go to war — the competitive access provisions provide shippers with leverage at the bargaining table.

The railways seem to have resisted whatever temptation there may be to raid each other's turf through competitive access. This is readily understandable in view of the revenue losses which would follow from an all-out tong war. Studies by Peat Marwick and other independent consultants have demonstrated the very large potential revenue attrition in the event that the competitive access measures were to be fully utilized.

Another major variable is the state of the economy. North America has enjoyed a long and sustained period of economic growth since the 1982 recession. The prosperous conditions of the late 1980's have been kind to most enterprises, including shippers and at least some carriers. It is fortunate that the new régime has been launched under these favorable conditions. While it is difficult to forecast the impact of a major economic downturn, it seems reasonable to conclude that carriers would suffer more than shippers.

There are many other unknowns, including the eventual impact of free trade with the United States. Perhaps our most important conclusion is that the events which have occurred to date are truly the "early results". Things may look much different in the year 2000.

REGULATORY CHANGE IN TRANSPORT TO THE YEAR 2000

by John Heads*

The Transport Institute of the University of Manitoba has been working over the past year on a study of the present transportation scene in Manitoba and the changes that are likely to occur over the next decade. The study is currently being submitted to the client and the detailed results are at present proprietary, although it is expected that they will be publicly released before the end of the year. In carrying out this study attention has been directed to the likely thrust of major changes which will affect the transport industries. The regulation of transport by the various levels of government is obviously one of the issues to be considered and this subject is, of course, not of a confidential nature.

The paper commences with a few comments on the rationale for transport regulation. Three transport modes - air, highway and rail - are reviewed by summarizing the major regulatory changes which came into effect last year, the probable results and the likely thrust of future transport regulation. The paper does not cover the water mode. Academics are allowed to speculate and, with the notable exception of Dr. Alfred Kahn at the U.S. Civil Aeronautics Board, they are not required to bring their speculations into the real world. The final section of the paper takes advantage of this. To avoid duplication with other papers in the conference session, rather less space is devoted to the Western Grain Transportation Act and the results of recent regulatory change than had been the original intention.

I. THE RATIONALE FOR TRANSPORT REGULATION

It is not the intention in this paper to review the history of transport regulation in Canada and the reasons advanced over the years to justify or refute the need for such regulation. However, it is useful to start with a brief summary of the arguments for and against transport regulation by government as they apply today, not in the past, in order to set the stage for the discussion of recent and prospective regulatory change.

In terms of economic theory, it is often argued that optimal results are achieved by reliance on competition in markets where there are a

multitude of buyers and sellers and where each individual buyer or seller has little ability to influence price or market conditions. In addition, the operation of the market must not cause external social costs or external social benefits to third parties who are not part of the market process. Unfortunately, these ideal conditions prevail more in economics text books than in the real world.

In the specific area of transport, there are often very few carriers operating in any individual market and an attempt is made to justify government regulation of transport in order to protect the users of transport services. Transport operations have repercussions on third parties in terms of social costs and social benefits. These social costs are generally tangible, for example, noise pollution, and economic regulation is only one of several possible means of dealing with this problem. The social benefits from transport have been identified in terms of national unity, regional economic development and income redistribution and these have been variously advanced as reasons for government regulation.

An appreciable proportion of the costs of transport carriers are fixed as distinct from varying with traffic - although this is less true today than in earlier times - and government regulation is justified as protecting carriers from the vagaries of the market place and increasing stability in the provision of transport services. Finally, government seems convinced that, left to their own devices, carriers would pursue an inadequate level of transport safety. This is used to justify government regulation of safety, even although it is difficult to imagine that, in an unregulated economy, maintenance would be so neglected that truckers would revel in delays caused by breakdowns of their vehicles and that railroaders would rejoice every time a rail car left the tracks!

The case for transport regulation in Canada rests today on alleged needs to protect the shipper, the passenger, the carrier, the public interest, regional development and national unity. The opponents of regulation question whether these objectives can be achieved and instead prefer to rely on market forces. This is summarized succinctly in the preface to the 1985 publication "Freedom to Move" where the then Minister of Transport, the Hon. Don Mazankowski, stated that he had "been guided in particular by the following principles:

(a) Less regulation, leading to less government interference, will encourage innovation and enterprise;

(b) Greater reliance on competition and market forces will result in lower unit costs, more competitive prices, and a wider range of services to shippers and the public;

(c) Canadians require a regulatory process that is open, accessible, and not excessively costly or time consuming."[1]

Mr. Mazankowski then went on to state that "In the environment of the 1980s, the existing regulatory regime represents an obstacle to

economic growth, innovation and competitiveness". He then paid the usual tribute to regulation of safety, stating that he "would like to indicate unequivocally that the Government will neither propose nor permit any regulatory reform that might be detrimental to safety standards".[2]

The regulatory changes in Canada of 1987 were, of course, partly inspired by the major deregulatory thrust which had taken place in the United States at the beginning of the decade. Yet, it is misleading to consider that Canadian transport was universally under the heavy hand of rigid regulation before the 1987 National Transportation Act. Prior to the Carter administration in the United States and the legislation culminating in the Staggers Act of 1980, transport was much less regulated in Canada than in the United States. The 1967 National Transportation Act had freed the Canadian railways from rate regulation and given them compensation for publicly imposed duties, particularly in respect of uneconomic passenger services and uneconomic branch lines. For some thirteen years thereafter, the flexibility of railway regulation in Canada was the envy of the United States.

Although truck regulation was stringent in many of the provincial jurisdictions in Canada, the situation prior to 1980 was no worse than south of the border. When the airline industry was regulated in the United States, this was probably more restrictive than in Canada. With the extinction of the Civil Aeronautics Board under a sunset clause in 1981, regulation of domestic air services in the United States virtually disappeared. However, under the example of U.S. experience and the competition that ensued, government control over fares, entry and exit had been greatly relaxed in respect of Canadian domestic air transport by 1984 and there had been some relaxation of regulation of fares on international routes.

Greater reliance on competition and market forces had been the inspiration of the 1967 National Transportation Act and the results were very real in terms of greater pricing flexibility for the railways, although this Act had minimal affect on highway and air transport. The winds of change from the United States were affecting Canadian transport from the beginning of the present decade and this was also in the direction of greater reliance on market forces. The principles adopted as the inspiration for the 1987 National Transportation Act did not therefore constitute a departure from previous modes of thought or a quantum change in policy, but rather a continuation in the direction which had already been established.

The National Transportation Act of 1987 took effect on January 1, 1988 and the provisions of the new legislation have been summarized in useful informational brochures issued by the new National Transportation Agency (NTA). These brochures include a brief philosophical statement of objectives and it is useful to quote, as an example, the first paragraph of the brochure on air transport. This summarizes the objectives of the legislation against which performance will be judged under the statutory requirement for annual reports to Parliament and the in-depth review scheduled for 1992.

> The new National Transportation Act reflects the principle of less regulation to encourage innovation and enterprise. This greater reliance on competition and market forces will improve service to both shippers and the public. The new Act also provides for a new, more open and efficient regulatory process.[3]

II. AIR TRANSPORT

The 1987 National Transportation Act effectively deregulated air transport in southern Canada. This gave legislative confirmation to changes which had already occurred three years earlier, resulting from the fall-out from deregulation in the United States. The 1987 Act retained a degree of regulation for air service to northern and remote areas, but the degree of regulation of these services had been reduced prior to the new legislation and this continues. Apparently, no applicant for a scheduled air service to northern or remote areas has been refused for at least two years. International air services were not affected by the new legislation. The changes in each sector of the air industry are now considered in turn.

Domestic air service in southern Canada is now subject to very little regulation. Provided that the carrier is of Canadian nationality, there is freedom of entry on demonstration that the carrier is "fit, willing and able to provide the service". In broad terms, all that this implies is adequate insurance and a safety certificate from Transport Canada. The effects of the entry of a new airline on carriers already serving a route is now considered irrelevant. Airlines can leave a domestic route with only 120 days advance public notice of their intention. There is no control over rates in southern Canada, confidential contracts are permitted, and air carriers are no longer required to file tariffs with the regulatory body. However, the NTA will review, on complaint, increases in basic passenger fares on monopoly routes in southern Canada.

Domestic air service to northern and remote communities is still subject to a greater degree of economic regulation because of the so-called "fragile" nature of these markets. As in southern services, the market is reserved for Canadian carriers. The previous requirement for entry to air service in northern and remote areas was based on a test of "public convenience and necessity". Under the new legislation, the NTA must be satisfied that the new service will not "significantly decrease or destabilize existing air services in the area". The NTA may still subject licences to conditions related to such matters as the type of service, the size of aircraft and the points served.

The discontinuance rules for northern and remote air services are the same as for southern domestic services, namely 120 days advance public notice. Pricing regulations has been relaxed, but not to the same extent as in southern services. The NTA may still hear complaints about unreasonable passenger fare levels or increases and

can order fare reductions and the refund of excess charges. Finally, in respect of air services to northern and remote communities, it is stated that no community will be left without essential air services as a result of the new air policy and that subsidy will be provided where necessary.

The regulation of international air services remains unchanged under the new legislation. Market entry and exit are still controlled through bilateral negotiations between Canada and foreign countries. Air fares are still subject to regulatory approval and, in September 1988, the NTA demonstrated that these powers could be exercised by ordering Air Canada to reduce basic passenger fares on Trans Atlantic services.

Conditions in air transport have changed very substantially in the 1980's, even if much of this change preceded the passing of the 1987 legislation. For many years, the structure of air transport in Canada had been two trunk carriers, five regional carriers, Wardair, which was basically an international charter carrier, and a large number of third level carriers, mainly serving northern and remote areas. Under the stimulus of competition, the role of the regional carriers gradually became irrelevant and there is now a duopoly of two mainline carriers, Air Canada and Canadian, since Wardair has been absorbed by Canadian, and the third level carriers mainly confined to northern and remote points.

When the first draft of this paper was being prepared in late 1988, the competition among the mainline air carriers in southern Canada was severe. While this competition continued, there was a problem in respect of adequate returns for the carriers, but the need for consumer protection through regulation was relatively slight. There were then three mainline carriers competing in southern Canada and the ultimate disappearance of at least one carrier was fairly obvious to any transport analyst. Nevertheless, the consolidation to two carriers took place earlier than most of us had expected.

Given the experience of Wardair, together with the similar experience of People's Express in the United States, the viability prospects for additional mainline air carriers in southern Canada are, to say the least, dim. There are now two carriers and conditions of competitive duopoly are unstable. There is always the danger of competitors becoming more obliging to each other in terms of limiting competition on fares and service. Duopoly can be innovative, but there is no guarantee that it will result in "lower unit costs, more competitive prices, and a wider range of services", as expected from the previous quotation from "Freedom to Move". In fact, if each mainline carrier were still operating on the declining part of its cost curve, duopoly could be more expensive than monopoly. The economic pressure would be towards merger and monopoly, not competition.

Air regulation in Canada has, in many ways, been a dismal story for well over two decades. The attempt to find a role for regional airlines ultimately failed, as indeed was inevitable. The regulator

is now faced with a duopoly and, even if the regulatory agency had control over rates and conditions of entry, it would be difficult to cope with a situation where there are only two carriers. The NTA is bereft of powers to deal with the situation likely to emerge in mainline southern Canadian air services - this statement is not made negatively because the new legislation had little choice other than to confirm the developments of the three previous years which had removed an intolerable burden on the air industry.

There are no obvious solutions to the problem of how to make a duopoly behave without exercising its ologopolistic power. A number of scenarios are possible. Firstly, Canada could continue to hobble along with a duopoly for the next decade relying on restraint by the duopolists in the exercise of their power, as the regulatory agency has no means of control. This is quite a likely solution, given the long Canadian experience of duopoly in rail transport, and perhaps not much worse than the attempts to regulate air transport over the last two decades.

Secondly, there could be a merger of the two duopolists into one enterprise, either owned privately or publicly. In theory, this could produce lower cost air transport if there are increasing returns to scale in mainline southern Canadian air services, but the price would be the development of inefficiencies inherent in any monopoly. In the view of the present author, this scenario is unlikely to unfold.

Thirdly, although transport is presently excluded from the Free Trade Agreement, new developments over the next decade could lead to a greater integration of the Canadian and U.S. air markets, with both Air Canada and Canadian, or one or the other, or neither joining the six top carrier conglomerates which dominate air transport. This is not an unlikely scenario.

In any event, regardless of the outcome, the NTA is likely to be an observer rather than a controller; moreover, it is not clear how this situation can be redressed by further regulatory change. Anti-trust legislation is an alternative to regulation, but past history is not encouraging here. We seem to have an emerging public policy issue for which there is at present no obvious solution.

As already indicated, economic regulation over air services to the north and remote points still continues, but the regulation has been operated very loosely over at least the last two years. This has increased competition and the effects on these so-called "fragile" markets remains to be seen. There is also the safety issue in respect of northern air transport, as small aircraft flying in isolated areas are inherently less safe than the larger aircraft operating in southern Canada. This has recently been examined, for example, in a submission prepared by the Consumers' Association of Canada.[4] In view of the sparse traffic generated by northern and remote communities, after the honeymoon with de facto deregulation is over, there may well be a return to more restrictive regulation of these markets and the regulatory tools are, of course, still

available.

Although air transport is not part of the Free Trade Agreement, pressure may grow over the next decade to allow greater competition between U.S. and Canadian carriers on transborder flights and greater pressure to integrate the U.S. and Canadian air markets. This would spill over into international flights, with an even greater use of U.S. exit points for international flights by Canadian travellers. Major Canadian cities would be in danger of becoming spokes to U.S. air hubs, but it is difficult to see what measures a regulatory agency could take to influence this.

III. HIGHWAY TRANSPORT

Although Part IV of the 1987 National Transportation Act relates to motor vehicle transport, this covers only transport which is exempt from the Motor Vehicle Transport Act. As there are very few exemptions from this legislation, effectively it is the Motor Vehicle Transport Act of 1987 which contains the changed government approach to regulation of highway transport.

Federal jurisdiction of motor vehicle carriers is confined to extra-provincial carriers, which carry freight or passengers across a provincial boundary or across an international boundary. Highway carriers operating solely within a province are regulated by the province and the federal government has given similar authority to the provinces for the intra-provincial operations of extra-provincial carriers. The new Act makes no change here and no changes to the bus industry, so that the new legislation relates solely to the extra-provincial operations of motor carriers. Federal authority on these extra-provincial carriers was delegated to the provinces as long ago as 1954. The new Motor Vehicle Transport Act of 1987 continues this delegation of authority, but with different rules covering how the provinces can use the authority.

There is no regulation of rates or exit from extra-provincial trucking and the regulation therefore covers only conditions for entry. Prior to the new legislation, the market entry test for extra-provincial trucking was on the basis of "public convenience and necessity". This has been replaced by a "fitness" entry test and a "reverse onus" public interest test. The "fitness" test simply relates to insurance coverage and compliance with transport safety regulations.

Under the "reverse onus" test, all new fit applicants will be granted a licence unless an opponent of the application can demonstrate that the granting of the licence would not be in the public interest. This test is designed as an interim measure scheduled to expire on January 1, 1993, after which time the "fitness" criterion will become the sole standard. However, there is opportunity for review of the operation of the "reverse onus" test in 1991 and the transition period could be extended. Accompanying this liberalization of entry into extra-provincial trucking, there have been the development of a

National Safety Code for Commercial Trucks and Buses and relaxation in highway limits on truck weights and dimensions.

The National Safety Code covers all aspects of driver and vehicle safety including driver licence requirements, hours of service worked by drivers, the compilation of daily log books, vehicle maintenance standards, daily trip reporting of defective equipment, roadside inspections and safety audits of carrier operations. The Code has built on existing safety standards with additions in key areas, mainly hours of service and record keeping. The principal objective has been stated as national safety uniformity on the basis of nationally approved standards. Implementation requires legislative and regulatory action by the federal, provincial and territorial governments. Many standards are already in place and the objective is full implementation by the end of 1989.

In terms of truck weights and dimensions, there has been a long term trend of relaxation of the limits allowed on Canadian highways and this has greatly increased the efficiency of the trucking industry. The problems with increasing motor vehicle weights and dimensions lie in two areas - the stress on highway infrastructure and the interaction with other traffic, particularly in respect of safety and vehicle delays. Although attempts have been made to measure these factors, a comprehensive framework for analysis still does not exist. It is therefore not surprising to find that different provincial jurisdictions have considerable variation in their weight and dimension restrictions and this extends to different regulations for different roads, different seasons and the issuance of special permits.

On February 12, 1988 a memorandum of understanding was signed between the federal and provincial ministers of transport to approve standardization of weights and dimensions for heavy trucks used in inter-provincial traffic. In this agreement, an effort was made to secure gains in efficiency and productivity, without prejudicing highway infrastructure and standards of safety.

The standards are summarized below:

- height, including load, must not exceed 4.15 metres;
- width, including load, but excluding mirrors, lamps and securing devices must not exceed 2.6 metres;
- length, including tractor, must not exceed 23 metres, with the maximum permissible semi-trailer length at 15.65 metres;
- tridem axles must comply with national standards, with weight and capacity incentives to encourage the most stable configurations;
- maximum gross vehicle weights will be 46,500 kg for semi-trailers, 53,500 kg for A train and C train configurations, and 62,500 kg for B train configurations.

Ease of entry into the trucking business allowed under the new Motor Vehicle Transport Act has therefore been reinforced by more uniform

weight and dimension limits on trucks and increased safety requirements through the new National Safety Code. The competitiveness of the truck vis-a-vis rail has increased over the years, partly as a result of technological developments and partly as a result of more generous limits on weights and dimensions. These trends will continue. While there is always a possibility of postponement of the abolition of the "reverse onus" test, it is reasonably certain that there will be freedom of entry to extra-provincial trucking before the mid 1990's.

Foreign ownership is more marked in the Canadian trucking industry than in any other transport mode, although foreign owned firms account for only some 7.4% of the total revenues of Canadian trucking companies. The danger has been raised of increased U.S. involvement in Canadian trucking as a result of greater freedom of entry and increased north-south trucking movements from the Free Trade Agreement. However, while these developments could well occur, it is unlikely that this would impinge on the regulatory function and no further regulatory change seems to be on the horizon.

Compared with other transport modes, the trucking industry in Canada is still dominated by small firms. In 1986, the ten largest companies accounted for only 19.3% of total trucking operating expenses (SC 53-222, p. 18). However, this concentration is growing with, for example, the 1988 demise of Route Canada and the acquisition of Kingsway by Canadian Motorways. Nevertheless, there may still be enough companies in the trucking industry to rely on competition and market forces to "result in lower unit costs, more competitive prices and a wider range of services to shippers and the public", to quote again the words from "Freedom to Move". The new regulatory climate for extra-provincial trucking could stand the test of time over the next decade, but the outcome will almost certainly be greater concentration in the industry.

The changes from the 1987 legislation do not affect intra-provincial trucking, although this has also been liberalized to some extent. For example in Manitoba, tariffs prescribed by the Motor Transport Board are now only maximum tariffs, whereas previously they also served as minima. Entry to the intra-provincial market has also been made easier for extra-provincial carriers. Future developments in intra-provincial trucking will, of course, vary from province to province and space does not allow adequate consideration of this issue.

IV. RAIL TRANSPORT

In respect of the rail mode, the National Transportation Act of 1987 has been regarded very much as "a shipper's Act". The following comment by lawyer Richard Lande in late 1987 summarizes this reaction.

> Now that Bills C-18 and C-19 have received Royal Assent and will be coming into effect next January, shippers have reason to be optimistic about imminent rate reductions and service improvements.

> Never before in Canada or internationally have such an array of legislative provisions been enacted which provide the users of rail service with enhanced negotiating opportunities and substantive legal recourse designed to offset locational dependence upon a railway.[5]

In order to allow shippers to have access to more than one rail carrier, the new legislation took action along two fronts. In respect of shippers located mainly in urban areas, there are prescribed rates for the transfer of rail cars from one railway to another railway within a prescribed distance of an interchange. The new legislation has extended the limits to which these interswitching arrangements apply from 6.4 kilometres to 30 kilometres. Under the old interswitching limits, the Canadian Manufacturers' Association estimated that 50% of industrial plants in Canada had access to more than one railway through interswitching requirements and that this has now been increased to 80%.

To reduce the captivity of industrial establishments without access to more than one railway, the new legislation introduced competitive line rates. A shipper located on one rail line may ask the railway to establish a competitive line rate for moving goods along the line on which he is captive for interchange to a competing carrier's line. The shipper must have the agreement of the competing carrier before requesting the competitive line rate. If such a rate cannot be satisfactorily negotiated, the shipper may ask the NTA to set a rate according to the guidelines contained in legislation.

However, the competitive line rate arrangement was introduced in the face of extreme opposition from the railways. Firstly, these rates could act as a disincentive to make investments in branch lines to service new resource developments. Secondly, they would give an advantage to U.S. railroads in obtaining traffic from Canada without any similar compensating advantage to Canadian railways.

The new legislation established confidential contracts in the rate area, following the practice introduced in the United States in 1980. Shippers and carriers can make a confidential contract to fit the particular circumstances of movement without having to disclose the rate information. Prior to this, all charges for the movement of freight were in the public domain and effectively any charge negotiated by one shipper was available to other shippers able to offer traffic under similar conditions.

While confidential contracts were necessary to end a competitive advantage held by U.S. shippers and carriers, nevertheless this practice curtails public knowledge of freight rates. In addition railways are no longer required to file other tariffs and agreed charges with the regulatory agency and they are no longer allowed to publish joint tariffs. The downside to these developments is an increased lack of knowledge of freight rates. Markets in which both shippers and carriers do not know the charges levied or paid by their competition are not conducive to an efficient allocation of

resources. In particular, it is the smaller shipper who will suffer, partly because the smaller amounts of traffic offered reduce his bargaining position in the market and partly because his ability to obtain information is less than that of the larger shipper. There is a very real problem of inadequate information as we proceed helter-skelter into a world of secret freight rates.

Mediation services are offered by the NTA to help resolve disputes between shippers and carriers over rates and conditions of service, but this is not a new development. Final offer arbitration introduces a more formal way to resolve disputes between shippers and railways. Each party makes a final offer in the arbitration process, the arbitrator selects the final offer without power to compromise between the positions of the two parties, and the decision is binding. The NTA can also investigate disputes that have a broader impact on the public interest, but this provision also existed under legislation prior to 1987.

Streamlined rules for branch line abandonment have been introduced, including arrangements for the sale of rail lines to qualified companies who wish to operate short line feeder services. However, the effectiveness of the new rules will be limited over the next few years. Firstly, railway companies may not abandon more than four percent of their total route mileage in any one year prior to 1993. This is a very modest rate of abandonment, given the situation with CP Rail, where 50% of the rail mileage operated generates only 3% of the workload, and the similar conditions for CN Rail. Secondly, almost all the branch line network in the Prairie Region is still frozen by Order-in-Council until the year 2000.

Following the first year of operation of the 1987 National Transportation Act, it is clear that the confidential contract arrangements have proven very attractive; over 1,200 contracts were signed in 1988. Competitive line rates have not yet had any impact and there are no rates presently in effect. Because of the limitations contained in the new legislation, branch line abandonment in 1988 cannot have been much higher than in 1987. The mediation services of the regulatory agency have continued as in previous years, but final offer arbitration has been shunned by both railways and shippers. As a leading shipper member of CTRF remarked back in 1987:

> The new National Transportation Act should not make the new agency power brokers who allocate profits between shippers and carriers. If mediation, final offer arbitration and public interest appeals replace honest, hard headed negotiations, we have failed.[6]

The likelihood of any further major regulatory change in the direction of increased shipper protection is not very great. Firstly, after the debate of the last three years, there will be reluctance to embark on further regulatory initiatives. Secondly, there is already concern that the 1987 legislation may have worsened the already weak financial viability of the railways, particularly

Canadian National Railways, and there would be some hesitation to proceed yet further in this direction.

The Western Grain Transportation Act is, however, likely to be changed, hopefully in a fairly short time frame, to allow government assistance for the transport of grain to be paid directly to the producers and not to the railways. The change to "pay the producer" would reduce the incentive to ship feed grains from the prairies and allow more livestock feeding in Western Canada. Trucks would also be in a stronger position to compete with the railways in grain transport. Moreover, the change could also accelerate pressure to unfreeze prairie branch lines presently protected to the year 2000.

In the area of rail safety, the railways have long complained that they are regulated too closely by government. A new Railway Safety Act became operative on January 1, 1989. This has removed out-dated regulatory requirements, but only the operation of the new Act will show the extent to which the railways have really been freed from regulatory intervention. The railways had been hoping for reduced regulatory restrictions on their operating practices as some quid pro quo for the increased protection given to shippers in the 1987 National Transportation Act. However, given the thrusts for greater safety in the air and highway modes, together with the long term obsessional interest of the Canadian public in railway transport, it is not at all clear that rail safety regulation will, in fact, be substantially reduced.

V. FURTHER REGULATORY CHANGE TO THE YEAR 2000

With the extensive transport regulatory activity of 1987, it is not expected that regulatory change will be a major issue in the Canadian economy before, say, 1994. This statement excludes safety legislation, where the government has indicated its intention to establish a national multimodal accident investigation board. In addition, the Western Grain Transportation Act will probably be amended to a pay the producer basis and this could be followed by an end to the freeze on many prairie branch lines. However, a general reaction of ennui among the participants in the struggles leading to the 1987 legislation and the statutory requirement for a review of the operations of the new Act in 1992 will probably squelch any other activity.

The 1967 National Transportation Act took effect in February that year and the Canadian transportation scene was reasonably quiet for roughly the four years from 1967 to 1970. The railway freight rate issue re-emerged in the west in 1971 and rapidly escalated into the Western Economic Opportunities Conference of 1973. Transport had pride of place at this conference, but very little action resulted.

History does not necessarily repeat itself. Nevertheless, the review of the new legislation in 1992 will occur after a time interval from 1988 roughly comparable to the time period which had to elapse after 1967 before interest in transport legislation revived. The review of

the NTA in 1992 could be a damp squib like the first review of the Western Grain Transportation Act in 1986. However, even if this were not so, transport regulation is not likely to become a major issue in the public domain before the mid 1990's, in other words after there has been a period of time to digest the 1992 review.

By the mid 1990's several new considerations will be affecting transport policy. Although the Free Trade Agreement with the United States excludes transport, this could be temporary if implementation of free trade elsewhere in the economy proceeds smoothly. With a closer integration of the two economies and a possible extension of this to the transport modes, there are obvious repercussions in competition from U.S. trucking companies and U.S. airlines. Environmental issues could be coming back into the political agenda and this could have repercussions on transport, particularly in respect of the externalities of the various modes in terms of fuel consumption, traffic congestion and safety. For what the forecasts are worth, the pundits are threatening another energy crisis towards the end of the century.

Turning to the transport modes themselves, we are already in the era of duopoly in transcontinental air services in southern Canada and there is really nothing the regulatory agency can do about this. By the mid-1990's this experience will have been with us for several years and, unless the problem is solved by competition from U.S. carriers, this will be a major public policy issue with no obvious solution. The regulatory agency has the tools to deal with air service problems in northern and remote communities and this does not need further comment. The trucking industry should not be a major cause of concern except in respect of U.S. competition.

In the rail industry, we shall presumably still be faced with complaints on rail rates from the resource industries and railway carriers without very impressive returns on investment. Canada has continued for a very long time with a duopoly in rail service and, apart from the United States, this is almost unique in the western world. Perhaps this situation could change in the next decade. The shrinking of the railways to core systems and the vast reduction in employment already underway could strengthen the case for merging the two carriers, either in the public or the private sector.

To conclude, the regulatory expectations for the next decade are not particularly exciting, but this statement is not made in any condemnatory fashion. Apart from the conversion of the Western Grain Transportation Act to a "pay the producer" basis, followed by some relaxation in the freeze on prairie branch lines, and the establishment of a multimodal safety board, the regulatory scene is likely to be inactive until after the 1992 review of the National Transportation Act. Interest may increase towards the mid 1990's with a closer integration of the U.S. and Canadian economies, a possible resurgence of environmental issues in transport, and the problem of duopoly in mainline domestic air service and in the railway industry. However, it is not clear that economic regulation has a major role to play in dealing with these issues. In fact, the

days of economic regulation as an important public policy instrument in transport would now seem to have passed.

ENDNOTES

1. Freedom to Move, Supply and Services Canada, Ottawa, 1985, first page of preface.

2. ibid., second page of preface.

3. The New National Transportation Act: A New Framework for Air Transportation, National Transportation Agency of Canada, Ottawa, 1987, page 1.

4. Carman D. Baggaley, A Matter of Faith: A Report on Air Safety, Consumers' Association of Canada, Ottawa, 1988.

5. Richard Lande, "Bill C-18 and C-19 Analysis", Canadian Transportation & Distribution Management", November, 1987, p. 47.

6. Bill Sheffield, "The Shipper's Perception", in E.W. Tyrchniewicz (editor), An Overview of the New Transport Legislation: Proceedings of a Seminar, University of Manitoba Transport Institute, Winnipeg, 1988, p. 45.

* Director, Transport Institute, University of Manitoba.

A GAME THEORY APPROACH TO TRUCK WEIGHT REGULATION ENFORCEMENT

by

Marvin D. Hildebrand and Barry E. Prentice[1]

I. Introduction

Public highways are built in the knowledge that they will deteriorate and that deterioration increases at an increasing rate as the weight of vehicles rise. Beyond some maximum weight limit, the cost to society of heavier vehicles exceeds the returns which they yield in the form of transportation services. Consequently, the enforcement of maximum weight regulations on public roadways is a concern in all jurisdictions.

Although there is extensive literature on the subject of weight regulation enforcement, an economic framework is generally lacking. Technical studies have been undertaken to measure the amount of damage to pavements caused by heavier trucks and the frequency of violations. Other researchers have evaluated the impact that differing levels of regulation enforcement have on compliance and the costs and benefits of various programs. In addition, some criteria for enforcement levels have been discussed. No guidelines exist however, for establishing the optimal attainable level of enforcement.

It is generally accepted that the costs associated with complete compliance are excessive. At the same time, the nature of public highways is such that some level of enforcement is necessary. Roadways are vulnerable to the economic problem that confronts many publicly supplied goods. The private gains to truckers from overloading are greater than their share of the public costs of pavement damage that result from their actions. In the absence of effective enforcement, individual truckers have an economic incentive to exceed the posted weight limits.

The theoretical model presented in this paper provides a strategic framework for analyzing the economic outcome of different levels of fines and enforcement efforts. An economic concept known as "game theory" is used to model the decisions of truckers and the highway enforcement officials. The truckers have two choices: to comply with the law, or to overload their truck. The regulation enforcers also have two choices: they may have the scale open and weigh passing trucks, or close the scale. Assuming a randomized operation of scales and random

---

[1] Research Associate, and Professional Associate, University of Manitoba Transport Institute.

overloading by truckers, the game theory model establishes the equilibrium level of weight regulation compliance, given a set of enforcement parameters.

The paper begins with an overview of weight regulation enforcement and a review of the relevant literature. Subsequently, the game theory model is developed to estimate the equilibrium levels of enforcement and compliance. The paper concludes with a discussion of the model results and its implications for highway transport policy.

II. Overview of Weight Regulation Enforcement

1. Transgression and Restitution.

Like most areas of law, weight regulation enforcement is justified on the basis of the resulting benefits that accrue to society. Specifically, governments seek to maximize the net social benefits that accrue from the use of a public highway system by legislating maximum vehicle weights at optimal levels, and by punishing those who exceed the maximums. Beyond this point however, the government's mandate in enforcing weight regulations is less clear. For example, should governments seek to equalize the costs (such as pavement damage and enforcement) and benefits (such as fine and permit revenue) of the enforcement process? Or should its mandate be to reduce the incidence of overweight vehicles as far as possible?

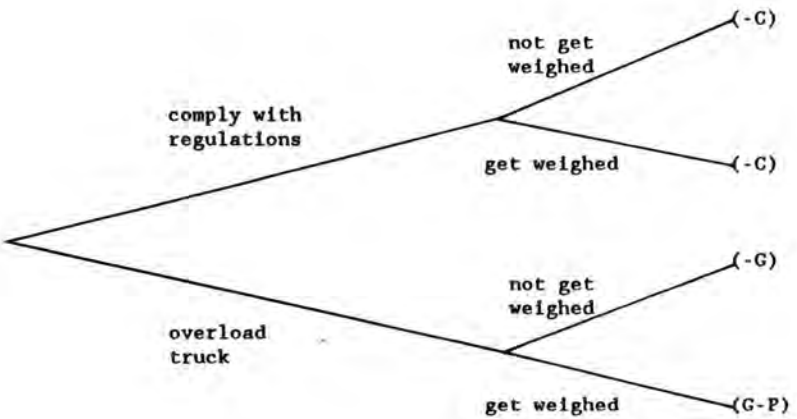
Governments operate permanent and portable scales to physically check the weights of some proportion of the total truck population. Truckers found to be in violation of weight limits are normally assessed a monetary penalty. These two parameters, the proportion of trucks inspected and the penalty assessed, represent the basic tools available to governments in their enforcement endeavours.

The enforcement-compliance decision process, and the payoffs for the individual players are illustrated in Figure 1.

Figure 1: Strategy Options and Payoffs Associated with the Enforcement Compliance Process

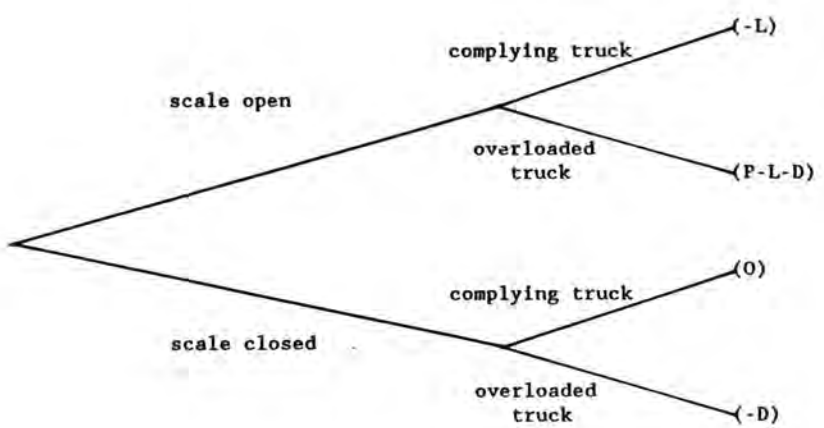
(a)

Trucker Perspective



(b)

Public/Gov't Perspective



In Figure 1a, the decision choice and financial outcome from the perspective of the trucker are portrayed. The trucker has the option either to overload or not to overload. Whatever his choice, there is some probability that his truck will be weighed by highway inspectors and some probability that he will not be weighed. (These two probabilities must sum to 1.0). If he does not overload, the only cost incurred by the trucker is the cost (if any) of ensuring that he is within the legal limit, denoted (-C). If he overloads, he does not incur the cost of compliance (-C), and earns more revenue because of a larger payload (G). If the scale is open, however, the trucker will be caught and forced to pay the associated penalty (P). In this diagram, the truck operator is not forced to off-load the excess weight, so the net cost is (G-P).

The government also has two basic options relating to the above process for a given period of time; it may operate a given scale or it may leave the scale closed. The decision choices and outcomes for the government are shown in Figure 1b. If a complying trucker passes through an open scale, the government incurs the variable cost of operating the scale (-L). If an overweight truck passes an open scale, the same variable cost is incurred as well as extra pavement damage, denoted (-D), but the government receives the fine revenue paid by the trucker (P). If the scale is closed and the passing truck is not overweight, the government incurs neither the variable cost of scale operation, nor damage to the road. The last combination, a closed scale and an overweight truck, yields a payoff of (-D) (the extra pavement damage due to the overweight portion of the load).

Although the exact proportion of trucks inspected and the hours of scale operation are uncertain, experienced truckers typically develop a perception of the probability of apprehension for a given trip. Experienced truckers are also knowledgeable of the penalty fine structures which exist in various jurisdictions. The product of the fine, if apprehended, and the probability of apprehension represents the truckers expected cost of violating weight regulations. Since both of these parameters are under the control of government, it would be possible to adjust the parameters to achieve the lowest overall cost to society.

A cursory examination of the respective costs indicates that increasing the probability of apprehension would represent a considerable ongoing cost to society, while increasing the fine structure is a minor, one-time administrative cost. The case for fines as a penalty is well documented by Becker. Social welfare is increased if fines are used whenever feasible, for minor offenses, instead of imprisonment or probation. In order to be effective in enforcing regulations with minimal inspections, however, fines would have to be raised to levels that impose massive penalties on the few truckers that are apprehended. This, of course, would be unacceptable; as Becker points out, North American society has determined that the severity of a punishment be proportional to the seriousness of the crime (p. 346).

The appropriate structure for penalty fines is only partly justified on the basis of the revenue collected. Euritt suggests the following considerations in the design for an overweight fine schedule.

First, it should provide economic disincentives for overweight vehicles that offset any incentives to disobey the law. A penalty that does not exceed the economic gain from overloading will not deter would be violators, even if the probability of apprehension approaches certainty. Second, fines should recover the cost of associated pavement damage and an appropriate portion of the cost of enforcement.

Although Euritt's criteria appear to provide sufficient disincentives to overloading, it is uncertain whether the recovery of enforcement costs is a practical objective. As penalties increase to cover the costs of enforcement, a disproportionate burden is placed on the violators who are caught. The general deterrence effect of higher penalties will reduce the number of violators, since truckers have a greater incentive to escape detection. Furthermore, excessively high penalties justify the expenditure of more resources by truckers in avoiding scales altogether.

It appears then, that effective, equitable penalty structures must fall within a fairly narrow range of magnitude. Given this constraint, and also the goal of reducing the public cost of pavement damage and law enforcement, further consideration is given to the optimal level of enforcement. The next section reviews some of the relevant literature on the enforcement - compliance process, followed by the development of a game theory model in section III.

2. Literature Review

Benefit-cost analysis has been used by various authors to assess weight regulation enforcement programs in specific jurisdictions. The following review highlights several of these studies, and is followed by a discussion of the merits of the benefit-cost method for analysis of weight regulation enforcement.

Barron estimates the level and cost of pavement damage in New Jersey in relation to the revenue collected from overweight violators. The author found that detected overweight trucks cause a relatively small shortening of pavement life, but estimates that only one quarter of one percent of violators are apprehended. He proceeds to estimate the total overweight truck population and suggests total pavement damage attributable to overweight trucks in New Jersey may approach US$20 million per year. Fines levied generate US$1.1 million per year, an amount which does not cover even the cost of enforcement. Barron concludes that a substantial increase in the revenue generated by overweight trucks may be in order, which could be accompanied by increasing the fine structure, the level of enforcement, or both.

Paxson and Glickert examine the benefits and costs of overloading in the states of Tennessee, Iowa and Indiana. Estimates of the probability of apprehending an overweight truck, which range from 5 to 20 percent, are used to calculate the expected cost of overloading. After subtracting these costs from the associated extra revenue resulting from increased payloads, the analysis indicates significant net economic incentives to overload in all jurisdictions. The authors conclude that in order to reduce the level of overloading, the

effectiveness of enforcement programs must be increased. They suggest that the product of the probability of being weighed and the expected fine must be greater than the extra revenue earned.

Walton and Yu forecast the costs and benefits of overloading in Texas for a 20 year period by comparing a hypothetical 100 percent compliance case with the actual level of violation. Data from the annual Truck Weight Survey are used to estimate the actual overweight truck population, which is found to be 20 to 30 per cent of the total truck population. The analysis estimates the total benefit to truckers over a twenty year period to be US$1317 million, of which US$84 million is paid to the government for overweight permits and fines. For the same period, Walton and Yu estimate the cost of enforcement and highway pavement maintenance to be US$261 million, far in excess of the US$84 million collected in fines and permit sales.

A common conclusion of these and other benefit-cost studies pertaining to weight regulation enforcement is the need for increased penalties and/or levels of enforcement. The benefit-cost approach suffers however, from the problems of applying a static analytical tool to a dynamic process. An action taken by one player affects not only his own net payoff, but also that of his opponent and therefore his opponent's strategy as well. The result then, of a change in one of the parameters (eg. penalty structure or level of enforcement) is an iterative process that, given sufficient time to adjust, results in a stable equilibrium. A static analysis of the enforcement process may indicate the direction in which a parameter should be changed in order to bring about a desired result (as Barron, Walton, and others have done), but is unable to prescribe the magnitude of change or optimal parameter levels. Such directional changes are equivalent to a single iteration in the dynamic process described above.

As a result, the benefit-cost method is not pursued for the purpose of establishing an economic framework to estimate the optimal level of enforcement. Instead, the discussion now turns to another method of modelling the enforcement process, game theory.

III. The Game Theory Model

The fundamental characteristic of game theory is that the decision maker competes with other rational, intelligent, goal-seeking opponents under conditions of conflict or competition. This may be contrasted with decision theory where the opponents, such as the states of nature, are passive (Rapoport).

Game theory is generally classified according to the number of players, with two-player games generally differentiated from games involving three or more players. A further classification pertains to the total payoff available to the two players, with zero sum games distinguished from non-zero sum games.

The area of highway truck weight regulation enforcement provides an interesting example of a two player, non-zero sum game. Revenue

gains to truckers resulting from overloading are not the government's loss; similarly, the cost of enforcement is not a gain to truckers.

1. Parameters Modelled

The six parameters chosen for use in the subsequent model by no means exhaust the list of variables which affect the decision process of truckers and government. They are, however, thought to be among the most important.

The three parameters chosen from the truckers perspective are the financial penalty for overloading, the associated revenue gain, and the cost of compliance. The cost of compliance parameter reflects the jockeying and scaling of freight and equipment which is often necessary to legalize loads.

Parameters modelled on the government side include the extra damage to pavement caused by overweight trucks, the revenue collected from violators, and the variable cost of operating a given scale.

2. Model Development

Each player in the weight regulation enforcement "game" has two strategy alternatives. The trucker (Player A) may operate within the legal limits, or may overload. The government (Player B) may elect to operate a given scale, or he may elect to close the scale. These options, along with the respective payoffs for each player are presented in Figure 2.

Figure 2: The Game Theory Model with Respective Payoffs

		PLAYER B: Government	
		1. Scale Closed 1 - y	2. Scale Open y
PLAYER A: Trucker	1. Comply 1-x	-C, 0	-C, -L
	2. Overload x	G, -D	G-P, P-L-D

x - probability of Player A overloading; $0 \leq x \leq 1$
y - probability of Player B operating a given scale; $0 \leq y \leq 1$
C - cost of compliance
G - revenue gain from overloading

D - pavement damage due to overloading
L - variable cost of operating the scale
P - monetary penalty assessed to the over-weight trucker if apprehended.

Each cell in Figure 2 shows the payoff (ie. gains and/or losses) of Player A (the trucker) and Player B (the government) that correspond to a pair of pure strategies. In all cases, each player chooses one strategy. The first term in each ordered pair represents the payoff to the trucker, while the second term represents the payoff to the government. For example, if the trucker complies, he incurs the cost (-C), that is the first term in row 1. In this case, if the scale is closed (Column 1) the government cost is 0, while if the scale is open (Column 2) the government cost is (-L), the variable cost of operating the scale.

A strategy is said to be "dominant" if it results in the maximum gain for the trucker, regardless of which strategy the government selects, or vice versa. In Figure 2, strategy 2 (overload) will dominate strategy 1 (comply), if $G - C > 0$, and $G - P - C > 0$. In this case, the gains from overloading exceed the cost of compliance ($G > C$) and the gains from overloading exceed the cost of compliance plus the fine for overloading ($G > C + P$). Consequently, the trucker can maximize his payoff by always overloading. That is, strategy 2 dominates strategy 1.

In reality, a pure strategy of overloading would likely be rendered infeasible by implications that go beyond the parameters specified in the model. For example, the authorities could react to a high incidence of overloading by conducting detailed safety inspections on chronic violators. Alternatively, bulky commodities or legal sized truckload lots may not be conducive to overloading.

In many instances, the players may find it advantageous to use mixed strategies. In a mixed strategy, there exists some probability, x, that the trucker will overload, and some probability, y, that the government will perform a spot check (i.e. operate a given scale). Whether or not the trucker overloads on a given trip is determined by a random process, which in the long run will result in overloading on a portion of the total number of trips equal to x.

Since both players make their choices independently and in a random manner, the probability is $x \cdot y$ that the trucker is caught overloading. If caught overloading, the trucker pays the penalty (P), but has a gain (G) from overloading. The government receives the monetary penalty (P), but incurs the variable cost of enforcement (L) and the pavement damage (D) due to overloading.

Similarly, the probability is $x(1-y)$ that an overload is not caught, and $(1-x)y$ that a complying trucker is weighed.

3. Equilibrium Points

If the two players use mixed strategies represented by the probabilities x and (1-x) for the trucker, and the probabilities y and (1-y) for the government, their expected gains (denoted V_A and V_B respectively), can be calculated by multiplying the probabilities for each cell by their respective payoffs, and summing the four cells. That is:

PLAYER A: The trucker

$$V_A(x,y) = (1-x)(1-y)(-C) + (1-x)(y)(-C) + (x)(1-y)(G) + (x)(y)(G-P)$$
$$= x(G - yP) - C(1 - x)$$

PLAYER B: The government

$$V_B(x,y) = (1-x)(y)(-L) + (x)(1-y)(-D) + (x)(y)(P-L-D)$$
$$= y(xP - L) - xD$$

Given that the players may find it advantageous to use mixed strategies, the question becomes: What level of x (or y) should be employed? With what probability on a given trip should the trucker overload, or the government carry out a spot check? This can best be answered by using the concept of equilibrium.

The equilibrium state in a two player game can be defined as a mixed strategy pair, (X,Y) from which neither player has any incentive to deviate unilaterally. In the weight regulation enforcement "game", the equilibrium point for the trucker, $\bar{X}$, is a probability of overloading such that the government cannot increase its payoff by altering its equilibrium probability of a spot check. Similarly, the equilibrium point for the government, $\bar{Y}$, is a probability of operating a given scale such that the trucker cannot profit by altering his equilibrium probability of overloading.

The equilibrium level of overloading for the trucker, $\bar{X}$, can be determined by setting the expected payoff to the government under zero enforcement, assuming the trucker overloads with probability x, equal to the government's payoff under continuous enforcement, and then solving for x. That is, the government is indifferent since it's payoff in the long run is the same regardless of the level of enforcement. Algebraically:

$$(1 - x)(0) + (x)(-D) = (1 - x)(-L) + (x)(P - L - D)$$

This simplifies to:

$$\bar{X} = \frac{L}{P} = \frac{\text{enforcement costs}}{\text{penalty for overloading}}$$

Similarly, the equilibrium level of enforcement for the government, $\bar{Y}$, can be determined by setting the payoff to the trucker under "always comply" equal to the trucker's payoff under "always overload", and solving for Y. That is, the trucker is indifferent since

his payoff in the long run is the same whether he complies or overloads. Algebraically:

$$(1 - y)(-C) + (y)(-C) = (1 - y)(G) + (y)(G - P)$$

This simplifies to:

$$\bar{Y} = \frac{C + G}{P} = \frac{\text{compliance cost + gain from overloading}}{\text{penalty for overloading}}$$

Thus, we see that:

$$\bar{X} = \frac{L}{P} \text{ and } \bar{Y} = \frac{C + G}{P}$$

These values satisfy the equilibrium conditions and hence represent an equilibrium point. Before proceeding, it is important to recognize several characteristics of the relationships derived.

First, the equilibrium point derived above is a qualitative relationship, independent of specific parameter values. It can be thought of as a general framework which can be used to "fill in the blanks" and thereby derive specific numerical values for $\bar{X}$ and $\bar{Y}$. While these values may be re-evaluated as the various parameter values change over time, such changes in quantitative magnitude do not invalidate the framework and relationships which underpin the equilibrium.

Second, this work represents the first known application of game theory to the weight regulation process. As such, the model developed is not claimed to be the definitive work in this area, but rather is intended to provide an initial framework from which more realistic, detailed and elaborate models may be developed.

4. Payoffs Under Equilibrium Conditions

By substituting the equilibrium values for $\bar{X}$ and $\bar{Y}$ into the payoffs derived in the previous section, we are able to express the payoffs only in terms of the parameters C, G, P, and L.

That is:

$$V_A \text{ (Trucker)} = \frac{L}{P}\left(G - \frac{C + G}{P}\right) - C\left(1 - \frac{L}{P}\right)$$

which simplifies to:

$V_A = -C$ = the cost of compliance

and

$$V_B \text{ (Government)} = \frac{C + G}{P} \left(\frac{L}{P} \cdot P - L \right) - \frac{L}{P} - D$$

which simplifies to:

$$V_B = -\frac{LD}{P} = \frac{\text{enforcement costs x pavement damage costs}}{\text{revenue from overweight fines}}$$

In the case of the trucker (Player A) this means that on average, the trucker will incur the cost of compliance (C) on each trip. The government's payoff is also negative, and is equal to $-\frac{LD}{P}$. Except in the case of a dominant strategy, the payoffs to both players will be negative, or at best zero. This is because decisions are made under conditions of conflict and competition. If the model made allowance for collusion between players, the results would be quite different. Since collusion does not occur in practice, the theoretical result is a negative payoff to both players. Over time however, truckers who are able to predict enforcement operations or effectively avoid inspection may realize a positive payoff from overloading.

Although the damage parameter (D) appears in the calculation of the payoff to government, it does not appear in the equilibrium solutions for $\bar{Y}$ or $\bar{X}$. That is, it does not affect the decision to overload or to operate a scale. This is because the associated pavement damage occurs whether or not an overweight trucker is apprehended. The trucker is simply assessed a monetary penalty and allowed to proceed in an overweight condition.

5. Factors Influencing Equilibrium Points

The equilibrium points $\bar{X}$ and $\bar{Y}$ can be understood more clearly by considering their actual make up. This consideration reveals that $\bar{X}$, the trucker's level of non-compliance, is dependent on the government's costs and benefits. Similarly $\bar{Y}$, the government's level of enforcement, is based on the trucker's costs and benefits.

In the case of $\bar{X}$, the numerator is equal to the government's cost of inspection, while the denominator is equal to the government's gain in the case of apprehension:

$$\bar{X} = \frac{L}{P} = \frac{\text{Government's potential cost}}{\text{Government's potential gain}}$$

Notice that the pavement damage (D) parameter is not used to calculate $\bar{X}$, since it occurs whether the trucker is apprehended or not. In the case of $\bar{Y}$, the numerator is equal to the potential gain for the trucker, while the denominator is equal to the trucker's potential loss if apprehended:

$$\bar{Y} = \frac{C + G}{P} = \frac{\text{Trucker's potential gain}}{\text{Trucker's potential loss}}$$

6. Witting versus Unwitting Violators

Several authors differentiate between overweight violators who knowingly violate weight regulations and those who unknowingly or accidentally find themselves in violation of the law. Wyatt and Hassan refer to the latter as "unwitting infractors", and estimate the level at approximately 3 percent of the total truck population. The Midwest Research Institute study (1975) refers to this segment of the truck population as "undeterrable", and estimates the level at 4 percent.

Variances in human nature suggest that truckers (and trucking firms) will vary in their willingness to overload and thus in the ease with which they are deterred from overloading. Some firms may avoid overloading on the basis of moral standards or because it sets a poor corporate example. Others may have no problem with the idea and use the practice for their own gain where possible.

For the purposes of this study, however, violators are considered a homogeneous group. The model makes no distinction between those truckers who violate out of indifference and those who make a conscious decision to overload. In effect they are both indifferent to the laws against overloading. The main difference is that the knowing violator has expended the necessary resources to know, or accurately predict his truck weight and the applicable weight limits, while the "unwitting" violator has not.

7. Pavement Damage versus Economic Gains of Overloading

An important result of the game theory model is the insignificance of the pavement damage parameter in the equilibrium level of enforcement, $\bar{Y}$. Earlier, $\bar{Y}$ was defined as the trucker's potential gain from overloading divided by the potential cost if apprehended. Recall:

$$\bar{Y} = \frac{C + G}{P}$$

As was noted earlier, the level of pavement damage is irrelevant here as it is neither a cost nor a benefit to the trucker. Since the cost of compliance (C) may in many cases be zero, the most important parameters affecting the enforcement decision are the overload revenue (G) and the penalty (P). From the above relationships, one can see that as the penalty for overloading is raised, the required level of enforcement decreases. This concurs with the analysis of these parameters in section III.

Although weight limits are justified by premature pavement damage, effective enforcement of these limits must be based primarily on the relationship of two parameters: the revenue gain from overloading and the associated penalties. This result justifies the conclusions found in many of the benefit-cost studies of weight regulation enforcement.

The game theory model not only supports the conclusions reached by previous research in this area, but shows how and why it occurs. It is this understanding of the interrelationships of the various

parameters which sets the game theory model apart from previous work in this area.

V. Summary and Conclusions

Prior research pertaining to the economics of highway truck weight regulation enforcement has been limited to static analysis of costs and benefits. These results are highly specific to the jurisdiction examined, and may be made sub-optimal by the actions of either the government or truckers. The game theory model, which is presented in this paper, assesses the benefits and costs of the enforcement-compliance relationship in a dynamic setting. The outcome is a theoretical result that may be generalized to all jurisidictions.

The model incorporates the two strategy options for each player as well as the respective payoffs, and establishes equilibrium levels of overloading and enforcement from which neither player has any incentive to deviate unilaterally. Because of the non-cooperative context, the usual result is a negative or zero payoff to the players over time, which nevertheless represents the best possible result. The equilibrium value may be considered a strategic outcome, rather than a solution to an optimization problem. Also the result is not unique to the specific parameters of the model. Consequently, the game theory equilibrium may serve as a useful tool for assessing the environment created by weight regulation policy.

The weight regulation enforcement process is an important function of government with considerable implications for society. There is a consensus in the literature that penalty structures should be designed to remove the economic incentive to overload. The game theory model developed in this paper supports this contention, and illustrates how and why it should be done. The results provide jurisdictions with an economic framework to review current penalty structures and scale operations.

ENDNOTES

1. Governments appear to practice a combination of these two objectives in their enforcement programs, presumably because of pragmatic and political considerations.

2. Spot checks are commonplace in many areas of society. Other examples include customs operations, income-tax auditors, and campaigns to apprehend drunken drivers.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. Irwin Lipnowski, Department of Economics, University of Manitoba for his constructive suggestions and comments.

REFERENCES

1. Barron, R. T. (1985). "Analysis of Pavement Damage Attributable to Overweight Trucks in New Jersey", Transportation Research Record 1038.

2. Becker, G. S. (1971). "Crime and Punishment: An Economic Approach". In W. Breit and H. M. Hochman (Eds.), Readings in Micro Economics, Second Edition. New York NY: Holt, Rinehart and Winston.

3. Borch, K. (1980). "Fidelity Guarantee Insurance Or Auditing The Auditor", Reports and Studies, International Insurance Seminars Inc., Paris.

4. Euritt, M. A. (1985). "Overweight Truck Operation in Texas: Developing Effective Fines and Penalties to Deter Violators". Professional Report, Faculty of Graduate School, University of Texas, Austin.

5. Iowa Department of Transportation (1975, Updated 1980). "Optimum Staff Size of Traffic Weight Operations", Midwest Research Institute, Ames, Iowa.

6. Paxson, D. S., & Glickert, J. P. (1982). "Value of Overweighing to Intercity Truckers", Transportation Research Record 889.

7. Rapoport, Anatol. N-Person Game Theory: Concepts and Applications. Ann Arbor: The University of Michigan Press, 1970.

8. Transportation Research Board, National Research Council (1981, November). "National Cooperative Highway Research Program Synthesis of Highway Practice: Criteria for Evaluation of Truck Weight Enforcement Programs". Washington, D.C.

9. Walton, C. M., & Yu, C. (1983). "Truck Size and Weight Enforcement: A Case Study", Transportation Research Record 920.

10. Wyatt, J. J., & Hassan, M. U. (1985). "Some Tentative Findings About the Effect of Level of Enforcement on Compliance with Truck Weight Regulations", Transportation Forum, 2(3).

Aspects of Overweight Trucking in Manitoba

by A. Clayton[1] and R. Girling[2]

ABSTRACT

The policies governing and the nature and extent of overweight trucking on Manitoba provincial highways are investigated. Overweight permit policies were found to be conservative when compared to the equivalent policies in adjacent jurisdictions - both in terms of the amount of trucking activity authorized by permits, and the overweight allowances permitted. Illegal overweight trucking was found to be common, particularly for a few selected commodities such as gravel. 7- and 8-axle double trailer units had a greater propensity for illegal overweight operations than other truck types common to weight-out operations. While illegal overweight trucking was found to be common, its implication in terms of extra 18 kip equivalent single axle loads appears to be small.

1. INTRODUCTION

The extent, nature, and importance of overweight trucking is poorly understood in Canada, and indeed in all countries. Few highway agencies have any objective appreciation for such issues as: (i) the amount and characteristics of illegal overloading of trucks; (ii) the vehicle types and commodities most prone to illegal overloading; (iii) the extent and nature of legally authorized overloading; (iv) the relative importance of truck overloads versus legal loads to total pavement and bridge loadings. And yet, these same agencies (and others) often argue that truck overloading is, to quote a recent O.E.C.D. report, "one of the most important reasons for unsafe traffic situations and road and bridge conditions" (O.E.C.D, 1979).

The development of more rational policies and regulations governing overweight trucking, and the basic weight and dimension regulatory envelopes which define overweight trucking, will be assisted by a more objective, systematic understanding of the overweight trucking phenomenon itself. This paper presents some of the key findings of a research project directed at improving the understanding of overweight trucking in Manitoba (Girling, 1988).

---

[1] *Associate Professor, Dept. of Civil Engineering, University of Manitoba*
[2] *Graduate Student, Dept. of Civil Engineering, University of Manitoba*

2. OBJECTIVES

This paper: (i) describes the basic policies governing overweight trucking in Manitoba; (ii) examines the extent and nature of overweight trucking on Manitoba's provincial highways based on an analysis of truck weight survey data collected by the Manitoba Department of Highways and Transportation (MDHT), samples of overweight permit data, and an analysis of overweight offence notices; (iii) examines an indicator of the relative importance of illegal overweight trucking in Manitoba, as measured by its contribution to total (18 kip) equivalent single axle loadings (ESAL's); and (iv) presents commentary on possibilities for improving/rationalizing some of the policies which govern overweight trucking in Manitoba.

3. WHAT IS OVERWEIGHT TRUCKING?

Overweight trucking is defined as the operation of trucks beyond the basic weight limits (i.e., tire loads, axle weights or gross vehicle weight (GVW) - and combinations thereof) prescribed by governing statutes and regulation. While this appears simple on the surface, a variety of complications emerge in any effort (including this one) to investigate overweight trucking, because of the complexity of the basic regulations themselves, tolerance policies concerning their enforcement, and the fact that the basic regulations are regularly changed. Thus, what was considered overweight trucking yesterday may be normal trucking today; what is considered overweight trucking in one season is normal trucking in another; what is considered overweight trucking on one road may not be overweight on another; what appears to be overweight trucking when looking at a weigh-scale may not be overweight, given the applicable tolerance policy.

Trucks may be legally overweight (i.e., operating pursuant to regulatory exemptions or permits) or illegally overweight. Legal overweight operation by exemption involves the granting of general (legislative, regulatory or policy-type) exemptions from the weight limits - usually for certain vehicle types (e.g., snow clearing equipment, farm trucks) or specialized commodity movements (e.g., garbage trucks, concrete mixers). Legal overweight operation by permit involves the issuance of permits by road authorities allowing - on a selective basis - higher than normal weights for certain vehicle types, routing and/or commodity handlings.

4. LEGALIZED OVERWEIGHT TRUCKING IN MANITOBA BY PERMIT

This section examines the type and extent of legal, specially-permitted overweight trucking in Manitoba. Overweight operation by exemption in Manitoba is restricted to snow clearing equipment and some farm equipment.

4.1 Manitoba's Overweight Permits

Manitoba has three categories of permits for authorizing overweight operations: (i) single trip permits; (ii) extended permits; (iii) extended transportation permits. Single

trip permits allow a single specified overweight move of an particular vehicle along a designated route (e.g., a heavy transformer from Winnipeg to Limestone along Highway XX in a designated 3-S3 unit at a given load). Single trip permits are generally intended to facilitate the handling of unique movements of "indivisible" loads moving on an intermittent basis and which cannot be accommodated within the provisions of the basic weight limits. Extended permits provide blanket authority to operate a particular vehicle at a specified overweight level on an unlimited basis for a specified time period of up to one year (e.g., permitting excess loading of steering axles on concrete mixers). This type of permit is generally directed at facilitating the more efficient trucking of (otherwise) "divisible" loads of particularly important commodities (e.g., raw timber) or commodities requiring the use of unique vehicles. Extended transportation permits are "self-recording", industry-enforced (in effect "blanket") single-trip permits allowing any number of moves of (normally) construction or industrial equipment to be made up to a specified overweight (or overdimension) limit (e.g., a bulldozer is moved many times by its owner to/from various construction sites), with each individual move being recorded and reported to MDHT.

4.2 The Extent of Operations Pursuant to Overweight Permits

MDHT does not maintain a computerized file of permit information. Manual processing of raw permit form data is therefore necessary to develop any understanding of the extent and nature of trucking activity pursuant to these permits.

From a 3% random sample of a total of 14889 single trip permits and extended permits issued for both overweight and overdimension operations by MDHT in 1986/87, Girling (1988) estimated that there were 6100 overweight trips made under the authority of single trip permits and extended transportation permits during that year. The single trip permits accounted for 70% of the 6100 trips.

The data base did not permit an estimation of the number of overweight movements which would have taken place pursuant to extended blanket permits relating to overweight operations on forest product movements or on the steering axles of selected vehicle types. The major movement taking place under such permits involves the handling of raw forest products in northern Manitoba during the winter months. As an indicator of the amount of this activity, Manitoba issued forest product permits for 191 tractors in 1987/88 - half being for the overweight operation of standard 5-axle tractor-semitrailers, with the other half being for the overweight operation of 7-axle double trailer B-trains.

4.3 A Comment on the Manitoba Overweight Permit Policy

The Manitoba overweight permit policy is conservative compared to the Saskatchewan and Alberta policies - both in terms of the amount of activity taking place pursuant to overweight permits, and the level of overweight allowance provided.

As a (rough) indicator of the first of these issues, Saskatchewan issued 37101 single trip overweight/overdimension permits in 1986 (nearly 3 times the number of such permits issued in Manitoba); Alberta issued an estimated 55612 overweight/overdimension permits in 1986/87 (4-5 times as many as issued by Manitoba). In addition, both Alberta and (particularly) Saskatchewan have very liberal policies concerning blanket overweight/overdimension permits as compared with Manitoba. For example, Saskatchewan and Alberta issued overweight "timber-related" permits for 680 and 1027 tractors respectively in 1986/87 (vs. Manitoba's 191). Further, Girling (1988) estimated there were some 43495-22.5 t (3-S2) equivalent truckloads of movement made pursuant to the Saskatchewan Bulk Commodity Act in 1986/87 - all on an overweight basis in a variety of vehicle configurations.

As a (rough) indicator of the relative leniency of the overweight permit policies in the prairie provinces, it is informative to compare the GVW limit levels which were authorized for single trip permits by a permit clerk (i.e., for all intents and purposes, "across the table" or "over the phone" with little, if any, technical evaluation) in 1987/88: Manitoba (60000 kg); Saskatchewan (63500 kg); Alberta (70000 kg).

5. ILLEGAL OVERWEIGHT TRUCKING IN MANITOBA

This section presents the results of an analysis of the extent and characteristics of illegal overweight trucking in Manitoba. The analysis is based on data developed in the MDHT annual truck weight surveys between 1975 and 1985. Girling (1988), and Clayton and Lai (1985) present details concerning the scope and content (and limitations) of these truck surveys, and the modifications which have been made to normalize the raw survey data (i.e., standardize units of measurement and commodity codes), to permit the year-to-year type of comparative analysis presented here. An analysis of overweight offence notices is also presented.

5.1 Methodology Used in Determining the Characteristics of Illegal Overweight Trucks

Two key alterations were made to the (normalized) truck survey data prior to undertaking the overweight analysis. First, all observations of empty trucks were removed from the data set. (This means that all statistics presented here are given in terms of "trucks with load" rather than "all trucks"). Second, all observations made during periods of spring weight restrictions or winter weight premiums were removed from the data set. (Observations during spring restrictions were removed because it was unknown to what degree or for how long roads were weight-restricted; observations during winter premiums were removed to allow comparisons through the years, since the winter premium policy varied from year to year).

With this normalized and modified data set, overweight trucks were then identified by comparing tire loads, axle weights and GVW of each truck weighed with the appropriate governing Manitoba weight limit, giving due regard to the road class on which the vehicle operated and when each truck was weighed (i.e., Manitoba weight regula-

tions are different for different road classes, and have changed with time). A truck was deemed to be overweight on gross if its total weight was greater than the lesser of the sum of loads allowed on its axles or the governing highway GVW limit. In all cases, the allowable load on a steering axle was the lesser of the load allowed on the tires of the steering axle or the steering load limit. All other axles were assumed to have sufficient tire such that the axle load limits rather than tire load limit governed.

In all cases, axle spacings were assumed adequate to permit full axle loadings. By so ignoring the axle weight-reduction requirements prescribed by the regulations for inadequate axle spacings, the analysis tends to underestimate overloading problems. Further, tolerances were ignored in establishing whether or not a truck was overweight. This leads to an overestimate of what the MDHT would in practice consider overweight (i.e., a vehicle must be over the basic limit PLUS tolerance to be overweight).

Overweight truck observations were also divided into legally overweight and illegally overweight. Where an overweight truck was identified by the survey as "having a permit", it was assumed that the truck was loaded within the provisions of that permit (i.e., the possibility of operating at a weight level beyond the provisions of the permit was ignored). Overweight trucks which were not identified as having a permit were assumed to be illegally overweight. (Trucks which exceeded their registered GVW were not considered overweight in this analysis).

5.2 Data and Survey Limitations

The data presented in subsequent sections, and the observations and conclusions which are derived from that data, must be considered in the light of the following qualifications:

- the original weight survey probably underestimates illegal overweight truck operations within Manitoba because operators of such trucks would have an obvious tendency to avoid the survey scales (despite the fact that MDHT did not issue overweight violations during weight surveys);

- the information obtained during the surveys concerning whether or not a truck was operating "with a permit" is of questionable quality (Lai, 1988). The 1979 survey, for example, identified no trucks as "having a permit". This will result in an overestimate of illegally overweight trucks.

5.3 The Results

The analysis led to the following general findings:

Illegal Overweight Operation is Common

For the loaded trucks surveyed through the period 1975-1985 inclusive: 26% of 36,150 were illegally overweight; 10% of these 36,150 trucks illegally exceeded their allowable

GVW; 12% of the 36,150 steering axles, 4% of the 12,121 single axles, and 16% of the 48,341 tandem axles illegally exceeded their allowable weight limits. The mean overweight for these axles was 397, 701 and 859 kg respectively.

Secondary Highways Experienced a Much Greater Proportion of Illegal Overloading than was the Case for Primary Highways

For the loaded trucks surveyed through the period 1982-1985 inclusive: 42% of 1566 trucks observed on secondary highways and 27% of 7121 trucks on primary highways were illegally overweight. 30% of the trucks operating on secondary highways exceeded their GVW limit (vs. 6% of those on primary highways); 12% of 792 single axles on secondary roads exceeded their 8200 kg limit, by 843 kg on average (vs. 3% of 2661 on primary roads exceeding their 9100 kg limit, by 439 kg on average); 43% of 2145 tandem axles on secondary roads exceeded their 14500 kg limit, by 1373 kg on average (vs. 9% of 13264 on primary roads exceeding their 16000 kg limit, by 592 kg on average).

A Limited Number of Commodities Account for the Vast Majority of Illegal Overloads

For the loaded trucks surveyed through the period 1975-1985 inclusive: nearly 2/3 of 9396 illegally overweight trucks were handling one of five different commodity groups, namely - in descending order of importance - gravel (2520), building materials (1050), fuel (939), timber (751), grain (590). Anywhere from 1/3 to 1/2 of all surveyed trucks handling these particular commodities were illegally overweight.

Gravel and timber trucks were particularly prone to being overweight on gross (21% and 31% of each was so overweight) - as compared with the average of 10% overweight on gross across all commodities. Gravel trucks were also particularly prone to being overweight on front steering axles (23% of 5023 steering axles were overweight, by 561 kg on average) - as compared to the average of 12% across all commodities.

7 and 8-axle A and B-train Double Trailer Combinations are More Prone to Illegal Overweight Operation Than are Single Unit Trucks and Standard 5-axle 3-S2 Combinations

Table 1 summarizes the distribution of illegal overweight operation by truck type through the period 1975-1985 inclusive. Nearly 1 of every 2 double trailer combinations was overweight, as compared to 1 of every 3 standard 5-axle tractor semitrailers.

The 3-S3 is also frequently illegally overweight (47% of 238 observations). This combination is commonly used to haul overweight indivisible loads. There are two possible reasons for the high illegal overweight rate for this vehicle. One is that many

moves of heavy indivisible loads are moving without permit; the other is that the existence of an overweight permit was not properly recorded during the weight survey.

TABLE 1.
Illegal overweight operation by truck type.
1975-85

Truck Type	Number Surveyed	Percent Overweight
SU2	8385	7
SU3	5664	33
3-S2	19327	33
A-train[1]	772	44
B-train[2]	175	57

[1] (3-S1-3); (3-S2-2); (3-S2-3)
[2] (3-S2-S2)

Overweight Operation is More Frequent at Temporary Survey Locations Than at Permanent Weigh Scale Locations

For the loaded trucks surveyed through the period 1975-1985 inclusive, 21% passing through Manitoba's three permanent weigh scale locations (Westhawk at the Ontario-Manitoba border; Emerson at the Manitoba-Minnesota border; Headingley on the Trans-Canada just west of Winnipeg) were illegally overweight. This compares with an average of 27% illegally overweight trucks at temporary scale locations. Some of the temporary scale locations experienced particularly high frequencies of overweight operation. For example, 46% of the trucks passing through the Bird's Hill Scale, just north of Winnipeg, were overweight. This site has a high volume of gravel traffic moving from north of Winnipeg into the city.

5.4 Illegal Overweight Trucking in Manitoba based on Offence Notices

There were 2314 overweight offence notices issued by MDHT Transport Compliance Section in 1987/88 (8% more than for the previous year). The notices were issued for exceeding any one of the following restrictions: (i) allowable tire loads; (ii) allowable axle loads; (iii) allowable load on any axle group as a function of axle spacing; (iv) GVW; (v) registered GVW; (vi) the GVW limit on a restricted bridge; (vii) specially-permitted allowable load. Notices were issued at both permanent scale sites and on field patrols by officers of MDHT. The data base does not include any overweight notices processed by other enforcement officers (which in general are believed to be relatively minor regardless). (It is to be noted that an overweight notice records only one overweight offence (the worst one), even though the vehicle may have been illegally overweight on more than one issue (e.g., GVW and one particular axle)).

A sample of 118 overweight offense notices issued in 1987/88 (excluding ones involving overweight on registered GVW) was randomly selected. Analysis of that data base led to the following findings:

Axle Overweights Dominate the Overweight Offence Notices

93% of the 118 offence notices analyzed involved overweight axles (i.e., 46% on drive tandems, 26% on trailer tandems, 14% on steering axles, 7% on single axles). All other violations including overweight on GVW accounted for only 7% of the total.

A Limited Number of Commodities Account for the Majority of Overweight Offenses Notices

The following list shows the seven most frequent commodity handlings in the sample: building materials (15%); human food (14%); livestock (13%); gravel (11%); timber (8%); chemicals (5%); grain (5%); all other commodities (29%).

3-S2's Account for 3 of 5 of all Overweight Offence Notices

The following list shows the relative importance of various vehicle types in the sample: 3-S2's (59%); 2 and 3-axle single unit trucks (16%); 7-axle B-trains (11%); 7 and 8-axle A-trains (7%); all other vehicles (7%).

6. THE RELATIVE IMPORTANCE OF ILLEGAL OVERWEIGHT TRUCKS FROM THE PAVEMENT PERSPECTIVE

This section summarizes the results of the Girling (1988) analysis directed at developing an indication of the incremental pavement loading (as measured by incremental 18 kip Equivalent Single Axle Loads) experienced by Manitoba highways as a result of the operation of illegally overloaded trucks in Manitoba.

6.1 Methodology and Assumptions

The analysis involved calculating the total number of 18 kip equivalent single axle loads (ESAL's) created by the observed truck fleet - including overweight trucks - weighed in the course of the MDHT truck surveys through the period 1975-1985 inclusive, and comparing this with the total ESAL's which would have been experienced by an idealized "all-legal" fleet hauling the same payload. The calculations were based on AASHTO equivalency factors for asphaltic pavement, based on a structural number (SN) of 1 (a thin pavement) and a terminal serviceability index of 2 (the pavement is allowed to deteriorate to a low quality before it is considered failed). See Girling (1988) and related references for details.

The following method was used to calculate the ESAL's which would have been produced by a fleet of trucks operating at legal weights:

For Trucks Which Were Overweight on Gross: (for each truck type)

First, the GVW of each overweight truck was reduced to its allowable GVW (in effect by reducing the payload - and creating a "bank" of excess payload). Second, the resultant legal GVW was allocated throughout the vehicle in proportion to the vehicle's legally allowed axle weights. Third, the ESAL's of the resulting legalized vehicles were calculated and summed. Fourth, an "excess" fleet of trucks (assumed to be operating at maximum weights) was "created" to handle the bank of excess payload. Fifth, the ESAL's for the excess fleet were then calculated and added to the ESAL's previously calculated for the legalized vehicles, to arrive at the sum of ESAL's which would have been realized with "all-legal" GVW operations.

For Trucks Which Were Overweight on Axles Only:

The actual GVW's of these trucks were re-allocated across the trucks' axles in proportion to the legal axle weight limits, and the resulting ESAL's which would have been realized (given these legal loadings) were then calculated.

The tare weights used in the calculation of payloads were based on the average empty truck weights for each truck type as determined by Plett (1988) from the MDHT truck weight survey.

6.2 The Results

Table 2 shows the observed and "legalized" ESAL's (by truck type) for the total loaded truck fleet weighed by the MDHT survey through the period 1975-1985 inclusive. As indicated in the table, overweight trucking in Manitoba through the period 1975-1985 created (in the order of) 5% more 18 kip ESAL's than might otherwise have been experienced if all trucks had been operated at legal weights.

It is of interest to observe that of the 2458 ESAL's which would have been eliminated by creating the above legalized operation, one-half would have been realized by legalizing 3-S2's and another one-third by legalizing 3-axle single unit trucks. The Girling (1988) analysis also indicated that the legalizing of loadings of three commodities (gravel, building materials, and timber) would have eliminated one-half of the "extra" ESAL's generated by illegal loads.

TABLE 2.
Observed and Legalized 18 kip ESAL's of Manitoba Truck Fleet 1975-85: by Truck Type

Truck Type	Within Limits	Observed ESAL's			Legalized ESAL's	
		Overweight		Total	From Illegal Overweight	Total
		Legal	Illegal			
3-S2	19,927	336	16,078	36,340	14,876	35,139
SU2	2,709	6	976	3,691	743	3,458
SU3	3,451	11	4,459	7,921	3,708	7,170
2-S2	701	4	139	844	105	810
3-S2-2	763	4	969	1,735	886	1,653
2-S1	196	-	55	252	48	241
3-S3	58	258	300	616	270	586
Other	94	4	180	276	175	271
3-S2-S2	182	17	342	541	298	497
3-S1-3	318	13	232	563	220	550
3-S1-2	258	8	66	333	55	321
3-S2-3	122	2	180	304	138	262
Total	**28,777**	**662**	**23,976**	**53,415**	**21,518**	**50,958**

7. COMMENTARY

(a) Manitoba's overweight permit policy is conservative compared to the Saskatchewan and Alberta policies. This is true for both the amount of trucking activity which is permitted to take place by special permit, and the overweight allowances normally granted by permit. Wise liberalization of the Manitoba policy could provide important economic benefits for the province.

(b) There is a substantial amount of illegal overweight trucking occurring in Manitoba. Only a small fraction of this overweight activity is apprehended. A limited number of commodities (in particular, gravel, building materials, fuel, timber and grain) account for the vast majority of these illegal overweights. To the extent that illegal overweight trucking is in fact a problem for Manitoba roads, it would seem that a more selective enforcement program directed at this short list of commodities would be beneficial.

(c) 7- and 8-axle double trailer combinations have had a greater propensity for being illegally overweight than other truck type used in weight-out operations. Again, to the extent that illegal overweight trucking is important, this could be of growing concern as the use of these vehicles continues to increase in Manitoba.

(d) There is proportionately more overweight operation occurring on lower class highways than occurs on the primary highways. It would seem that Manitoba has been more sympathetic to permitting proportionately more overweight trucking on

its lower class highways than it does for its premium highways. The wisdom of this approach is not obvious.

(c) While illegal overweight trucking is relatively common in Manitoba, its implications in terms of extra ESAL's on pavements appears to be quite small. Is it possible that illegal overweight trucking - from the pavement perspective - is "much ado about nothing"? And if that is the case, what about our whole approach to the pavement-related aspects of weight and dimension regulation in general?

ACKNOWLEDGEMENTS

Funding support from the Natural Science and Engineering Research Council of Canada and the University of Manitoba Transport Institute is gratefully acknowledged.

REFERENCES

Organization for Economic Cooperation and Development. (1979) "Evaluation of Load Carrying Capacity of Bridges". December 1979.

Girling, Robert. (1988) "Overweight/Overdimension Trucking in Manitoba and Western Canada", M.Sc. Thesis, Department of Civil Engineering, University of Manitoba, October 1988.

Clayton, A. and Lai, M. (1985) "Data Requirements and Problems Respecting Truck Transport in Manitoba". The Proceedings of the 1985 Annual Conference of the Canadian Society of Civil Engineers. Saskatoon. 1985.

Lai, M. (1988) Manitoba Department of Highways and Transportation, Traffic Analysis Engineer. Personal Communication.

Plett, R. (1987) "Weight and Dimension Characteristics of Large Truck Combinations as a Function of Regulatory Limits: Manitoba Highways". Draft M.Sc. Thesis, Department of Civil Engineering, University of Manitoba

TRANSPORTATION SYSTEM ANALYSIS IN THE NEW ENVIRONMENT: A CASE STUDY

M.C. Ircha, F.R. Wilson, J. Christie, and G. Hogg,
UNB Transportation Group

INTRODUCTION

The entry into the new era of regulatory reform initiated by the National Transportation Act and other legislation may provide the necessary ingredients to enable Canada's container ports to aggressively compete with their U.S. counterparts. The Port of Saint John provides a wide range of shipping services from bulk oil to neobulk forest products to containerized general cargo. Although its activities in the bulk and neobulk trades continue to grow, the Port's containers throughput has dropped precipitously during the past few years.

In 1988, the UNB Transportation Group undertook an analysis of the Port's container traffic. This study included a review of changes in shipping technology, origins and destinations of container movements in eastern North America and in particular New Brunswick, port competition, and inland transportation systems. In addition, the study evaluated the Port's marketing programs and administrative structure.

Vessel and port-of-call rationalization has affected the Port of Saint John and other Canadian ports. For example, the "workhorse" of the container trades is shifting from the smaller 1800 twenty foot equivalent unit (TEU) vessel to a 2500-3000 TEU vessel. In terms of inland transportation, the primary competition is first between rail and truck and second between CP and CN. One option is for the Port to operate a short line railroad to Montreal . Truck transport of containers is another option from Saint John to Montreal.

One of the problems affecting the Port appears to be marketing. What seems to be required is a marketing strategy which reflects the Port's role as a "broker" between the water and land-side transportation modes. Marketing not only involves courting the shipping lines, but also shippers and receivers as well as inland transportation systems.

To achieve renewed growth in the Port, the Marketing unit should be restructured to enable the Port to provide "one-stop shipping" service by acting in a role akin to a freight forwarder/broker.

DYNAMICS OF CONTAINERIZATION

The world's container fleet has developed during a period of considerable turbulence in the marine environment. The heavy, boom period for international trade in the 1970's has given way to the 1980's recession. Optimistic forecasts in the late 1970's coupled with selective approaches by shipyards and governments around the world for easy and low cost ship building led to an over-supply of ship tonnage in the world fleet. The overcapacity of the world's container fleet is estimated by UNCTAD (1988) as being 25 to 35 percent.

Overcapacity of supply in a period of a slow increase in demand has had a dramatic impact on freight rates for marine containers. UNCTAD estimates the 1987 freight rates for liner cargo (primarily containers) are only 22 percent higher than they were in 1980. This means that ship owners must ensure their vessels are being handled as efficiently and cost effectively as possible. The container fleet has sought such efficiencies through building larger vessels and operating out of ports which offer rapid turn-around (today, time in port is measured in hours rather than days).

Larger ships tend to be less flexible in the sense there are a limited number of port facilities which can handle them. Few ports have the ability to increase their manoeuvring areas and water depth to accommodate ever larger container ships. Many ports also lack adequate storage space to handle their increased cargo loads. In the early 1970's, the typical cellular container vessel carried up to 1800 TEU. By the 1980's container ships were at the 3000 to 3700 TEU level. In mid-1980, the world's largest container ships, U.S.L.'s Econships at 4258 TEU, were placed in service. In the late 1980's, the 2500 to 3000 TEU container ship is becoming the average size vessel for the world's major trades.

High capital costs in the container trade has led to a rationalization in the number of ports being served by major shipping lines. Improved land-side intermodal service by both railroads and trucking firms have enabled container services to be consolidated in load centre ports. Container traffic from a large hinterland can now easily be transported to a major port consolidation facility. Larger container ships can then limit their ports of call to load centre ports. The development of a limited number of load centres along the east coast of North America implies that the choice of port for intermodal containers will increasingly be decided by the ocean carrier rather than the shipper. In many cases today, the shipper is "port-blind" with respect to how the containers are shipped. The matters of concern to the shipper tend to be cost, reliability, and total transit time rather than the port being used (Hanelt and Smith, 1987).

One of the most remarkable innovations in intermodal service is the introduction of double-stack container trains (DST). These specialized trains involve the stacking of domestic and marine

containers in a two-high configuration on board specially designed, deep well, railway flat cars. In 1983, only about 1 percent of the U.S. intermodal traffic was carried on double stack rail platforms. By 1988, this form of intermodal movement has been estimated to be 35 percent of all moves (Pilsch, 1988). At the end of 1988, some 76 weekly departures of dedicated DST's were scheduled from U.S. west coast ports to eastern destinations.

Canadian National inaugurated a DST service from Vancouver to Toronto early in 1989. Canadian National may also consider a DST service from Halifax to central Canada. A 1988 study of Halifax as a potential load centre considered the economics of operating a mixed double-stack/single-stack service from the Port to intermodal yards in Montreal and Toronto. Based on this analysis, it was "estimated that double-stack service would achieve savings in the order of 20% of existing rail service costs" (Peat Marwick, 1988). The consultants went further to argue "that the economics of double-stack are sufficiently attractive that double-stack rail service will become a reality at Halifax within the foreseeable future".

The growth of double-stack container trains moving marine containers from west coast ports has had a significant effect on east coast ports in both Canada and the U.S. Initially, the rail movement of containers across the continent was seen as a premium service for time sensitive commodities able to bear high freight rates. Lower rail rates due to volume discounts for scheduled service coupled with reduced costs arising from double-stack service now compete favourably with the rates charged for the all-water route from the Far East through the Panama Canal to the North American east coast. Shippers can now receive the benefits of timely delivery (important for just-in-time inventory systems) at modèrate cost.

Currently, U.S. west coast ports handle about 75 percent of the U.S. - Far East container traffic. As the major west coast ports expand to handle the growing demand for container throughput, they will continue to erode Far East traffic moving through east coast ports.

Port of call rationalization by major container shipping lines has had a direct impact on the container throughput in the Port of Saint John. In 1987, the Japanese Three (Mitsui O.S.K., NYK Lines, and Yamashita-Shinnihon) ended their fifteen year association with the port. As the round trip voyage from New York to Saint John added four more days to their vessel schedules, the Japanese carriers terminated the Canadian leg of their all-water service from the Far East.

MARKET ANALYSIS

Statistics Canada data (1986) was used to determine trade patterns for Canadian imports and exports with other regions of the world. Although the data was the best available, it contained inherent flaws which must be kept in mind when interpreting results of analyses. Due to the weakness in determining specific destinations in

import data, it was used to observe the general patterns in Canadian trade. Export data is not a problem as it is based on the actual province of origin.

Using 1986 data, it was found that New Brunswick was a small market, accounting for about 2.0 billion dollars (value) of traded goods. The Port of Halifax relies on Nova Scotia as its local hinterland. Halifax has little natural advantage over Saint John since Nova Scotia accounted for only 2.6 billion dollars of trade goods. Nova Scotia had a much greater imbalance of trade (in favor of imports) than New Brunswick.

It is Quebec and Ontario that dominate Canadian international trade. In 1986, Quebec trade accounted for a traded value of over $15 billion and Ontario, almost $20 billion. The Quebec market was over seven times as large as New Brunswick and the Ontario market was almost ten times as large. In contrast, the Nova Scotia market was only 30 percent larger than New Brunswick. The balance of trade favored imports for both Quebec and Ontario; there were twice as much imports as exports in terms of value. The imbalance resulted mainly from the difference in value of imports and exports; the value of exports was typically lower.

The major destinations of Canadian exports in 1986 were Europe (30 percent), Asia (29 percent), and the Middle East (29 percent). The remaining 12 percent of Canadian exports were destined to other regions of the world. The two principal areas where 1986 imports originated were Western Europe (43 percent) and Asia (40 percent).

New Brunswick, Quebec, and Ontario are the greatest potential sources of Canadian traffic for the Port of Saint John. The 1987 exports by sea for these provinces shows that although Ontario trade was higher in value than Quebec, Quebec exports accounted for many more tonnes than Ontario. A significant proportion of Quebec exports have consisted of low value high volume products such as minerals and ores. Western Europe and Asia were identified as the major overseas markets when volume is considered instead of value.

In a previous Port of Saint John marketing study by Stevenson, Kellogg, Ernst and Whinney (1987), fourteen U.S. states were identified as being the potential hinterland of the Port of Saint John. The designated states, consisted of the following Northeast states and Midwest states which border the Great Lakes:

1. Michigan
2. Minnesota
3. Wisconsin
4. Illinois
5. Indiana
6. Ohio
7. Pennsylvania
8. New York
9. Vermont
10. Massachusetts
11. Connecticut
12. New Hampshire
13. Rhode Island
14. Maine

Trade data (for 1986) was obtained by the Port of Saint John from

the Journal of Commerce PIERS database for those fourteen States.

Western Europe and Asia were found to be the main destinations for exports, while imports originated mainly from Central America, South America, and Western Europe. Western Europe commanded 33 percent of exports and Asia accounted for 32 percent, while other regions each accounted for less than 10 percent. Western Europe generated 24 percent of imports, while Central America and South America generated 19 and 23 percent respectively. There was an obvious imbalance of imports and exports, not only in terms of volume, but also in terms of origins and destinations. For Western Europe, which was the only overseas market which commanded a significant portion of both imports and exports, there was a 33 percent imbalance of trade in favor of U.S. exports.

When the same trade was considered in terms of the state of origin/destination, New York stands out as the principal market, followed by Pennsylvania and Connecticut. Maine and Massachusetts, are small markets in comparison to New York, but are significant markets when compared to Canadian provinces. These markets might be difficult for the Port of Saint John to penetrate due to the proximity and strength of the Port of New York.

How much of the U.S. traffic might be diverted? U.S. container cargo diverted through Canadian ports has almost tripled between 1975 and 1985, growing from about 51 000 TEUs to 148 000 TEUs (Container Market Analysis, 1986). About 98 percent of the diverted U.S. cargo was routed through eastern Canadian ports while the remaining two percent went through Vancouver. Diverted U.S. containers provide a potential market for Saint John.

The Canada Ports Corporation data on 1984 diverted U.S. exports and imports showed the majority of export traffic was destined for Western Europe (74 percent) and 11 percent, for Asia. The majority of exports originated in the U.S. Midwest while the Northeast also represented a significant share of diverted traffic. The same pattern emerged for diverted imports. Western Europe was the largest overseas market while the U.S. Midwest and Northeast were the dominant inland markets.

A significant amount of the diverted U.S. container flow is through the Port of Montreal. Increased aggressiveness by U.S. east coast ports seeking to recapture diverted traffic could erode Montreal's container throughput. For example, both Baltimore and New York are now offering rebates to shipping lines for containers destined for the Midwest coming through the port. To capture some of this diverted cargo Saint John must provide service to Western Europe.

PORT TRAFFIC TRENDS

The recent growth in port traffic volume (shown in Figure 1.) is mostly due to an increase in liquid bulk, and to a lesser extent, dry bulk traffic. Container and break bulk traffic have been low in

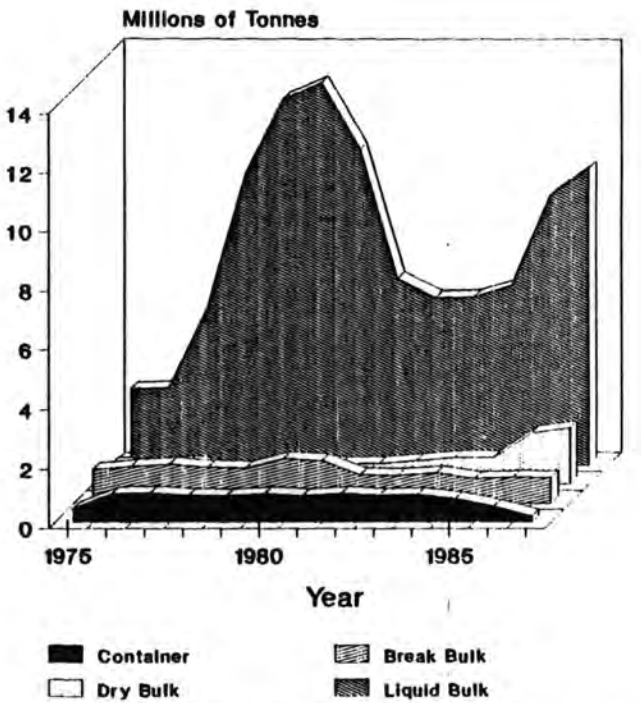


Figure 1. Port of Saint John Traffic Trend Analysis - Container, Break Bulk, Dry Bulk, and Liquid Bulk Traffic Source: Ports Canada

volume and, in fact, have been decreasing. It is interesting to note that the growth in port volume can be attributed mainly to the increased sales of Irving oil products and potash from Sussex.

To determine which commodities generated the most port revenue, a comparison was made between traffic volume (in tonnes) and the revenue generated. Petroleum accounted for 78 percent of the total port tonnage but only contributed 9 percent to its revenue. Potash accounted for 10 percent of the tonnage and contributed a more favorable 36 percent of revenues. Forest products claimed 5 percent of the total tonnage but accounted for 31 percent of revenue. It is interesting to note that while container traffic was only 2 percent of total tonnes, it accounted for 16 percent of the Port revenue.

Container traffic grew in the mid 1970s, leveled off, and then dropped off since 1984. During this time period the container markets have been growing. To understand Saint John's position in the market place, it is useful to observe the Port's share of the container trade in eastern Canada. Saint John is one of four eastern Canadian ports which have handled container traffic in purpose-built container terminals in recent years. This market share analysis considers traffic through the ports of Quebec, Saint John, Halifax, and Montreal as a total market. Figure 2 shows the market share trends for the four ports.

Between 1975 and 1987, Saint John's container volume dropped by 33 percent, yet total traffic for the four eastern ports more than doubled. Saint John market share dropped from a high of 23.5 percent in 1976 to the 1987 low of 2.5 percent. Since the trend is downward, market share is expected to be even lower in 1988.

Traditionally, Halifax has been considered to be Saint John's main rival. This feeling was reinforced when the Japanese container lines moved from Saint John to Halifax. This belief is a misconception. Halifax has lost market share dropping from 37.2 percent in 1975 to 32.7 percent in 1987. Montreal has actually been the main competitor for eastern Canadian container traffic. During a time period when total container traffic grew by 150 percent, Montreal's container volume grew by 365 percent. Its market share jumped from 35.3 percent in 1975 to 64.8 percent in 1987. In 1987, Montreal handled about 26 times the volume handled by Saint John and about twice the volume handled by Halifax.

It is crucial that Montreal's dominance in the container market be realized, and that Montreal be recognized as the real competitive threat - not Halifax. For the Port of Saint John to grow, it must change its focus and target Montreal traffic.

SURVEY OF NEW BRUNSWICK SHIPPERS

Since locally produced goods accounted for a large proportion of Saint John's volume, the UNB project team surveyed New Brunswick shippers who ship or receive goods to or from overseas markets. The

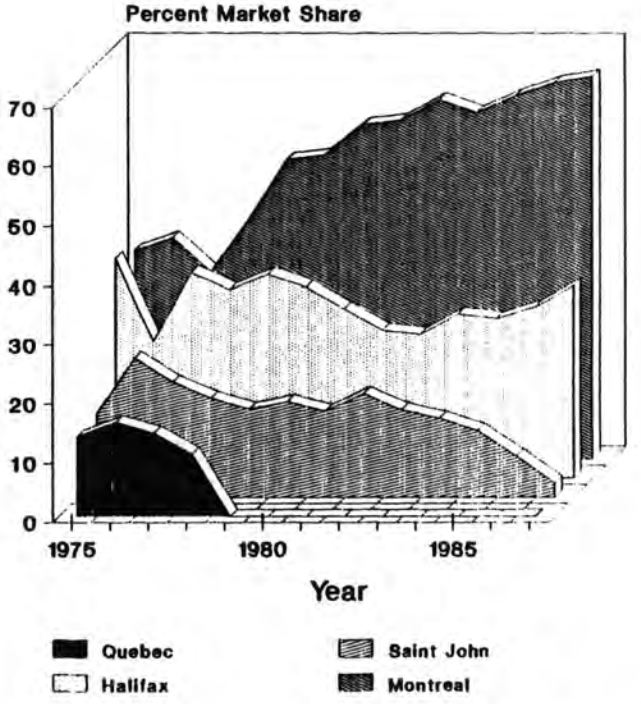


Figure 2. Market Share of East Canadian Ports (Percent Market Share)
Source: Ports Canada

objective of the survey was to identify:

- which ports were chosen by New Brunswick shippers and to what degree they were used,
- who made the shipping arrangements (in other words, who was the decision-maker),
- what shipping services were used,
- what means of inland transportation was used, and
- if they did not use the Port of Saint John, why?

With the assistance of the Port of Saint John and New Brunswick Department of Commerce and Technology, 226 potential users of port services were identified. Questionnaires were sent by mail to each of the 226 shippers and 28 percent responded.

The choice of ports by shippers and receivers for imports and exports showed that Halifax was chosen most often, with Saint John second. Montreal was chosen by a significant number of shippers. New York and Boston have not been used by many shippers but some indicated a preference for Quebec and Chatham (included in "other" category). Similar patterns in the choice of ports were observed for both imports and exports.

The results of who made the shipping decisions showed that most decisions were made by company headquarters. Freight forwarders and consignees were also noted as important in the decision making process. In contrast to these observations, the Port, in the past, directed its marketing efforts to the shipping lines. Based on the responses, future marketing efforts would be better directed to company head offices, freight forwarders and consignees.

Almost all respondents used trucks for inland transportation. The survey results showed that 76 percent of the shippers used trucks for their imports and 90 percent used trucks for their exports. Rail was used minimally.

INLAND TRANSPORTATION ANALYSIS

Inland transportation plays an important role in the competitive position of ports in North America. For a port to attract shipping lines and customers, it must have effective and low cost inland transportation. Inland transportation costs account for a large portion of the total shipping costs via Saint John so it is imperative that low cost efficient transportation be provided.

Trucking generally tends to be the most cost effective means of inland transportation for markets within 500 to 600 miles, with rail becoming more cost effective for markets with longer inland hauls. The competitive range of trucks has been increasing over recent years, and in certain circumstances the range is almost 1000 miles. Trucking provides greater flexibility and faster service than rail, but the need for these benefits must be weighed against the higher costs over long distances. The benefits often outweigh the increased costs for

high value and time sensitive commodities.

Rail is typically the most cost effective means of transportation over long distances. Although rail is normally slower than trucks, it can be very competitive in terms of service where dedicated, scheduled trains are operated.

Trucking dominates inland transportation for New Brunswick and the U.S. Northeast since these markets are well within trucking's competitive range, but rail dominates for the Quebec, Ontario, and the U.S Midwest. Since Quebec, Ontario, and the U.S. Midwest have been identified to be the largest potential markets, it is especially important to have a good rail link to these markets.

Although both Canadian National (CN) and Canadian Pacific (CP) presently serve the port, they do not compete with one another directly. CN operates on the east side of the port, normally handling bulk traffic, and CP operates on the west side, usually handling container traffic. Contrary to the belief that it is beneficial to have two railways serve the port, it seems to be a serious limitation. There does not appear to be enough traffic for two rail firms to profitably offer services. CP has particularly encountered this problem, since it had little port traffic to rely on with the decline of the container trade. CP has reorganized its operation east of Montreal by creating the business unit called Canadian Atlantic Railway (CAR) for operations east of Megantic, Quebec. CAR has been and will continue to take aggressive steps to expand markets to make rail lines as profitable as possible.

For the Port to succeed in recapturing some of the container market, it needs to have access to all key inland markets from a continuous, low cost, rapid, transportation service. Two options were considered: a shortline railroad continuing rail service between Saint John and Montreal, and trucks replacing rail service.

A computer model of a shortline railroad was developed to evaluate the feasibility of a shortline operation. The model accounts for the various operating costs, revenues, and eastbound and westbound volumes of commodities which would be handled under various scenarios.

Before discussing the shortline model results, it is helpful to reflect on rail rates that have been offered for the Saint John - Montreal corridor. The 1988 tariff rates which have been filed by CN and CP and the actual revenues which were received (derived from Statistics Canada data) show that the rates ranged from $279 to $773 per TEU, highly favoring large shippers. Rates were higher for imports than for exports. For shippers with volumes over 20 TEUs per week the range of rates was much smaller (between $279 and $425 per TEU).

It is important to realize that rates offered to shippers are usually lower than the published rates; private contracts have often been negotiated based on on the volumes that shippers contracted for

transport. The average revenues that were received in 1985 for New Brunswick to Quebec container movements were only $348 to $377 per container. Since it would be reasonable to expect that there would be about 1.5 TEUs per container, revenues per TEU would actually have been much lower.

A railway would need to profitably offer rates similar to those stated above to be competitive in the long run. Therefore, a railway between Saint John and Montreal would need to operate at a cost of less than $300 per container.

From the computer model it was evident that the cost of transporting containers from the port to the CP terminal in Montreal was most sensitive to changes in traffic volume and the directional balance of traffic. Examples of recent port container volumes were used to determine the costs to transport containers by rail to Montreal. Using 1987 container traffic volumes, a dedicated shortline would have costs so high that it could not compete. It would either be extremely unprofitable (charging competitive rates such as those listed earlier) or it would not be able to get business (if rates were set at or above its costs). The 1987 traffic volumes are simply not enough to support a dedicated shortline railroad.

Operating at the 1984 port volume level, a shortline would be more viable; unit costs would be 30 percent of those just mentioned. Referring to the tariff rates (which are assumed to be competitive), the shortline would still be encountering costs which are too high to be competitive or viable.

The analysis showed that a rail operation can only be viable at traffic volumes which approach the capacity of the port. At port capacity (assuming perfectly balanced traffic volumes) the shortline could operate at $295 per TEU, showing a small profit. If container volumes were as high as those encountered in 1987 at the Port of Halifax, the shortline's unit costs would be even lower, less than $265 per TEU.

The second option considered was the feasibility of substituting trucks for the rail service for the same Saint John to Montreal corridor. The approach was much less detailed than the computer model developed for rail, but the results were effectively the same. The unit costs of two alternative configurations of trucks were analyzed to transport containers between Saint John and Montreal:

- a six axle tractor trailer combination (commonly known as triaxles or tridems) having a capacity of two TEUs, and
- a seven axle B train tractor trailer combination having a capacity of three TEUs.

Six axle trucks can be contracted for about $1.70 per mile. Assuming load factors could be maintained above 60 percent for both directions, it would cost between $500 and $830 per TEU to transport

containers between Saint John and Montreal. These costs are higher than the published rail tariffs, but are lower than the unit costs of a shortline operation at 1987 port container volumes.

Considering the same relationship as described above for a seven axle tractor trailer shows the cost of transporting three TEUs is not much higher than for two TEUs thus unit costs are lower for this alternative. A seven axle combination can be contracted for about $1.90 per mile. Assuming load factors above 60 percent as before, this combination results in costs of between $370 and $620 per TEU.

Since trucks offer more flexibility, faster delivery, and less container handling, their higher costs could be offset by their advantages in certain cases (such as for transporting high value commodities). Truck transportation therefore appears to be more viable as an alternative than rail with the present port container volumes.

PORT COMPARISONS

An evaluation of the ocean transport operations and costs and associated port charges revealed that the Port of Saint John is in a competitive position with the Port of Montreal and the Port of Halifax. Regardless of whether a north-south trade route or an east-west trade route is considered, Saint John and Halifax are equi-distant from markets (within a half day). In both cases the Port of Montreal is significantly further away from the overseas markets than either Saint John or Halifax.

The Port of Montreal enjoys a larger share of the container trade simply because of the large volume of freight available at the Port. That is, the very high intermodal throughput volume per vessel call makes a service call at the Port of Montreal highly productive and more economical. To put it into perspective a typical vessel would turnover four to five times as many containers per vessel call in the Port of Montreal as compared to either the Port of Halifax or the Port of Saint John. Therefore, the vessel serving ports like Saint John would have to make four to five times as many port calls to do the same volume of business.

An examination of the port charges associated with various North American ports revealed that the Port of Saint John and the Port of Halifax have the lowest charges. Ironically, the ports with the highest container traffic volumes also have the highest port charges (for example, New York). Relative to the total voyage cost, port charges represent only three to five percent of the total cost; any reduction in port charges is almost insignificant compared to the total transport cost. Port charges do not really play a major role in determining the competitive position of ports.

Future technological changes many prove more critical to regaining the Port of Saint John's container market share. Trends in container vessels size were examined. It was revealed that to date

vessels in the order of 2000 TEU capacity have generally been considered the 'workhorse of the sea'. In the future vessels with capacity in the order of 2500 TEU or larger will dominate the fleet. The Port of Montreal's draft restrictions limits its service to vessels of about 2000 TEU capacity. Clearly a market niche could be created with the trends towards larger vessels. This traffic may be available to the Port of Saint John or the Port of Halifax or any other competing port with the capability of handling vessels larger than 2000 TEU capacity.

PORT MARKETING

A strong marketing unit is required that will develop a comprehensive marketing plan and program with clearly defined, quantified goals and objectives. An equally strong and aggressive sales force is required that will make personal contacts with shippers and receivers here in North America and overseas in the various market areas of the world. The sales force must have a bargaining authority required to provide 'one-stop-shipping' services that existing and potential customers expect and receive in other ports throughout the world.

To establish the marketing requirements the following questions should be answered:

- What does the Port of Saint John have to market?
- What were the historical marketing efforts?
- Who are the competition?
- Who should do the marketing?
- Administrative Structure - What is needed?

Survival of the Port of Saint John in the container trade is critically dependent upon a strong, aggressive marketing effort. The marketing for the Port must be done with authority to make deals between the customers, transportation companies and terminal operators. Marketing leadership must be established. The Saint John Port Corporation has been identified as the most appropriate agency to act as the central marketing body. The Port Corporation is essentially the only one in a position to provide the all encompassing marketing initiative required provided they are given marketing and bargaining authority.

In summary, marketing is the key to the survival of the Port of Saint John in the world container trade. Target markets have to be identified and attracted to the Port of Saint John. The Port of Saint John must be in a 'deal making' position so that the best package can be put together to meet the customers needs while giving due consideration to the expectations and requirements of the transport companies and terminal operators. This can only be accomplished with a strong marketing organization and an effective ongoing marketing program.

REFERENCES

Corporate Services, Container Market Analysis: Trends and Prospects for the Growth and Diversion of North American/Overseas traffic, Ports Canada Competitive Strategy, June, 1986, p. 26-40.

Hanelt, R.L. and Smith, D.S. 1987, "The Dynamics of West Coast Container Port Competition", Journal of the Transportation Research Forum XXVIII, no. 1, pp. 82-91.

Peat Marwick Consulting Group, 1988, Halifax Load Centre Cost Analysis, Nova Scotia Department of Transportation.

Pilsch, M.C., 1988, "Double-stack Cars: Whose Are They Anyway?" World Wide Shipping 51, no. 7, (October/November), pp. 54-55.

Statistics Canada, 1986, Imports By Countries, Catalogue 65-006, p. 11.

Stevenson Kellogg Ernst Whinney, Marketing for the Future: Port of Saint John Marketing Strategy, prepared for the Government of Canada - Atlantic Canada opportunities Agency and the Government of New Brunswick, Toronto, September 15, 1987.

UNCTAD, 1988, Review of Marine Transport 1987, United Nations Conference on Trade and Development, New York.

AN ANALYSIS OF THE USE OF DAYTIME RUNNING LIGHTS IN THE CVA FLEET IN SASKATCHEWAN

Gordon A. Sparks; University of Saskatchewan
Russell D. Neudorf; Clayton, Sparks & Associates Ltd.
Anne E. Smith; Decision Focus Incorporated
Glen Parker, SaskAuto

INTRODUCTION

One potential way of reducing both the number and severity of motor vehicle accidents is to use headlights during daylight operations. The use of headlights during daylight hours significantly increases the visibility of a vehicle which in turn intuitively would be expected to reduce the potential for vehicle accidents. This increased visibility would be expected to play a very important role, particularly under non-optimal lighting and/or driving conditions. For example, when drivers are heading into the sun on two lane, two way roadways either in the early morning or late evening periods, or during periods of inclement weather. The increased visibility would be expected to have a generally positive impact on both accident rates and accident severity in many other situations as well.

In the interest of promoting public safety, the Province of Saskatchewan has funded a campaign suggesting that the motoring public use their headlights during daytime operations. In addition, Saskatchewan Government Insurance has installed automatic daytime running light devices (DRL's) on approximately 4000 [1] vehicles operated by the Provincial Central Vehicle Agency (CVA). These devices will automatically turn on the vehicle lights when the vehicle is started and turn them off when the vehicle is stopped. (This device overcomes the problem of forgetting to turn the lights on when operating during daytime hours, as well as forgetting to turn them off when a trip is completed.)

As noted, running with the headlights on would intuitively be expected to reduce the number and severity of accidents. In fact, experiments and studies in other regions of the world have

---

[1] There are a total of approximately 5400 vehicles in the CVA fleet. Approximately 4000 of these vehicles had the DRL device installed. The remaining 1400 vehicles are assigned to non-maintenance leases and as such did not have the DRL devices installed. This study is conducted on the 4000 vehicles that received the DRL device.

indicated a positive effect. There is however a need to quantitatively assess the impact that running with headlights on during daytime operations would have in the Saskatchewan setting. It is particularly important to scientifically establish that indeed running with headlights on during daylight periods does have a positive impact on accident rates and severity in Saskatchewan. Further, it would be highly desirable to specifically identify and quantify the benefits associated with wide use of headlights during daytime operations. Specific information of this nature could play an important role in formulation of policy and regulations as well as playing a role in the cost/effectiveness evaluation of possible alternative countermeasure programs.

For example, such information could be used to evaluate the cost/effectiveness of installing the DRL's on the CVA fleet, or the cost/effectiveness of the "Lights On For Life" campaign conducted by the Province. Further, if it can be demonstrated that driving with headlights on during daylight hours is particularly effective, it may be cost/effective for insurance companies to install DRL devices on all vehicles free of charge or it may be desirable to promote DRL devices as standard equipment on all new vehicles.

In summary, driving with headlights on during daylight operations (using DRL devices) may be a cost/effective way to reduce the number and severity of motor vehicle accidents. There is, however, a need to quantify the potential benefits of such in the Saskatchewan setting. With this in mind, the Saskatchewan Government Insurance Corporation, Traffic Safety Service Branch requested proposals from organizations interested in undertaking the study design and subsequent analysis components of the required work. The firm of Clayton, Sparks & Associates Ltd. in association with Decision Focus Incorporated was subsequently commissioned to undertake the required study design and analysis. This document reports the results of this project.

STUDY OBJECTIVES

The overall objective was to evaluate the effectiveness of the use of daytime running lights on accident rates, accident severity and value of accident claims in the fleet of vehicles owned by the Central Vehicle Agency of the Department of Supply and Services, Government of Saskatchewan and operated by employees of Government Departments and Crown Corporations.

PROFILE OF CVA ACCIDENTS

The data used in this study was obtained from the Traffic Accident Information System (TAIS) database. The database is maintained by Saskatchewan Highways and Transportation and contains detailed information about accidents as reported to the local police departments.

From the TAIS database, a profile of CVA accident experience was

developed in a number of steps. These steps are identified in Figure 1. The objective of this exercise was to develop a profile of those accidents in which the use of headlights may have been a contributing factor. The CVA accident experience by total number, total cost, number of vehicles, time of day, and accident configuration was obtained for all CVA accidents. These numbers were then broken down step by step as illustrated in Figure 1 until the number, cost, severity and configuration of multiple-vehicle, daylight accidents (defined as a DRL-related accident) was obtained.

A review of this data indicated that a change in the definition of a reportable accident at the end of 1983 from one involving more than $200 in damages to one involving more than $500 in damages had a dramatic impact on the total number of accidents reported each year prior to 1983 relative to those years following 1983. This change in definition has implications on the statistical analysis therefore the impact of this change was removed from the analysis by removing all accidents with property damage of $500 or less from the data considered (i.e. all fender-bender type accidents were removed). In the context of this study, this is reasonable because this removes the effect of the change in the definition of an accident.

STATISTICAL TESTING FOR SIGNIFICANT DIFFERENCES

In determining if DRL's have a statistically significant impact upon the number, cost and severity of CVA accidents, a time-series approach using a simple difference of means test was undertaken.

The sampling distributions associated with the difference between mean accident levels before and after DRL's, which will be labeled $\overline{X}_1$ and $\overline{X}_2$, can be assessed as follows:

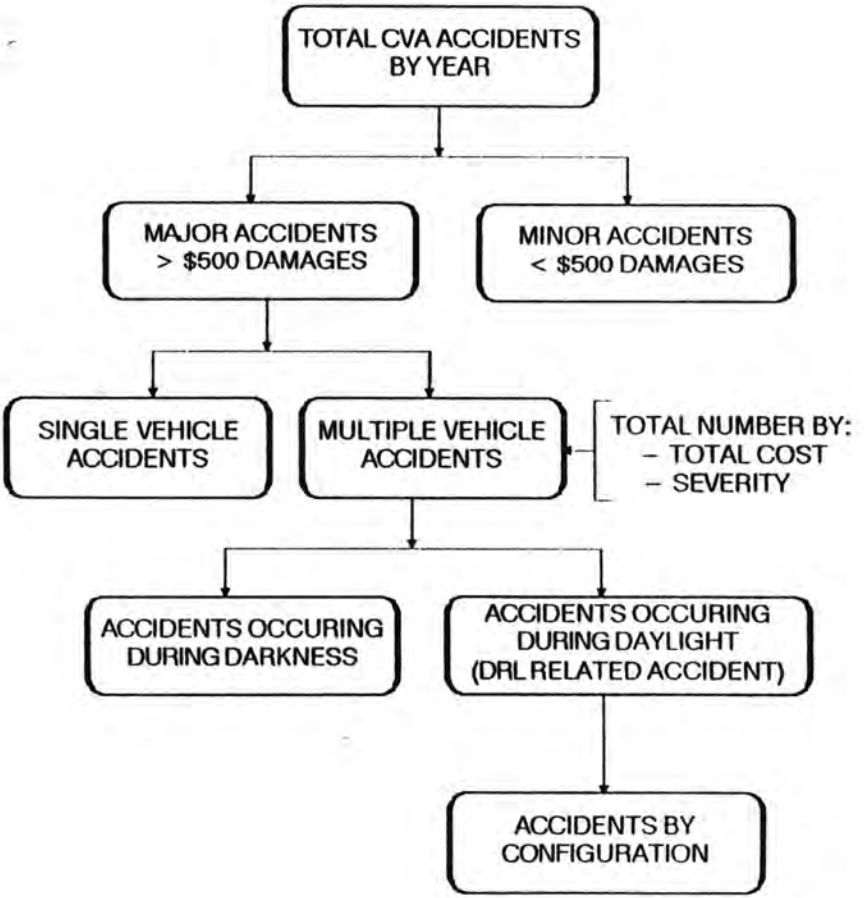
$\overline{X}_1 - \overline{X}_2$ will be distributed

$$N\left(\mu_1 - \mu_2, \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}\right)$$

where:
- μ_1 = true mean number of accidents pre-DRL's
- μ_2 = true mean number of accidents post-DRL's
- σ_1^2 = variance of number of accidents pre-DRL's
- σ_2^2 = variance of number of accidents post-DRL's
- n_1 = number of time periods pre-DRL's
- n_2 = number of time periods post-DRL's.

The significance of the difference in means can be tested based on the Z-statistic, since the sampling distribution has approximately the normal distribution. The Z-statistic is calculated as:

FIGURE 1
COMPONENTS OF THE CVA FLEET ACCIDENT PROFILE



$$Z_{actual} = \frac{\mu_1 - \mu_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

If we hypothesize that $\mu_1 > \mu_2$, then we can use the criteria for the hypothesis test as illustrated in Figure 2 where the α value is the required confidence level for accepting or rejecting the observed difference as real. If, for example, we require a 95% confidence, the Z_α value would be 1.645. If Z_{actual} is greater than Z_α, then we would accept our hypothesis that $\mu_1 > \mu_2$, at the 95% confidence level. If Z_{actual} is less than Z_α, we would reject our hypothesis, concluding that $\mu_1 \not> \mu_2$ at the 95% confidence level. The values for Z_α are obtained from normal probability distribution tables.

PROBABILITY OF DETECTING STATISTICALLY SIGNIFICANT RESULTS

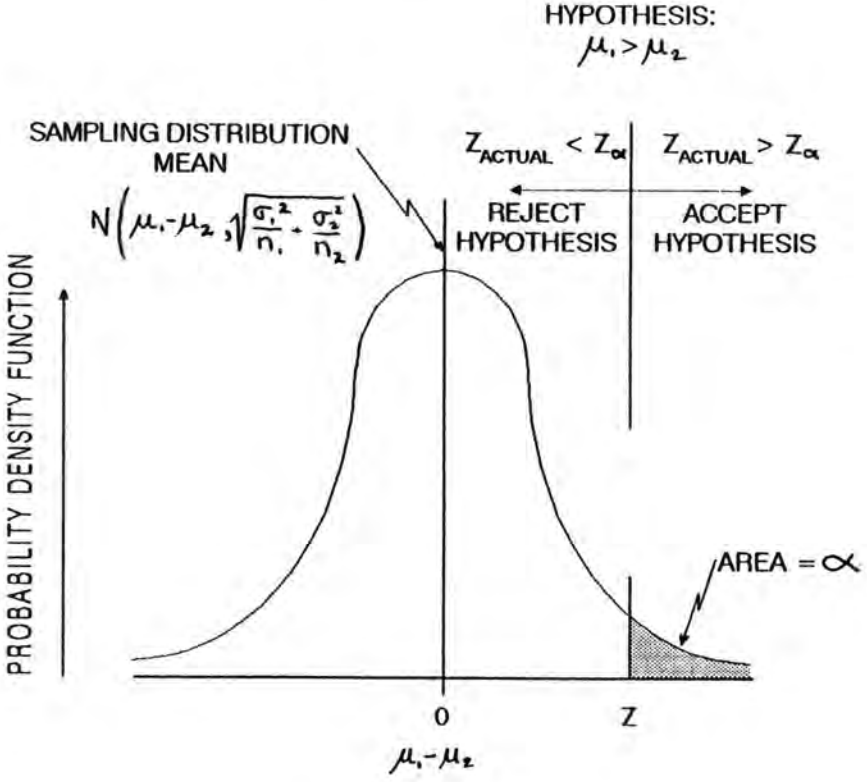
In advance of the actual statistical testing we can predict the success of a statistical investigation, based on the mean ($\overline{X}_1$) and standard deviation (σ_1) of the pre-DRL data and several assumptions.

If we assume that the true mean number of accidents pre-DRL's ($\overline{X}_1$) is 260 accidents per year with a variance (σ_1) of 250 and if DRL's have a 10 percent effect on the mean number of accidents, then we can say that the difference in sample means would be normally distributed, as described in the previous section, around a mean of (0.1)x(X_1), or a difference of 26 accidents per year and have a standard deviation of 12.91 (ie. ((250/6+250/2)**0.5)). This assumes that the variance is constant for the pre and post-DRL data. With sample sizes of 6 and 2, the sample outcomes will be distributed as shown in Figure 3.

At the 95% confidence level, we would require an observed difference of 21 accidents per year (ie. 1.645x12.91) to accept a hypothesis that there is a difference in the mean number of accidents. The probability of capturing this effect with our sample is equal to the shaded area as illustrated in Figure 3. Using the normal probability tables, we can say that this will happen with 65 percent probability. That is, if the magnitude of the DRL effect is 10 percent and the variability of accident levels per year is the same as in previous years, then we have a 65 percent chance of finding a significant change with a sample difference of means test. Further, if we reduce the significance level required from 95% to 90%, we can obtain about a 76 percent probability of observing a significant effect (however we increase the probability of a Type I error). Conversely, this says that there is a 24 percent chance of rejecting the hypothesis that there is a real DRL effect when the DRL effect is actually a 10 percent reduction in accidents.

Table 1 indicates the probability of obtaining a significant difference when the DRL effect varies between 5 percent and 20 percent, and where the required level of confidence varies between

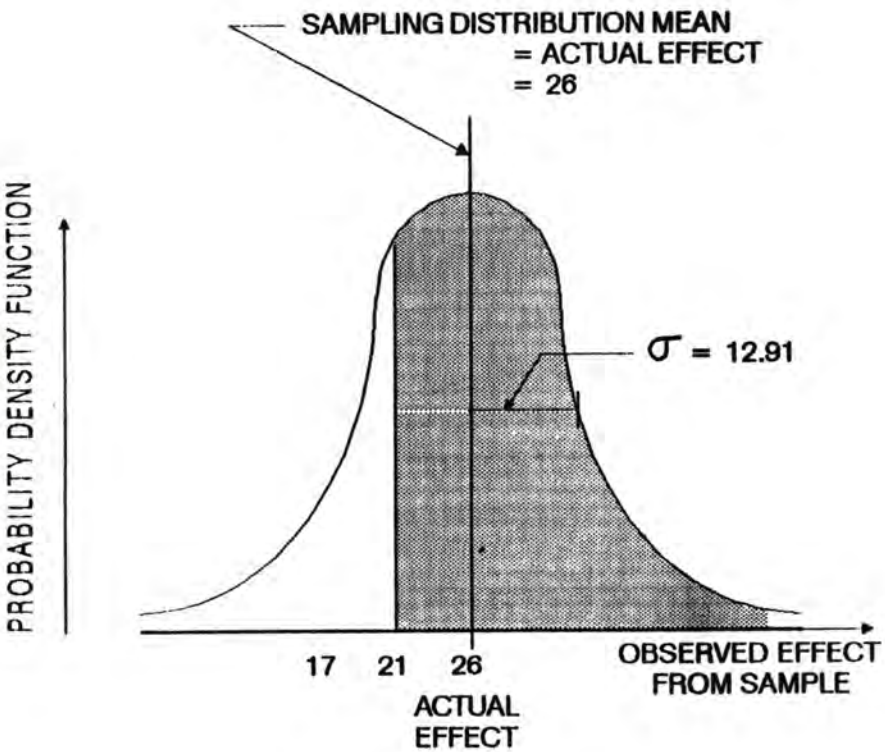
FIGURE 2
DISTRIBUTION FOR DIFFERENCES OF MEANS HYPOTHESIS TESTING



Z_α = FROM NORMAL PROBABILITY TABLES

$$Z_{ACTUAL} = \frac{\mu_1-\mu_2}{\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}}$$

FIGURE 3
DISTRIBUTION OF SAMPLE OUTCOMES



$$Z = \frac{21 - 26}{12.91} = -0.39$$

$$F(Z = -0.39) = 0.15 + 0.50$$
$$= 0.65$$
$$= 65\%$$
$$= \text{SHADED AREA}$$

5 percent and 10 percent.

TABLE 1

PROBABILITY OF OBSERVING SIGNIFICANT DIFFERENCES IN ACCIDENT LEVELS BEFORE AND AFTER DRL's ON CVA VEHICLES

Size of DRL effect	Level of Confidence 95%	90%
.05	0.27	0.38
.10	0.65	0.76
.15	0.92	0.96
.20	0.99	0.997

From the table it is apparent that for effects smaller than about 7 percent, this statistical procedure has a less than 50 percent power to discern the effect with statistical significance. Fortunately, the results of previous DRL experiments indicate that the DRL effect may be greater than 7 percent, so there is a reasonable chance that the CVA experiment will in fact reveal a significant result.

RESULTS OF THE STATISTICAL TESTS

The difference of means test, as described in the previous section, was conducted on the CVA accident data. A summary of the CVA accident data is presented in Table 2. Figure 4 illustrates both the total number of multiple-vehicle daylight accidents over the study period and other (single vehicle and darkness accidents) accidents. The results of the difference of means test are summarized in Table 3. A discussion of the results of the difference of means test is given below.

- The difference of means test was first performed on the total number of multiple-vehicle daylight accidents with damages greater than $500, as presented in Table 2. It is observed from Table 2 that the average number of CVA multiple-vehicle daylight accidents decreased by 11.6% from the pre-DRL period (1980 to 1985) to the post-DRL period (1986 and 1987). This decrease was statistically significant at the 99.9% confidence level. That is, we are 99.9% confident that the observed means for pre and post-DRL data are statistically different.

- This decrease of 11.6% in multiple-vehicle daylight accidents translates into an overall decrease in all types of accidents in the CVA fleet by 7.2% (ie. multiple-vehicle accidents account for 68.6% of accidents with damages greater than $500 and there are approximately 40 accidents per year that are reported but have less than $500 damages (after January 1,

TABLE 2

SUMMARY OF CVA ACCIDENT DATA
AS REPORTED IN THE TAIS DATABASE
MULTIPLE VEHICLE DAYLIGHT ACCIDENTS WITH DAMAGES GREATER THAN $500

YEAR	TOTAL NUMBER OF ACCIDENT	TOTAL ACCIDENT COST(1) ($)	AVERAGE ACCIDENT COST(1) ($/acc.)	ACCIDENT SEVERITY PROP. DAMAGE	PERS INJURY	FATAL	CONFIGURATION RT ANGLE (5)	HEAD ON (7)	HEAD ON (8)	HEAD ON (9)	TOTAL DBL EFFECT	NO DBL EFFECT (4,6,10-12)	OTHER ACCIDENTS (SINGLE VEHICLE, DARKNESS ACCIDENTS)
pre-DRL's													
1980	264	441,258	1,671.4	232	32	0	90	16	10	13	129	135	121
1981	255	656,511	2,574.6	213	42	0	83	10	4	18	115	140	129
1982	292	739,238	2,531.6	246	40	6	76	16	9	24	125	167	120
1983	243	662,407	2,726.0	202	38	3	69	12	11	22	114	129	111
1984	248	598,131	2,411.8	212	36	0	87	7	5	13	112	136	110
1985	259	840,881	3,243.6	220	36	3	72	10	9	11	102	157	104
post-DRL's													
1986	240	790,193	3,292.5	204	36	0	63	6	4	18	91	149	123
1987	220	758,120	3,446.0	193	26	1	58	5	2	18	83	137	108
AVERAGE													
pre-DRL's	260.2	656,268	2526.5	220.8	37.3	2.0	79.5	11.0	8.8	16.0	116.2	144.0	115.8
post-DRL's	230.0	774,157	3369.3	198.5	31.0	0.5	60.5	5.5	3.0	18.0	87.0	143.0	115.5
VARIANCE													
pre-DRL's	249.8	1.51E+10	2.17E+05	208.8	10.2	5.0	59.6	10.8	6.7	23.8	77.8	180.7	69.1
post-DRL's	100.0	2.57E+08	5.89E+03	30.3	25.0	0.3	6.3	0.3	1.0	0.0	16.0	36.0	56.3

NOTE (1) ACCIDENT COST BASED ON POLICE ESTIMATE OF TOTAL PROPERTY DAMAGE

FIGURE 4
TOTAL NUMBER OF CVA ACCIDENTS
WITH DAMAGES > $500

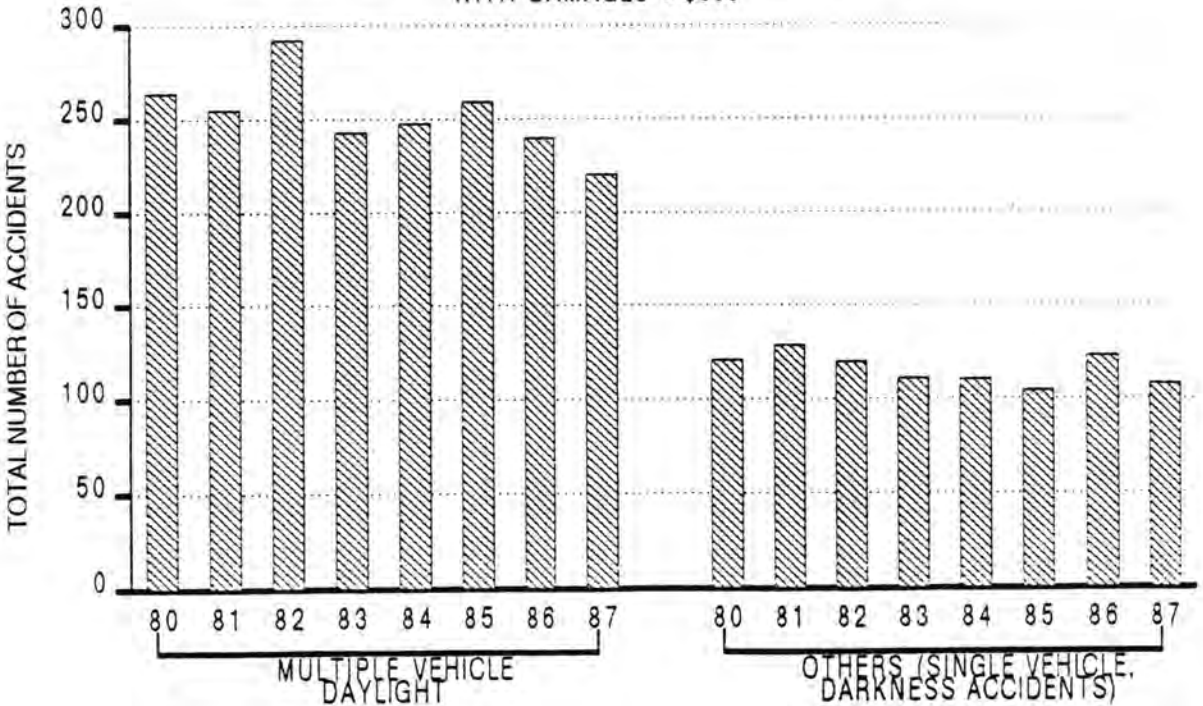


TABLE 3

SUMMARY OF STATISTICAL ANALYSIS
DIFFERENCE OF MEANS TEST

VARIABLE	MEAN pre-DRL's	MEAN post-DRL's	DIFFERENCE Number	DIFFERENCE Percent	STATISTICAL SIGNIFICANCE OF DIFFERENCE
Multiple-Vehicle Daylight Accidents					
Total Number	260.2	230.0	30.2	11.6%	99.9%
By Severity:					
Property Damage	220.8	198.5	22.3	10.1%	99.9%
Personal Injury	37.3	31.0	6.3	16.9%	95.3%
Fatality	2.0	0.5	1.5	75.0%	93.7%
By Configuration:					
Right Angle (5)	79.5	60.5	19.0	23.9%	99.9%
Head on (7)	11.8	5.5	6.3	53.4%	99.9% *
Head on (8)	8.0	3.0	5.0	62.5%	99.9% *
Head on (9)	16.8	18.0	-1.2	-7.1%	72.2% *
Total (DRL affected)	116.2	87	29.2	25.1%	99.9%
Total (non-DRL affected	144.0	143.0	1.0	0.7%	55.6%
Total Accident Cost	656,268	774,157	(117,889)	-18.0%	99.0%
Average Accident Cost	2526.5	3369.3	-842.8	-33.4%	99.9%
Other Accidents (All Single Vehicle and Multiple Vehicle darkness)	115.8	115.5	0.3	0.3%	51.2%

* NOTE: These number of observations are small (ie. less than 20-30) therefore the normal approximation for the difference of means test may be inappropriate. These results must therefore be interpreted with care.

1984)).

- There was a decrease in the number of accidents by severity in all three catagories. That is, property damage accidents, personal injury accidents, and fatality accidents all exhibited a decrease in the average number of accidents from the pre-DRL years to the post-DRL years. The most significant decrease was noted in the property damage accidents, where a 10.1% decrease was observed. The confidence level associated with this decrease was 99.9%. Personal injury accidents decreased by 16.9% (95.5% confidence level) and fatality accidents decreased by 75% (93.7% confidence level). The reason for the large percent decrease in the personal injury and fatality accidents and yet the lower confidence level is due to the small sample size (ie. the total number of each type of accident).

- The total number of accidents was broken down by accident configuration. Overall, those configurations in which the DRL's would have an effect (ie. would be expected to increase the visibility of the vehicle and hence decrease the probability of that particular type of accident) showed a decrease of 25.1 % from the pre-DRL to the post-DRL time periods. Statistically, there is >99.9% confidence that there was an actual decrease in the number of accidents. At the same time, those configurations in which the DRL's have no (theoretical) effect remained constant (an actual decrease of 0.7%). Individually, there was a decrease in three (ie. 5, 7 and 8) of the DRL-affected configurations. Configuration number 9 actually increased marginally, by 7.1%. The individual decreases were all statistically significant except for the increase in configuration number 9 which was not significant.

- Both the total accident cost and the average accident costs increase from the pre-DRL data to the post-DRL data. In general, this increase is due to the upward trend in the data, probably due to the higher costs associated with accident repairs.

- The difference of means test was conducted on those accidents which are not affected by the use of DRL's (ie. all single vehicle accidents and multiple-vehicle darkness accidents). A comparison of means pre and post-DRL installation indicated (essentially) a constant accident level. That is, the number of non-DRL affected accidents remained constant (actually decreased by 0.3%) from the pre to the post-DRL period. The average number of non-DRL related accidents pre-DRL's was observed to be 115.8 accidents per year. The post-DRL accidents level was 115.5 accidents per year.

If DRL devices were extended to the total Saskatchewan vehicle fleet (800,000 vehicles) and had an 7.2 % decrease in the number of accidents, this would translate to a reduction of 2452 property damage accidents (ie. total number of property damage accidents of

34069 x 7.2%), 610 less injuries per year (ie. total personal injuries per year of 8465 x 7.2% decrease), and 15 fewer fatalities per year (ie. total fatalities of 214 per year x 7.2% decrease). (The data used in the calculations is from "1985 Saskatchewan Traffic Accident Facts" published by Saskatchewan Highways and Transportation.)

Caution needs to be exercised in extrapolating the CVA fleet experience to the total Saskatchewan vehicle population. The CVA fleet is comprised of publicly owned vehicles, operated by government employees mainly during working hours. This type of exposure would not be the same as the total Saskatchewan vehicle population. The CVA fleet in a subset of the entire Saskatchewan vehicle population with specific characteristics. The above calculations are included to give only an order of magnitude estimate of the impact of the use of DRL's in the total vehicle fleet in Saskatchewan.

CONCLUSIONS AND RECOMMENDATIONS

The objective of this study was to evaluate the effectiveness of the use of daytime running lights on accident rates, accident severity and the value of accidents claims in the Central Vehicle Agency vehicle fleet. This objective was accomplished by firstly developing a profile of the CVA accident experience and subsequently conducting a statistical analysis (difference of means test) on the data.

The results of the analysis indicate that daytime running lights have had a positive, statistically significant impact on multiple-vehicle daylight accidents in the CVA fleet, as summarized previously in Table 3.

The vehicles owned by the CVA have unique operating characteristics which must be considered when comparing the CVA accident experience to the total Saskatchewan vehicle population. Driver characteristics, time of operation, and location of operation must all be considered in any comparison.

REFERENCES

1. D.A. Attwood, "The Potential of Daytime Running Lights as A Vehicle Collision Countermeasure". Road Safety Unit, Road and Motor Vehicle Traffic Safety Branch, Transport Canada, 1981.

2. D.A. Attwood, "Daytime Running Lights Project II: Vehicle Detection as a Function of Headlight Use and Ambient Illumination". Road Safety Unit, Ministry of Transport, Report No. RSU 75/2, April 1975.

3. "A Study of Daytime Running Lights". Road Safety and Motor Vehicle Regulation Directorate, Transport Canada, June 1985.

4. K. Anderson, G. Nilson, "The Effects on Accidents of Compulsory Use of Running Lights during Daylight in Sweden". National Road and Traffic Research Institute, 1981.

5. K. Anderson, G. Nilson, M. Salusjarvi, "The Effect of Recommended and Compulsory Use of Vehicle Lighting on Road Accidents in Finland". National Road and Traffic Research Institute, Report No. 102, 1976.

6. H. Stein, "Fleet Experience with Daytime Running Lights in the United States". Insurance Institute for Highway Safety, June 1984.

7. Thomas D. Cook, Donald T. Campbell, "Quasi-Experimentation, Design & Analysis Issues for Field Settings 1979.

TESTING AND SAFETY/MONITORING DEVICES IN THE U.S.: DRIVER AND INDUSTRY PERSPECTIVES

Russell B. Capelle, Jr. and Richard Beilock

I. INTRODUCTION

Motor carrier safety ranks among the paramount transportation issues in the United States. Important facets of the safety issue relate to technical and cost efficiencies and to the legal/ethical appropriateness of laws governing speeds and driving times, safety devices, and inspection/testing procedures.

This paper focuses on the views of those most directly affected by the resolution of these debates, the drivers. This is important both because they bear many of the consequences and because they are in a unique position to judge the appropriateness of safety legislation. Surprisingly, however, drivers' views have rarely been solicited or considered in safety debates. When possible, driver views are compared to those of the industry, as represented by the American Trucking Associations (ATA) and the Regular Common Carrier Conference (RCCC). The topics addressed are:

Speed limits

Hours-of-service regulations

Seat belts

Radar Detectors

Antilock brakes

Testing for drugs and alcohol

Roadside Inspections

After a brief section introducing the data, each of the above issues will be examined in turn. The history of each issue will be outlined and the positions of drivers and industry examined. From the outset it should be stressed that the purpose of this paper is not to determine if drivers or industry hold the correct view. Rather, the purpose is to describe what these views are and attempt to shed light on the reasons for any divergences of opinion.

II. DATA

The primary data source for the study comes from three surveys of drivers of combination vehicles as they passed through agricultural inspection stations while exiting the Florida Peninsula. The survey sites were the stations located along U.S. I-10, U.S. I-75, and U.S. I-95. These stations account for in excess of 85 percent of all

traffic out of the Peninsula. It should be noted that stations are located along all possible exits from the Peninsula, they are open around the clock, and all trucks are required to stop. As avoidance of inspections is impossible, there are no reasons to suspect that drivers with particular safety-related characteristics would tend to take or avoid any routes.

In each year, the surveys were conducted in 1986, 1987, and 1988 on the first Friday, second Wednesday, and second Monday after labor day. Interviews were conducted between 6:00PM and 1:00AM, when truck traffic is generally the heaviest. Interviews were attempted with every driver of loaded combination vehicles and every third driver of empty combination vehicles. For more detail regarding the survey procedures see Beilock (1989). The numbers of completed interviews in each year and the participation rates follow:

Year	Completed interviews	Participation rate*
1986	1,312	87
1987	1,762	90
1988	878	82

* percent of all drivers asked who participated

The lower participation rate and number of completed interviews in 1988 are primarily due to a much longer questionnaire. Nevertheless, the samples in all years were large, participation rates good, and there was no indication that refusals were based on suspicions regarding the motives of the survey.

The primary sources for industry positions are the policy books of the American Trucking Associations (Congressional and Regulatory Issues 1988) and of the Regular Common Carrier Conference (Regular Common Carrier Conference Policies, January 1989). Reference will also be made to statements by officials of those organizations.

III. SPEED LIMITS

In response to the Arab oil Embargo in 1973, Congress instituted a 55 mph National Speed Limit. During the first several years under this legislation, it was generally recognized as an effective means of saving fuel and lives. However, with drops in the real price of fuel and improvements in vehicle designs, many began to question the appropriateness of continuing the 55 National Speed Limit. Widespread resistance to the limit became evident as some states had difficulty meeting federal minimum compliance levels and other states reduced fines for speed violations. Bowing to these pressures, in 1987 Congress permitted 65 mph speed limits along most rural interstates, and later extended the provision to comparable nonInterstate roadways. As of this writing, 40 states have taken full advantage of the provision and the rest have not.

Driver Position

Both immediately prior to relaxation of the National Speed Limit and since that time, driver support for higher speed limits has been close to universal:

	Desired Speed Limits on Rural Interstates (percent)		
Survey year	55 mph or less	65 mph	Between 60 and 70 mph
1986*	6	72	90
1987	3	84	93
1988	3	83	93

* before relaxation of the National Speed Limit

Almost surely the support for higher speed limits is due, in large part, to the fact that higher speeds translate into shorter work time per mileage covered. Surprisingly, however, many drivers also feel that the 65 mph speed limit has enhanced safety. In the 1987 survey, drivers were asked an open-ended question regarding the impact of the return to 65 mph on safety levels. Forty-six percent felt that the roadways were now safer, versus only 11 percent who indicated there had been erosions in safety levels. Two thirds of those who thought roadways had become safer saw traffic flow improvement as the reason, and 28 percent felt that the higher speed limits improved driver attention.

Drivers were also asked for the average cruising speeds of all truckers along Interstates. Consistent with the sentiment regarding improved safety since the return to a 65 mph speed limit, on average, drivers see reduced speeds where 55 mph is still posted and speeds close to 65 mph where that is the legal limit:

	Posted Speed Limit (average response)	
Survey Year	55 mph	65 mph
1986	65.0	n.a. *
1987	61.2	66.4
1988	61.3	67.4

* before relaxation of the National Speed Limit

It should be noted, however, that the one mph increase between 1987 and 1988 for roadways with 65 mph, though small, is significant at the .001 level. More disturbing, perhaps, is the difference in the percentages of respondents who pegged average truck cruising speeds above the legal 65 mph limit. In 1987 only 39 percent of the drivers felt that average cruising speeds exceeded this limit, versus 52 percent in 1988. With over half the drivers believing that their fellow drivers on average violate 65 mph speed limits, the legitimacy of that limit and incentives to obey it appear to be eroding.

Industry View

Of some surprise, industry and drivers could hardly be further apart in their positions regarding speed limits. Both ATA and RCCC have consistently opposed speed limits above 55 mph. Their objections are based on both safety and economic considerations. Their concerns regarding a linkage between higher speeds and reduced safety levels are supported by a recent study by the Office of Technology Assessment (OTA). In that study, "speed too fast for conditions" is listed among the three factors most often associated with heavy truck accidents.

Industry is concerned for costs of increased fuel usage and maintenance that result from driving at higher speeds. The estimated additional cost for a tractor designed to cruise at 65 mph, rather than 55 mph, is between $2,200 and $3,000, and fuel usage is 15 percent higher (Wilson). Moreover in the LTL segment, terminal facilities have been spaced and drivers trained based on the 55 mph limit (ATA).

Discussion

As there are productivity benefits associated with increased speeds, it is impressive that the industry has consistently supported the 55 mph limit. This suggests, as indicated by Wilson, that the economic benefits of lower speeds are significant.[1] Many carriers provide specifications to manufacturers so the tractors they purchase have engine and gear ratio limits that preclude speeds exceeding 58 mph. However it is implausible, that a competitive industry like trucking could reduce vehicle speeds without the force of law.

Driver opposition to speed limit reductions brings into question the feasibility and desirability of such reductions. Clearly without stringent enforcement efforts or mandatory tamper-proof speed limiting devices, a return to the 55 mph limit would bring back widespread violations. Either alternative would be extremely costly. If widespread violations were tolerated, the consistency of vehicle speeds would be sharply reduced. Inconsistency in vehicle speeds was cited as the reason why nearly one quarter of responding truckers felt the pre-65 mph speed limit environment was less safe. In a study of Indiana roadways, McCarthy found a relationship between accident rates and speed variations, which tends to support driver concerns regarding speed consistency across vehicles.[2] As a final note regarding inconsistent speeds, several drivers volunteered their view that differential truck and car speed limits are detrimental to safety.

IV. HOURS-OF-SERVICE REGULATIONS

Hours-of-service regulations (HSR) regulate the duration of time a driver may operate a vehicle. These rules have remained essentially unchanged since they were enacted by the Interstate Commerce Commission (ICC) in 1937 and 1938. The rules are complex and

difficult to enforce. Moreover, they do not take account of an individual's circadian cycle (which was unknown in 1938) and strenuous off-road activities, such as unloading, are not "docked" against the driver to the same extent as driving time.

Driver Position

During the 1986 survey, drivers were asked if HSR were too strict, too lenient, or about right. Fifty-six percent indicated that these rules are proper, 39 percent felt that they were too strict, and only 3 percent saw them as too lenient. Despite this general vote of approval, the drivers were generally of the opinion that HSR are commonly violated. Nearly three quarters of the respondents estimated that over half of their fellow drivers regularly violated HSR, and over half of the respondents indicated that 70 percent or more of all drivers regularly are in violation. Widespread violations of HSR and/or speed limits were also indicated by an analysis of driver schedules in the 1986 and 1987 surveys. Employing extremely conservative assumptions, it was estimated that roughly 30 percent of the truckers interviewed were then on schedules which could not be legally met (Beilock and Capelle).

To further explore driver sentiments regarding HSR and the problem of fatigue, in the 1988 survey, drivers were asked what percent of truck accidents are due to driver fatigue and for possible solutions to the driver fatigue problem. Their answers reveal widespread awareness of the problem. Drivers estimate, on average, that 36 percent of truck accidents are fatigue-related.[3] As would be expected, a wide range of responses was given to the open-ended question regarding fatigue-reducing strategies. However, over three quarters of the suggestions fell into five categories:

Eliminate violation-inducing schedules	33 percent
Increase enforcement on the highways	16 percent
Increase driver earnings	11 percent
Allow drivers to use their own discretion on how many hours to drive	10 percent
Do not require drivers to load/unload	8 percent

Three percent of the respondents suggested each of the following: on-board monitoring devices, increased speed limits, team driving for longer hauls, and expanded rest facilities.

Industry Position

The industry generally supports the concept of HSR. Some modifications are desired, primarily to clarify other work categories and to lessen paperwork requirements. A major concern within the

industry is that carriers not be held accountable for violations beyond their control. Both ATA and RCCC appear interested in current efforts to develop more informed rules more consistent with biological cycles.

Discussion

Both drivers and the industry recognize that fatigue is a major problem and that HSR are reasonable, though imperfect fatigue-prevention rules. Their complexity, near-unenforceability, and lack of accounting for circadian rhythms severely limit universal HSR effectiveness.

This appears to be an area in which considerable progress is possible because all parties recognize its importance and there now exists considerable knowledge regarding biorhythms. Moreover, electronic entry of HSR data directly by drivers and/or by automatic monitoring devices hold out the promise of greatly reducing paperwork and enforcement burdens. Of paramount importance is to design a system in which the responsibilities of carriers, shipper/receivers, and drivers are clear. Both drivers and the organized industry (effectively, the carriers) feel that they are or may be held responsible for actions beyond their control or which they are coerced into doing. Most notably, many drivers indicate that they are forced (directly or by the need to make a living wage) to accept illegal schedules from their carriers and carriers feel similar pressures from the shipper/receivers they serve.

V. SEAT BELTS

Seat belts are mandatory in several states. The majority of states, however, either do not require their use or exempt truck drivers. Using National Accident Sampling System data for 1981-85, OTA found seat belt usage to be strongly related to lower injury severity. About thirty percent of drivers involved in accidents in which they sustained no injuries were wearing seat belts, versus less than 5 percent of those who lost their lives.

Driver Position

Drivers are sharply divided regarding both seat belt usage and the appropriateness of laws requiring their use. When asked (in 1988) for the percentage of driving time they used seat belts, the average response was just over 50 percent. This statistic, however, masks the barbell-like nature of the distribution. Only 18 percent reported using seat belts between 10 and 90 percent of the time. The remaining 82 percent were almost equally divided between those using seat belts over 90 percent of the time and those using them for 10 percent or less of the time. Opinions regarding mandatory seat belt usage were similarly split, with 43 percent in favor, 53 percent opposed, and only 6 percent stating that they were neutral. Many of those not

using belts and/or opposed to a law mandating usage expressed the view that seat belts are of benefit for automobile drivers, but not themselves due to the 'facts' that they (truck drivers) are above the impact and face greater danger from fire.

Industry Position

Safety belts in trucks have been required by the organized industry for over 20 years. ATA and RCCC supported enactment and continuation of mandatory seat belt laws.

Discussion

The evidence regarding the safety benefits of seat belts for truck drivers seems unassailable. However, as with automobile drivers, compliance is a major problem. This suggests the need to consider requiring passive restraints or continuous alarms (buzzers) to force usage. However, there may be resistance from the industry if such measures require significant expenses. Also without education regarding the safety benefits of seat belts, many drivers will resist efforts to force usage and, likely, defeat any mechanism devised to that end, thus wasting the investments of carriers.

VI. RADAR DETECTORS

Despite periodic initiatives to ban them, radar detectors are legal in every state except Connecticut and Virginia, and in the District of Columbia. A recent study found a positive association between radar detector usage and speed (Insurance Institute for Highway Safety (IIHS)). IIHS and the American Automobile Association have petitioned Congress to prohibit their use. Based on the close association between speed and accidents, OTA has recommended consideration of such legislation.

Driver Position

In the 1988 survey, 62 percent of the drivers were found to use radar detectors.[4] Opposition to a nationwide ban on radar detectors is very strong. Only 5 percent of the drivers expressed support for a ban, while 94 percent were opposed and one percent was neutral or undecided. Opposition among drivers to banning radar detectors appears to be based in large part on beliefs that such laws are unconstitutional, rather than on self-interest. The basis for this conclusion is the fact that nearly 9 out of 10 drivers who do not use radar detectors nevertheless oppose a ban on their use. One possible reason for driver opposition is that such laws may be seen as infringing on private rights; another is that few drivers see any safety benefit in a ban. Only 15 percent of the respondents believed that a ban would improve compliance with speed limits. Many respondents stated that without radar detectors, truckers would return to relying on CBs or just take their chances.

Industry Position

Stating that they "serve no purpose other than to foster disregard of the law," ATA supports a total ban on radar detectors. RCCC's policies do not explicitly address radar detectors, but rather advocate development and mandatory adoption of effective speed limiting devices.

Discussion

Driver opposition to radar detector bans would likely render such measures ineffective or prohibitively costly to enforce. And, as pointed out by the truckers, there exist other means of securing information regarding speed surveillance activities. The RCCC suggestion to develop an effective speed limiting device appears to be a more fruitful, long-term approach.

VII. ANTILOCK BRAKES

The history of antilock braking systems in the U.S. has been somewhat checkered. In 1977 a National Highway Traffic Safety Administration (NHTSA) study indicated that antilock brakes reduced jackknifing by 29 percent over conventional braking systems (OTA). However, subsequent debates and lawsuits regarding the reliability of the systems, validity of the NHTSA tests, and the need for stringent braking standards seriously set back the pace of their adoption in the U.S., though not in Western Europe. At the current time domestic production of antilock systems is limited, though at least one manufacturer installs a European system in US vehicles (OTA). In October, 1988 NHTSA announced that it would begin a two-year fleet evaluation program of antilock braking systems.

Driver Position

Surprisingly considering their limited use in the US, 77 percent of the drivers questioned in 1988 indicated that they have driven trucks with antilock brakes. Nearly half (47 percent) feel that antilock brakes are safer than conventional brakes, while 29 percent belief the reverse to be true. Among those claiming experience with antilock brakes, 55 percent said they were safer, while only 14 percent of those with no experience felt them to be superior.

Only a third of the drivers indicated support for a law mandating antilock brakes on new tractors. However, opposition appeared to be based largely on safety considerations. This conclusion is based on the fact that nearly three quarters of those viewing antilock systems as safer also indicated support for a law mandating their use.

Industry Position

New systems almost invariably translate into more expensive vehicles. Therefore, the industry position regarding new braking

systems is understandably cautious. One reason for this caution is the existence of anti-jackknifing devices which may alleviate the primary problem addressed by anti-lock brakes. Yet, the tone of policy statements by the organized industry is supportive of the ongoing research.

Discussion

Both drivers and industry appear willing to be convinced regarding antilock brakes. The combination of the new NHTSA study and accumulated European experience should be sufficient to facilitate a decision one way or the other in the early 1990s.

VIII. DRUG AND ALCOHOL TESTING

As with virtually all sectors of American society, substance abuse is viewed as a major problem in the transportation industry. Unlike many professions, however, impaired functioning on the job by a truck driver constitutes a clear threat to public safety. In November, 1988 United States Department of Transportation (US DOT) issued rules which greatly expanded drug and alcohol testing requirements. However, they are currently under a preliminary court injunction due to a judicial challenge led by the Owner-Operators Independent Drivers Association.

There are no widely accepted statistics regarding drug and alcohol usage by truck drivers. Fatal Accident Reporting System data for 1985 indicate that about 15 percent of drivers killed in heavy truck accidents had positive blood alcohol levels, and, using voluntary blood and urine tests of 317 drivers in Tennessee, Lund et al found evidence of drugs (including prescription drugs) in 28 percent. These statistics, while of interest, suffer from the fact that they are based on very selective populations, i.e., deceased drivers and those willing to submit to testing. Also, as noted, the Lund et al data include prescription drugs.

Driver Position

In the 1986 RCCC Survey, drivers were asked what percent of their fellow drivers sometimes drive under the influence of alcohol or drugs. This method of posing the question avoided the problem of evasive answers to avoid self-incrimination. Of course, it requires drivers to estimate a parameter. Still, drivers would be expected to be aware of drug/alcohol activities among fellow drivers, and their answers should impart a sense of the general extent of the problem. The average respondent indicated that 18 percent of his/her fellow drivers sometimes operate under the influence of alcohol and 36 percent under the influence of illegal drugs.

Because of the surprisingly high incidence of drug usage indicated in the 1986 survey, in 1988 the question was repeated for

drugs, but with the alteration of asking about regular as opposed to occasional usage. The mean response was that 29 percent of all drivers regularly drive under the influence of illegal drugs.

In the 1988 survey, drivers were asked to name the two most commonly used illegal drugs. The answers were as follows:

Most commonly used illegal drug	Percent of respondents
Marijuana	50
Speed	25
Cocaine/crack	25
Amphetamines	11
Other uppers	10
Crystal, crank, angel dust	5
All other drugs	1

NOTE: Because each respondent could supply two answers, the percentages sum to more than 100.

To determine the extent to which drivers approve of drug usage (i.e., view drugs as tools or aids to working), they were asked to name any currently-illegal drugs which should not be banned for drivers. Eighty-three percent indicated that there are no drugs which should be decriminalized. However, 13 percent responded affirmatively and listed the following:

Drug which should not be banned	Percent of respondents who feel some drugs help drivers	Percent of all respondents
Speed	34	4
Uppers, "bennies"	33	4
Amphetamines	22	3
All other drugs	6	1
No drug named	7	1

As might be expected, the list of drugs which should no be banned consists almost entirely of stimulants, which may assist in keeping a driver alert, albeit dangerously so. It is particularly disturbing that drugs which can only be described as recreational and detrimental to performance (marijuana and crack/cocaine) were most frequently listed among the drugs most commonly used.

A third of the drivers indicated that they had been tested for alcohol and half had been tested for drugs. Almost all of those tested, had been tested in 1987 or 1988.

In 1987 and 1988, drivers were asked if they supported mandatory random alcohol and drug testing. While there was some slippage in support between the two years, still the large majority of drivers approve of the concept:

Carrier type	Percent of drivers approving mandatory random drug/alcohol testing 1987	1988
For-hire fleets	76	68
Private carriers	75	69
Owner-operators	67	68
All drivers	73	68

From conversations with interviewees, it is evident that the high degree of support for testing is due to concerns that a relatively small percentage of the drivers are responsible for creating dangerous conditions and spoiling the public image of truck drivers as a group.

A major aspect of the drug/alcohol testing debate is who should conduct the tests -- employers, government at roadside inspection sites, or others. When asked, in 1988, the responses were:

Tests should be conducted by	------ Percent of drivers ------ approving of testing	All
Employers only	42	29
Government only	26	18
Either empl. or gov.	19	13
Other	13	9

Industry Position

The organized industry has consistently favored mandatory testing prior to hiring (with allowances for trip leased drivers), testing at biennial DOT-prescribed medical examinations, and testing by employers if there is reasonable suspicion. The industry supports mandatory random testing if conducted by the government at roadside inspection sites. Finally, the industry is ardently opposed to measures requiring carriers to rehabilitate substance abusers (Johns).

Discussion

As indicated above, the most recent DOT action on drug/alcohol testing is under a temporary court injunction, which may become permanent. Despite this, a resolution to the issue appears reachable.

The industry position is based upon three concerns: 1. the public's safety, 2. avoidance of additional direct costs (from requirements that carriers perform testing and rehabilitation), and 3. avoidance of additional indirect costs (from efficiency losses due to delays resulting from any testing program). It could be argued that industry concerns regarding additional costs, both direct and indirect, should be subordinated in favor of public safety. Even if one adopts this position, the industry has one unassailable retort -- a significant share of the drivers on the road are owner-operators.

It is clearly impossible to expect owner-operators to randomly test themselves or be responsible for their own rehabilitation programs. Also, owner-operators rely heavily upon leasing to secure loads. Impediments to trip leasing resulting from pre-employment testing requirements would reduce the competitive position of owner-operators relative to permanent, company drivers. Moreover, the burden of requiring owner-operators to develop and maintain testing programs would likely be onerous. There appears to be appreciation of these facts in the federal government and a willingness to develop workable rules. Ultimately, governmental budgetary considerations may prove to be the biggest obstacle.[5]

The thorniest problems to establishing a testing program appear to be on the driver's side. The Teamsters Union and the Owner-Operators Independent Drivers Association are firmly opposed to random testing, as the following statements to the Federal Highway Administration indicate:

> The International Brotherhood of Teamsters is adamantly opposed to random drug testing ... We view it as an affront to the human rights and personal dignity of our members who may be subjected to it.
>
> The Owner-Operators Independent Drivers Association of America is flatly opposed to any form of random testing, whether by a carrier or by federal or state officers ... The association believes that random testing is highly invasive, offensive to due process, and completely unwarranted when weighed in relation to the known safety risk posed by drug use among commercial drivers.
>
> Source: Wastler

Fourth Amendment rights issues often involve balancing the concerns (or rights) of the few against those of the many. Truckers are being asked to be inconvenienced for the sake of the general public. In this regard, the positions of the Teamsters and the OOIDA are understandable, even laudable. However, their positions seem strange in view of evidence from the RCCC surveys that large majorities of those they purport to represent are in favor of mandatory random testing. Two thirds of the owner-operators and 79 percent of union drivers questioned in 1988 favored such testing. This divergence between drivers' and driver representatives' views may lead to avenues for a compromise.

IX. ROADSIDE SAFETY INSPECTIONS

With establishment of the Motor Carrier Safety Assistance Program, the number of roadside inspections increased from under 200,000 in 1984 to 1,000,000 in 1987 (OTA). While the need for such inspections is generally acknowledged, concerns remain regarding the appropriateness of inspection procedures and the burdens to drivers and motor carriers (Patten, Carroll, and Thomchick). The principal reason for concern regarding effectiveness in reducing accidents is

that the inspections tend to focus on mechanical factors, while human error appears to be the dominant cause for mishaps.[6] This criticism would be addressed in part if drug/alcohol testing became an integral part of roadside inspections. Another reason is that avoidance of inspection sites is often feasible.

Driver Position

Eighty-seven percent of the drivers in the 1988 survey reported having at least one roadside inspection over the past 12 months. The median number of inspections was 3 and the median delay per inspection was just over 20 minutes.[7] Drivers were asked to rate roadside inspections on a 1-to-10 scale (with 10 being the best) in terms of fairness and ability to get bad rigs off the road. The mean scores were 7.0 and 6.9, respectively. Less than a fifth of the drivers gave a score less than 4 on either of the questions:

	Percent of respondents rating roadside inspections in terms of...	
Score	Fairness	Getting bad rigs off road
Poor (1-3)	15	19
Average (4-7)	29	26
Good (8-10)	56	55

Industry Position

The organized industry supports roadside inspections. The principal industry concern regarding inspections is that service standards be fair and consistent across all states. The RCCC feels that roadside inspections are the most effective inspection method.

Discussion

Both the organized industry and drivers generally support roadside inspections. As discussed earlier, there remains debate regarding the advisability of integrating drug/alcohol inspections into this process. The industry and a majority of drivers appear to be in favor, while some influential driver organizations are opposed. A primary concern regarding roadside inspections and, indeed, all transportation enforcement efforts, is that they be consistent across all jurisdictions.

X. CONCLUDING COMMENTS

In this paper the positions of drivers and the motor carrier industry have been compared regarding several safety issues currently prominent in the U.S. It is not surprising that economic self-interests strongly shape these views. However, it would be a gross mischaracterization to depict the parties as only concerned with their respective bottom lines. For example, it is impossible to understand in economic (dollars and cents) terms why most drivers favor drug/alcohol testing or why most drivers who do not use radar

detectors defend the right of others to do so. Similarly, industry support for mandatory seat belt laws and banning of radar detectors is not necessarily in their best interest financially, at least in the short run.

To facilitate negotiations, it is important to understand both the economic and noneconomic reasons for the views of all parties. For example, the defense of the right to use radar detectors by non-using drivers suggests that the costs of enforcing a ban would be high and that many would not be persuaded by educational programs regarding the economic/safety pros and cons stopping their usage. For many drivers the issue is not radar detectors, but individual rights. If the radar detector issue is to be successfully addressed, it must also be addressed at that an individual rights level. On the other hand, drivers who view anti-lock braking systems as superior tend to support mandating their use. This suggests that this issue can be addressed in strictly in terms of economics and safety.

ENDNOTES

1. Popularity for the 65 mph speed limit is widespread among the general public. Therefore, it is difficult to conclude that support for a return to a 55 mph National Speed Limit is maintained for political reasons. Concerns regarding safety are, no doubt, sincere, but are probably rooted in economic as well as moral considerations.

2. McCarthy found somewhat increased cross-vehicle variations after the switch to 65 mph. This is the reverse of what drivers indicated to be the case. However, the main value of McCarthy's work, in the context of this paper, is that it supports the contention of a speed consistency-saftey linkage.

3. This estimate is very close to the 30 percent estimate arrived at by the National Motor Carrier Safety Board (OTA).

4. In an unpublished survey of owner-operators, the Owner-Operators Independent Drivers Association of America found that 69 percent of owner-operators use radar detectors (OTA). This compares to 76 percent in the 1988 RCCC survey.

5. In keeping with the currently in-vogue, user-charge philosophy, a possible solution might be to assess a tax or surcharge on commercial driver licenses.

6. OTA estimates that over 60 percent of all commercial motor vehicle accidents are due to human error.

7. Medians, rather than means, are presented due to the highly skewed nature of the distribution. A very large majority of drivers reported few inspections of short duration, while a few respondents indicated extremely large numbers of inspections and/or very long delays.

REFERENCES

Beilock, R. The 1988 RCCC Motor Carrier Safety Survey Regular Common Carrier Conference, Alexandria, VA, 1989 (forthcoming).

Beilock, R. and R.B. Capelle, Jr. "The Effect of the 65 MPH Speed Limit on Motor Carrier Schedule Tightness and Driver Perceptions of Safety Conditions" Journal of the Transportation Research Forum 29,1 (1988):7-17.

Insurance Institute for Highway Safety "Radar Detectors Spur Speeding" Insurance Institute Status Report Vol 22, no. 3, 1987.

Johns, W. Summary of ATA Comments to DOT on Drug Testing Proposals Memorandum to Parties Interested in Truck Safety, ATA Safety Management Council, September 22, 1988.

McCarthy, P. Highway Safety and the 65 MPH Maximum Speed Limit: An Empirical Study AAA Foundation for Traffic Safety, Washington, D.C., 1988.

Office of Technology Assessment Gearing Up for Safety OTA-SET-382, Washington, DC, 1988.

Patten, M. L., J. L. Carroll, and E.A. Thomchick "The Efficacy of Roadside Inspections in Reducing Heavy Truck Accidents" Journal of the Transportation Research Forum 29,2 (1989): forthcoming.

Wastler, A. "Random Testing Source of Fear for Both Labor and Management" Transport Topics September 19, 1988, pp. 9-10.

Wilson, J. "Spec'ing for 65: Pegging Costs of Increased Speeds" Heavy Duty Trucking January, 1988.

A Model for the Privatization of Rail Passenger Services in Canada

by

Richard M. Soberman
University of Toronto - York University
Joint Program in Transportation

Adil Cubukgil
Transmode Consultants Inc.

Introduction

All rail passenger service in Canada receives large government subsidies to offset the differences between costs and revenues. Per passenger, these rail subsidies exceed (by an order of magnitude) subsidies for airports and aids to navigation involved in air travel, and any subsidies to bus passengers related to road construction and maintenance. Only subsidies for ferry services in Atlantic Canada and British Columbia are comparable to those associated with rail passenger service.

Traditionally, transportation subsidies have been justified as a means of achieving a variety of public interest objectives that could not be realized by other means. In the case of rail passenger services, successive governments have always perceived a need to maintain some degree of rail accessibility, regardless of public cost. Periodically, of course, attempts have been made to rationalize these services in response to changing economic conditions and changes in the degree of accessibility provided by alternative means of transportation.

Under the National Transportation Act of 1967, for example, subsidies were authorized for those rail passenger services which, while uneconomic, were deemed to be in the public interest. The definition of "need" presumably implied the lack of adequate alternatives for satisfying the demand for intercity passenger travel in the absence of rail service. Thus, a remote community (for example, Churchill, Manitoba - which did have air services) would have a greater need for rail service than a community such as Ottawa which is well served by roads and bus services. More often than not, however, the determination of need has been based on the degree of public support that can be mobilized for the continuation of services that may be in jeopardy, or, alternatively, upon the level of public outcry against decisions to eliminate or reduce service.

Although the 1967 Act relieved the railways of a major financial burden, by the end of the 1970s, it became apparent that the railways had neither sufficient incentive nor interest to improve rail passenger service. For this reason, the federal government assumed direct financial responsibility for rail passenger service by establishing VIA Rail Canada to provide service under contract to the government. Since the infrastructure continued to be owned by the railways, VIA in turn, entered into operating agreements with CN and CP for train operation and maintenance. In other words, VIA became a "service broker" between the federal government and the railways, performing an overall management function.

With the creation of VIA Rail, the responsibility for defining need in relation to cost was allocated to VIA management (at least with respect to level of service) and the Minister of Transport and, as a result, became more *ad hoc* in nature. In 1981, for example, as a cost saving measure, the Minister of Transport unilaterally cancelled about 30 percent of VIA services; in 1985, to fulfil election promises, most of these were reinstated by another Minister. In 1986, new rail passenger legislation was proposed, but never tabled, which attempted to tie the definition of public need to some demonstration of public use.

The basic principle behind the creation of VIA was to retain direct control over service levels and to give responsibility for improving the performance and efficiency of the system to a separate operating authority. A decade later, however, it is apparent that the new operating authority has failed to meet this challenge.

In the eight year period following the establishment of VIA Rail, for example, the federal government contributed $3.4 billion in operating subsidies. In addition, VIA's capital expenditures, $930 million to date, have been publicly funded or secured. This heavy financial burden, however, achieved little improvement in the overall performance of the rail passenger system. In fact, ridership declined and public dissatisfaction with the quality of service increased.

Moreover, the large subsidies for VIA adversely affected the private bus industry. Highly subsidized rail fares essentially set a ceiling on bus fares, thus depriving bus companies of reasonable revenues on routes where they compete with VIA. This occurs mainly on high density routes and erodes the revenue base that is necessary for bus companies to offset losses on lower density routes where they are obligated to provide service. In addition, since the bus industry perceives VIA subsidies as unfair price competition, *there is little or no cooperation between the two modes* nor any attempt to integrate service, schedules, or reservations systems so as to improve the overall quality of service available to the public.

Faced with the large financial burden, the level of public dissatisfaction, and charges of unfair competition from the bus industry, it is timely to give serious consideration to alternative mechanisms for the delivery of rail passenger service that can improve financial performance, reduce distortions in price competition, and provide a more highly integrated and coordinated passenger transportation system which uses each mode to its best advantage.

This paper suggests a framework for a public-private joint venture that can effectively respond to the needs of the rail passenger system, and that at the same time, can provide significant opportunities for reducing the financial burden on the federal government.

VIA's Financial Performance

As shown in Table 1 and Figure 1, from the time of its creation in 1980 to 1987, VIA Rail revenues increased by about 40% while operating costs increased by 52%. Since the number of passengers carried and car miles operated actually declined over this period (by 23% and 34%, respectively), unit costs increased much more rapidly: cost per passenger by 96% and cost per car mile by 130%. Over the same period, the consumer price index for transportation increased by 66%. It is evident, therefore, that operating cost efficiency of rail passenger service has deteriorated significantly since the creation of VIA Rail.

Table 1

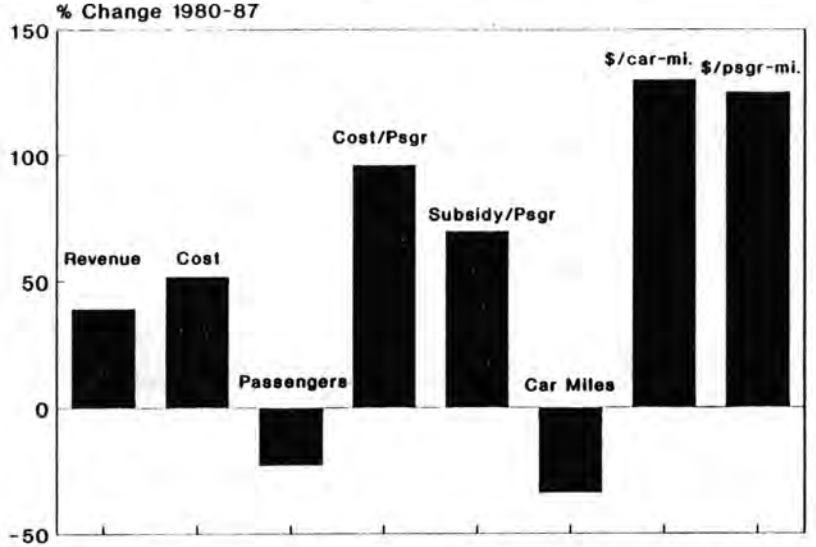
VIA Performance, 1980 to 1987

	1980	1981	1982	1983	1984	1985	1986	1987
Costs and Revenues ($millions)								
Railway Charges	322	392	357	390	342	401	236	189
VIA Costs	137	189	246	252	253	324	453	507
Total	459	581	603	642	595	725	689	696
Passenger Revenue	140	165	162	173	177	201	204	195
Cost Recovery (%)	30.5	28.4	26.9	26.9	29.7	27.7	29.6	28.0
Unit Costs								
$/train-mi	30.22	39.45	48.66	52.67	48.72	55.97	52.83	57.18
$/car-mi	4.50	5.80	7.66	8.95	8.25	9.50	9.29	10.35
$/pass-mi	0.24	0.30	0.38	0.43	0.40	0.47	0.49	0.54
$/passenger	60.51	72.54	83.48	98.15	87.89	103.07	109.61	118.67
Revenue/passenger ($)	18.50	20.60	22.40	26.40	26.10	28.60	32.40	33.20
Government Funding								
Operating ($millions)	320	412	431	451	398	524	462	452
Other ($millions)	90[1]	100[1]	104	147	75	107	44	84
Total ($millions)	410	512	535	598	473	631	506	536
$/passenger	54.0	63.9	74.0	91.4	69.9	89.7	80.5	91.4

[1] Estimate based on capital expenditures

Figure 1

Selected VIA Performance Measures
1980 to 1987 (in Current $)



Both total and unit costs increased steadily during the first four years of VIA Rail operations. There were some short lived improvements in 1984, and again in 1986, but 1987 was marked by the lowest passenger volume and the highest unit costs in the history of rail passenger service in Canada. Although the deterioration in financial performance does not appear to have been as rapid during the last four years, there are no encouraging signs of a turnaround in the fortunes of rail passenger service in Canada.

The earlier difficulties of VIA Rail have often been blamed on institutional arrangements which gave the agency little control over its costs. In 1980, railway charges (in accordance with existing operating agreements and costing regulations) accounted for 70% of total operating costs, over which VIA had little control. This situation was further exasperated by VIA's own rapidly escalating costs associated with marketing, reservations, administration and other overhead functions. Although the scope of VIA Rail's own activities changed little between 1980 and 1983, its cost (over and above railway charges) increased by more than 80%, while passenger volume declined by about 15%.

More recently, VIA has taken over direct responsibility for functions initially performed by the railways, starting with equipment maintenance and later taking over train crews. As a result, railway charges accounted for only 27% of VIA Rail's total operating costs in 1987. Although these changes were implemented to achieve cost savings, it is evident that there has been no improvement in operating cost performance, in terms of either total or unit costs.

The Proposed Model

Objectives

As noted above, recent experience shows that neither passage of the National Transportation Act of 1967 nor the establishment of VIA in 1979 have reduced the public costs of rail passenger service or improved in any significant way, the responsiveness of the rail passenger system to the travel needs of the Canadian public or the policy objectives of the federal government.

Complete government ownership, control and operation has not, as has been the experience in the U.S. and other industrialized nations, produced a satisfactory solution to the rail passenger problem. History and experience obtained from other modes of passenger travel strongly suggest that if public policy objectives are to be met with greater efficiency, ways must be found to introduce stricter commercial principles and practices into managing the delivery of this form of intercity passenger transportation.

The public-private enterprise suggested in this paper is designed to meet the following objectives:

- to maintain a level of rail passenger service that is consistent with federal government policies with respect to the role and function of this mode of transportation in various regions of the country
- to improve financial performance of the rail passenger system and reduce the financial burden on the Government of Canada through higher cost recovery and improved efficiency
- to eliminate unfair price competition with private bus companies and provide integrated bus and rail service instead, using each mode to its best relative advantage
- to eliminate the inefficiencies and unnecessary costs associated with VIA's administration through improved management
- to generate profit incentives for the reduction of railway charges per train mile and eliminate the uncertainty associated with open ended operating agreements based on costing regulations
- to achieve greater efficiency in equipment maintenance and reduce unit car mile costs which now represent the largest single cost component of rail passenger service
- to ensure that the rail passenger system is supplied with new equipment that is appropriate to meet the needs of different classes of service, that can be acquired at reasonable cost, and that is designed to allow for low cost maintainability.

The Concept

The rail passenger system can be greatly improved and integrated with the bus mode through the establishment of a mixed private-public sector enterprise. The most suitable

model for such an enterprise is a joint venture between the federal government, private bus companies, and manufacturers of railway equipment. The new enterprise would naturally adopt sound commercial principles and be more sensitive to the market discipline of the private sector than VIA's current management. It would be more responsive to opportunities for innovation and increased efficiency, and take advantage of the management capabilities of the private sector.

In addition, each of the three suggested participants could play a unique role:

- The federal government would ensure that the new enterprise is sufficiently responsive to public policy objectives.

- Bus companies could choose to integrate their operations with the rail network creating a more efficient surface transportation system.

- Manufacturing companies could meet new equipment requirements for improved rail service and provide the technical capability to deal more effectively with equipment maintenance, one of the most critical problems facing the existing system.

The management of the new enterprise should be guided by four basic principles. First, because the present institutional arrangements through which rail passenger services are delivered basically preclude significant improvements in performance or major reductions of public costs, *the authority must be given effective means of negotiating railway charges that are affordable in relation to potential revenues*. Costing regulations must be eliminated if costs are to be reduced. Regulation of railway charges must be placed on the same confidential contracting basis as would apply to any other shipper under the new NTA. The proposed authority must be able to negotiate firm prices with the railways for the operation of trains on a route-specific basis, independently of any costing regulations.

Second, weaknesses in VIA's management and performance could be eliminated by reducing overheads and acquiring managers who, in comparison to those managers transferred from the railways to VIA with their traditional approaches to passenger service, are more sensitive to market conditions and have a better understanding of the total intercity travel market.

Third, the inherent need for some level of subsidy for the rail operations of the authority must be incorporated into its financial structure in ways that do not detract from the profitability of bus operations nor otherwise interfere with overall management on the basis of sound commercial principles.

Fourth, it is important to recognize that there are geographic and demographic realities that place limits on the cost effectiveness with which rail passenger services can be provided to certain communities and regions. Even in these situations, however, a new authority that is permitted wider latitude in its negotiations with the railways should be able to reduce costs to some extent through more reasonable operating agreements and realistic concessions on the part of organized labour. Nevertheless, there will be cases where bus and air services can offer more attractive service in terms of schedule frequency and travel times at comparable or lower cost. Thus, in some cases, the new authority should be permitted to provide alternative bus service or contract with airlines where significant cost savings can be achieved. Such flexibility can be used by the authority to negotiate with the railways from a position of greater bargaining strength.

In essence, the new enterprise would be a substitute for VIA Rail that would achieve the objectives originally established for VIA more effectively by operating integrated rail and bus services. The necessary financial discipline would be imposed through the introduction of profit incentives. The system would be more efficient and reduce the financial burden on the federal government. The profit motive would, of course, be constrained within reasonable limits, by the policy objectives of the federal government.

Finance

The enterprise would be partially owned by the federal government and partially by private investors, possibly in proportions of 35% and 65% respectively. This level of federal ownership would be sufficient to provide adequate visibility of continuing federal government commitment and responsibility for the national rail passenger system. Private sector ownership would be shared by two types of companies: those presently involved in intercity bus services and those involved in the manufacture of rail passenger equipment.

The capital base of the enterprise would be established by contributions from all three equity partners. The federal government would disband VIA Rail Canada and lease those assets of VIA considered essential for operation to the new enterprise at a nominal fee for a period of ten years. The equity position of private bus companies would be secured by the fair market value of buses, other assets, and operating licenses transferred to the new authority. Equipment manufacturers would provide working capital through the purchase of shares. The enterprise and the federal government would jointly determine the new equipment acquisitions necessary to provide adequate service in accordance with internally defined specifications and available capital resources.

The operations of the enterprise would be financed from passenger revenues (both rail and bus), other income (e.g., trans-continental tour and accommodation packages), and government payments. Unlike the current arrangements with VIA, however, federal government payments to the enterprise would be better targeted and reduced over time. Initially, these payments could be limited to the actual operating deficit (e.g., $452 million in 1987). The strategy would then be to reduce the operating deficit through revenue increases and/or cost savings. In order to provide a direct incentive, the new enterprise would be allowed to retain a portion of the savings, but the federal government would still benefit from gradually reduced deficits. In order to insure that deficit reductions are not achieved strictly at the expense of service abandonments, the federal government would secure some contractual safeguards to maintain a desired level of service. The government will always have the option of retaining the resulting savings in the enterprise for the provision of additional rail service or for other purposes.

Charged with a profit motive, the new enterprise would have every incentive to improve its operating efficiency and trim its overhead structure. Unconstrained by costing regulations, the enterprise would enjoy considerable negotiating freedom with the railways, particularly if modal substitution (i.e., bus for rail service) can be used as a real threat. Since the commercially driven enterprise would be trying to maximize its revenues, rational pricing practices would emerge and service quality would improve. The government could still impose any rail service provision on the enterprise, but at least, modal substitution opportunities could be considered and those rail services that are maintained would be provided in as cost effective manner as possible.

Organization

A preliminary concept for the organizational structure of the proposed enterprise is shown in Figure 2. Board members would be appointed by the Federal government and the private sector shareholders in proportion to their equity positions. In the case of the Federal government, board members would be designated by the Minister of Transport.

The operating component of this organization is structured to emphasize the different roles and needs of the various types of rail and bus service, namely, transcontinental, corridor, and regional and remote services. Thus the operating division, under a senior vice-president, would consist of three separate organizations responsible for each of these classes of service. Certain functions common to each of the operating divisions such as ticketing and reservations, provisioning, and terminal operations would be directed by a central unit reporting to the senior vice-president.

Within this structure, divisional vice-presidents would retain a high degree of responsibility with respect to service planning and the integration of complementary bus and rail schedules, marketing the services provided by that division, and monitoring the performance of the railways in accordance with operating agreements and various penalty and incentive schemes. However, service plans for each division would be developed in cooperation with other divisions shown in Figure 2 responsible for finance, contract management, equipment maintenance and engineering and human resource development. The human resource development function is particularly important in that it would encompass responsibility for developing more realistic and efficient work rules for rail passenger operating labour than are currently in force.

Because one of the primary objectives of the proposed organization is to achieve better integration between complementary bus and rail services, special emphasis is placed on a management information group reporting directly to the president.

In general terms, the proposed organization would be considerably smaller than the existing VIA Rail organization. In developing a detailed staffing plan, for example, more emphasis would be placed on the use of purchased services, as required, so as to avoid the gradual build-up of unnecessary overhead functions.

Next Steps

Although the basic principles underlying the proposed new enterprise are described in preceding sections, further studies and analysis are clearly necessary to arrive at a proposal that is sufficiently detailed to serve as a basis for negotiation between the federal government and potential private investors.

In particular, more analysis is required to assess VIA Rail's current performance with respect to existing services on a route specific basis, and to evaluate opportunities for improving the financial performance of the rail passenger system in ways that recognize both the strength and weakness of this form of transportation in relation to the total market for intercity passenger travel.

The general nature of the studies required are outlined in Figure 3 and can be described in terms of three major sets of activities.

Figure 2

Proposed Organization

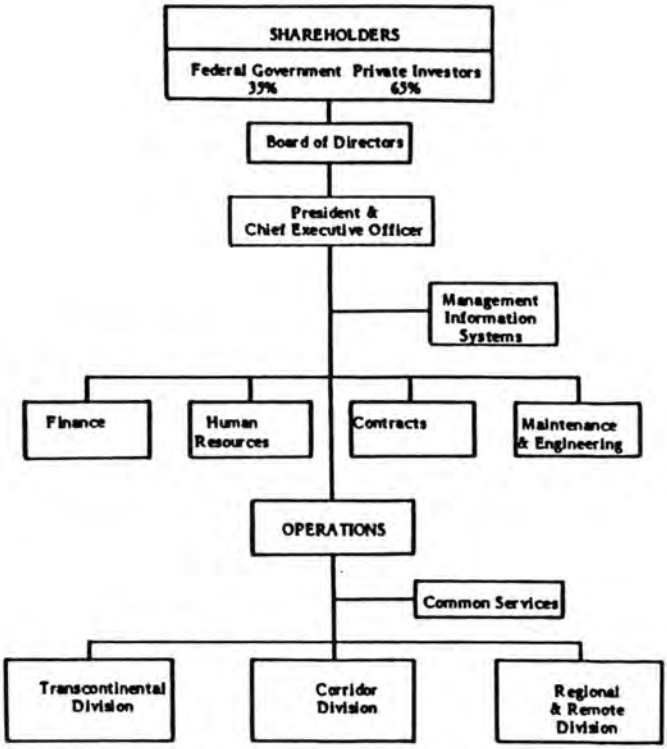
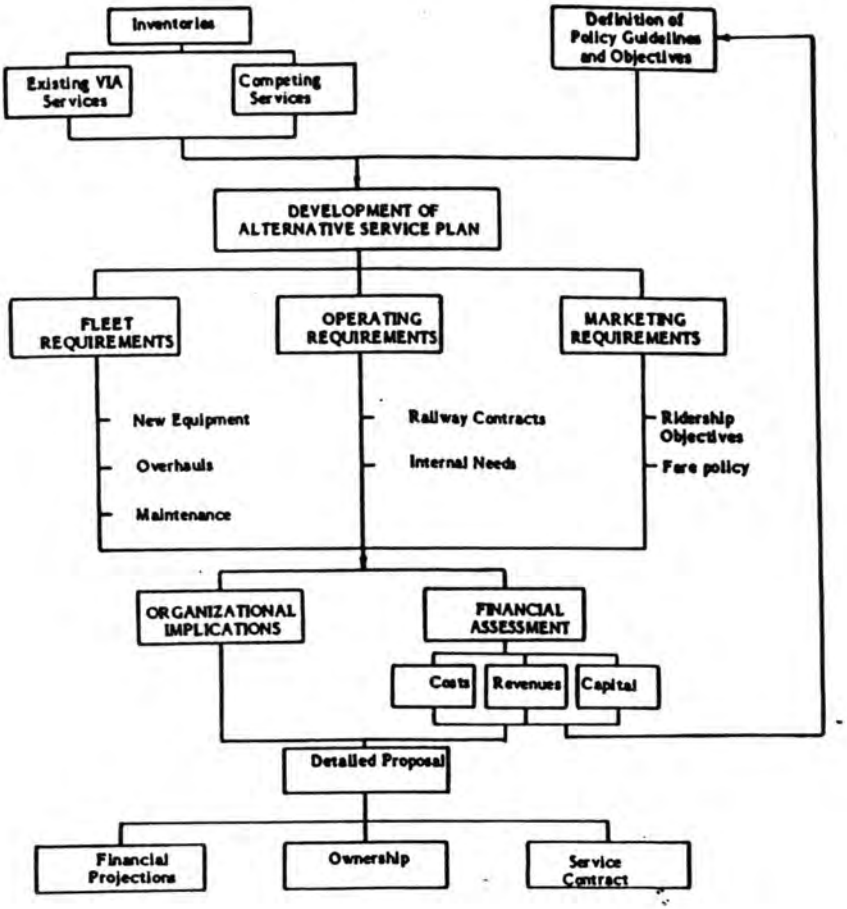


Figure 3

Proposed Work Plan



First, a detailed inventory of the existing services provided by VIA Rail must be developed in conjunction with an overall assessment of the potential market for intercity passenger service. This inventory would include detailed analysis of ridership patterns, railway charges, VIA overheads, and equipment requirements for each route now served. An analysis of this kind can only be accomplished effectively through complete access to all VIA records, statistics, and contractual arrangements. In addition, a complete inventory of all VIA assets including rolling stock and facilities would be required so as to determine those assets that should be acquired by the new enterprise.

For origins and destinations now served by VIA Rail, it is also important to assess the competition provided by other modes of transportation (principally bus) in terms of ridership, costs, fares, and various measures of the level of service provided. The major product from this stage of analysis relates to the identification of potential opportunities for increasing ridership and revenues from rail services, opportunities for improved integration with complementary bus services, and principal targets for cost reduction.

In this stage, it will be also important to clearly define a number of policy considerations related to federal government objectives for future rail passenger services that take into account the role and function of the various transcontinental, corridor, and regional and remote services.

Second, by combining the assessment of existing performance and opportunities with the basic policy guidelines, alternative service plans can be developed involving various combinations of integrated bus and rail networks. As shown in Figure 3, each of these service plans can be translated into fleet requirements for buses and rail vehicles, opportunities for combined bus and rail terminals, operational requirements, and marketing practices (including fare policy).

Fleet requirements must be defined in terms of new acquisitions and opportunities for refurbishing existing equipment, as well as various options for maintenance programs that will ensure adequate service reliability. In this regard, it will be necessary to reach agreement as to financing the purchase of new equipment through some combination of direct government contributions and profits of the enterprise.

Operational requirements include the development of appropriate terms and conditions for operating agreements between the railways and the new enterprise. The internal operations of the new enterprise must also be detailed. Marketing and pricing strategies would be developed within the context of the function and role of each of the different classes of service and the competitive environment within which these services are likely to operate. As noted in the previous section, quite different approaches to marketing are required for transcontinental services which draw heavily on the market for tourism than for corridor services, which compete under entirely different conditions.

Finally, for each of the alternative service plans developed, fleet, operational, and marketing requirements would constitute the basic inputs for comprehensive financial planning that estimates costs, revenues, and needs for working capital and new investment. At the same time, organizational requirements of the proposed new enterprise must be detailed. As shown in Figure 3, there is also an important feedback relationship between the assessment of financial performance of each service plan and the policy objectives of the federal government as the financial and service implications of the necessary modifications to the existing service plan become more apparent.

Summary

The rail passenger system in Canada is highly uneconomic and imposes a substantial financial burden on the federal government. It is unlikely that the entire system could ever become financially viable without government subsidy. Although the federal government has contributed $3.4 billion in operating subsidies and supported capital expenditures of nearly $1 billion over the eight year period following the establishment of VIA, ridership has declined and public dissatisfaction with the quality of service has increased.

Moreover, the large subsidies for VIA have adversely affected the private bus industry, which can reasonably complain of unfair price competition that deprives the industry of sufficient returns to provide adequate service on more remote routes, or improve quality of service where bus/rail competition exists.

There are, however, significant opportunities for improving the efficiency and financial performance of the system and achieving a high degree of coordination and integration among complementary bus and rail services. VIA Rail has been unable to realize any of these opportunities; in fact, it has increased the overhead burden on the system without any notable improvements in service. For this reason, it is now timely for the federal government to consider an alternative for meeting its service and financial objectives by drawing on the capacity of the private sector.

This paper recommends the establishment of a new enterprise to be owned jointly by the federal government, intercity bus companies, and rail passenger equipment manufacturers. This enterprise would be responsible for the provision of all existing rail passenger services, as well as the operation of supplementary and feeder bus services, all of which would be integrated within a single national bus and rail passenger authority.

In this proposal, VIA rail would be disbanded with those assets of VIA necessary for rail operations leased by the federal government to the new authority at a nominal fee for a period of ten years. The federal government would retain 35% of the ownership of the new enterprise. For the remaining 65%, equity of the private bus companies would be secured by the transfer of equipment, other assets, and operating licences. Rail equipment manufacturers would purchase their share and ownership so as to provide the new enterprise with working capital.

Under this proposal, the new enterprise would be free to negotiate confidential contracts on a firm price basis for the rail services provided by the railways. The enterprise will also be free to explore alternatives for reducing the costs of equipment maintenance now performed by the railways through competitive bidding or the use of its own technical resources. Incentive payments would be made by the federal government to the new enterprise in respect of reductions in railway charges and equipment maintenance costs on a per car or train mile basis. The actual savings will be realized by the federal government, reducing its annual payments from the initially committed amount. In addition, the federal government will receive its share (35%) of the dividends disbursed by the new enterprise.

Under this structure, profit motives instilled by private sector participation would maximize opportunities for improvements in efficiency with respect to both reducing costs and increasing revenues. Through the participation of private bus companies, an integrated bus/rail system can be developed that uses both modes to their relative advantage. Participation of rail equipment manufacturers can ensure that necessary new

rolling stock is acquired that is appropriate to the needs for rail service in various regions of the country. The rail equipment manufacturers also provide technological capability for improving the efficiency of equipment maintenance. Direct government involvement will ensure that the necessary policy direction continues to be provided.

This proposal provides the federal government with an opportunity to reduce subsidies for rail passenger service well below projected levels without reducing service. It also relieves the federal government of the need to establish specific cost recovery targets for individual services, relying more on market mechanisms to establish fares and level of service that maximize revenues. Essentially, implementation of this proposal would develop a delivery system for intercity rail and bus passenger services that:

1. improves performance of the Canadian rail passenger system in a more cost effective manner by lowering costs, thereby achieving higher cost recovery from improved services,

2. reduces by a significant amount, the burden of rail passenger subsidies on the Government of Canada, without deterioration in the availability of adequate transportation to specific communities or regions of the country,

3. eliminates many of the distortions in the pricing of competitive modes of surface transportation resulting from direct government subsidies,

4. encourages the development of complementary feeder services, and provides the travelling public with a highly integrated and coordinated surface transportation system that uses rail and bus services to their best relative advantage.

At this point, further studies and analysis would be required to develop a more detailed proposal as the basis for negotiation between the federal government and potential private investors.

In all aspects of public enterprise, the current government and supports the need for greater private sector initiative and involvement. The federal government is committed to increased privatization of public sector activities in ways that do not jeopardize the public interest. Because the public interest is clearly at stake in the provision of rail passenger service, the government cannot entirely relinquish its responsibility. However, through privatization of the "service brokerage" role that VIA now plays, private initiative responding to a clear profit motive would be an effective means of addressing VIA's original mandate of improving efficiency and performance of the rail passenger system, without compromising on the public interest.

MARITIME PRIVATIZATION - Authors J.Eyre, Dimitri Plionis

INTRODUCTION - ABSTRACT

"..few systematic attempts have been made to monitor SOE financial performance...."

The World Bank (1.)

An SOE is a State Owned Enterprise. This tactful understatement is from the Bank 1988 World Development Report which considers the struggle between public and private operations. Privatization of ports and shipping is a philosophic cousin of deregulation, free trade, laisser faire and user pay. All are attempts to reduce the role of governments. In the maritime world these fashionable efforts come along with violent technical change and a long spell of depression caused by too many ships. This paper considers the public interest in widely varied attempts to privatize deep sea ship lines and the ports they serve. It also offers comments on the situation in the Year 2000. For background, it starts with a review of the present situation as reported in the maritime press and observed in recent studies by the authors. It concludes that;

1. Tankers, bulk carriers and their ports form mainly free market industrial systems which will not greatly change.

2. East/West containership services are competitive, efficient and becoming daily more sophisticated, mostly in private hands.

3. Ships and ports in Africa,India and Latin Amrerica are behind the times and ripe for privatization.

4. Ports are dependent on public finance and often locked into hopeless labour situations. They need private operators.

5. Government owned ship lines are minus factors in balance of payment accounts.

6. However, their worst problems are subsidy and protection which insulate them from the real world of shipping.

THE SITUATION - SHIP LINES

New Zealand Line Reflags, Cuts Staff to Attract Buyers
Puerto Rico to Probe Ship Repair Bills
India Eases Regulation of Ship Aquisitions

Lloydbras on the brink (Brazil)
Africa Ocean Lines Restructures
Argentina's ELMA for Sale
Further Privatization in Philippine Shipping
Peru's Ship Line Wallows in Sea of Financial Woes. (2.)

These headlines from recent papers and magazines show the areas where governments own most of their shipping;-Africa, Latin America, India, Australia and New Zealand. Both the USA and Canada have had brief painful bouts with shipping SOEs, and both avoid them now. France, Italy and Spain are phasing out their costly government shipping involvements. The Scandinavians and British have always looked to their private owners. The Japanese seem to have private shipping, but have their own excellent forms of government-industry understanding. Australia and New Zealand are trying to get out of shipping, and when they do the OECD nations will be generally united in their rejection of maritime SOEs. The so called non market countries, Russia, China and the Warsaw Pact nations naturally resist private ship line ownership. This may explainin their lateness in adjusting to the containership revolution. The Chinese are loosening the power of Cosco, their dominant deep sea line, and they will soon be big players in the container ship game.

This paper concentrates on government ownership versus private. The distinction is seldom that clear. Subsidies, cheap or guaranteed loans, favored port treatment, protection, quotas, bilateral cargo sharing, and part ownership are but a few of the ways in which a government can be involved without actually owning.

General cargo ships are the types most often in SOEs. Bulk cargos, dry (ores etc.) and liquid (Oil etc.) move mainly in unscheduled ships traded in open markets. Transport to markets consumes sixty percent of the value of coal, twenty five for most ores, fifteen for wheat and over ten for oil. None of these raw materials can stand the high costs of SOEs. Brazil, France, Mexico and a few others have state owned tankers and bulk carriers, but they absorb or hide the losses. These are exceptions to the rule in what is called the most free and undisciplined of world markets. Tanker rates, prices and costs are well publicized, and there is even a futures market for bulk carrier services.

Efforts to sell the Shipping Corporation of New Zealand (SCNZ) reveal a few of the problems in finding private buyers. For many years the government has, as in many countries, avoided confrontation with the Merchant Service Guild and other maritime unions. The office staff was oversized and well supplied with political appointees. Ingenious accounting tricks hid losses. For example,two unsuitable ships served the Cook Islands, Niue and Tahiti. Their red ink was written off as aid to the Cook Islands, and

the service was said to earn a small profit. Now (Feb.1989) three buyers are showing interest at prices ranging from NZ 15 to NZ 50 million dollars. However, no buyer will live with chronic labour problems. Thus two ships (the New Zealand Pacific and New Zealand II) have been put under Hong Kong flags and others sold. Office staff has been cut. One buyer has run his own audit and found the company to be nearly bankrupt. The 1988 loss was NZ$42 million. With the balance sheet in poor shape, the ships and staff questionable, the main asset appears to be some sort of favorible position in obtaining business.

USA trade is protected for US flag/built ships under the Jones Act.This includes Puerto Rico,Hawaii,Alaska and some islands. In the early 1970s Puerto Rico's Gov. Colon and his Popular Democratic Party decided that the three lines serving USA ports (Sealand, TMT and AUT) were not adequate. He purchaced many of their ships and set up Navieras, a SOE. Soon thereafter losses developed. and he began a long series of FMC appeals for higher rates. By 1977 losses were unbearable and the rival New Progressive Party took power. They could find no buyers, and the losses continued. Their ships are now obsolete and thus they have purchaced five twenty year old "Lancer Class" ships from the bankrupt U.S.Lines. Repair costs were estimated to be ten million dollars, but exceeded forty million. Sealand and TMT are back in the trade, even though Navieras has a favored position in obtaining government influenced cargos. The private lines are relatively efficient and enjoy rate levels held high enough to sustain their SOE rival. This means protected profits. By giving better service they have driven Navieras' share of the trade from two thirdss to about one third.

India's Shipping Corporation (SCI) is government owned and managed. It has been constantly favored over private rivals such as the now bankrupt Scindia. India has used her national merchant marine as a vehicle for promoting local shipyards. Indian ports and ship lines are so inefficient that most round world containership lines transship their cargos at Colombo, Sri Lanka. Faced with bitter complaints from cargo owners, the Government has in 1989 relaxed the laws against purchacing ships in the open market. Privatization is discussed, but not imminent there.

Brazil's Lloyd Brasiliero is a basket case. They are 190 million dollars in debt and burdened with an obsolete fleet. They need forty million of new money to stay in business through 1989. Their Netuno class ships are described as "an admiral's dream", enormous officer quarters, fine lines, big fast engines, but modest narrow cargo spaces. Their only privatization assets are government cargos and a flow of subsidy money from cargo flow taxes. Here, as in much of Latin America and Africa, outsiders are discouraged. Greek, Norwegian. and Asian non conference independents

would like more Brazilian business, but they are kept out by 50-50 deals. Thus happy OECD trading partners enjoy rates held high enough to keep the Third World carrier alive. Brazil has an excellent private shipping group (Netumar, Alianca et al), but these have been constantly subject to the wishes of the state line.

In Africa shipping is an emotional and political issue. There UNCTAD 40-40-20 cargo sharing quotas are strictly enforced. Frequently former colonial associates lend invisible management assistance. For example, Cote d'Ivoire's SOE, Sitram has several Belgian (CMB) executives quietly in residemce. Sitram serves UK/Continent ports and usually reports modest profits, employing special accounting devices. By contrast Sivomar, a completely private line in Asian and Mediterranean trades is said to be exremely profitable. They have Danish associates.

In the Philippine islands shipping is vital,and private operators have long been tolerated.(3.) However the National Shipping Corp. was formed, largely to enjoy protected cargos in trade with the USA. It is for sale , but its ships are old and almost worthless. Maria Ana Madrigal and A.P.Madrigal SS.Co are willing to pay $26.6 million, possibly in the hope of continued preference business. To pull this off they are pressuring their friend President Corazon Aquino.

ELMA, Argentina's shipping SOE is, if possible, in deeper trouble than Lloyd Brasiliero. The Doderos and others were once cores of a good private shipping community. However, the private shipowners have been poor politicans. Here as in most of Latin America there are fifty-fifty cargo sharing deals with the USA. This means that private USA shipowners do well under the umbrella of rates held high to keep ELMA alive. The big losers are the exporters and importers of Argentina. While the details are different, the end result is about the same in Peru.

THE SITUATION - PORTS

The World Bank avoids loans to state owned ship lines, but they lend freely to ports. Here the public interest is clear because a nation can be weakened in foreign trade if her ports are constipated. France, Italy, Australia and Venezuela offer examples. Bulk cargo ports, like the ships that serve them, are parts of industrial logistic systems and generally privately owned or operated. There are exceptions, especially in African and Latin American ports where governments own and run almost everything. But general cargo and container ports are almost always dependent on public finance. Ports run entirely by governments are more expensive and less efficient. The most popular compromise finds a state, province or city providing capital for docks, cranes and infrastructure, but leasing or contracting with

private firms for operations. A few examples will suggest that there is no clear worldwide pattern.

Canada's National Habours Board built and owned most general cargo ports. About ten years ago this situation was diluted by creation of locally managed port corporations for Halifax, Montreal and other major ports. In the process past capital expenditures were forgotten. The Federal Government still runs some grain elevators and lends most money for capital improvements. The port corporations tend to lease facilities to private operators such as Ceres, managers of the Fairview containerport in Bedford Basin, Halifax.

USA ports have resisted Federal Government management, even turned down their money. States, cities and autonomous public trusts (NY/NJ) own almost all general cargo terminals. Some, Norfolk,Va. for example, actually operate and employ union labour. Most follow the Canadian pattern in leasing to professional stevedoring companies or to shipping companies. Because there is severe competition and tax free money the USA system is slightly overbuilt.

Ports of Antwerp, Rotterdam, Bristol, Bremen, Hamburg. Kobe, Yokohama and most in Norway, Finland and Sweden. are owned by cities. They have usually prospered as a result. Private ports are a rarity. Felixstowe booms because it is tightly managed and competing with public ports burdened with painful labour obligations. Hong Kong thrives because there is plenty of cargo and money plus a pleasantly passive government. In Africa newly independent socialist governments own most enterprises, and ports are no exception. The same is true of the older established Spanish speaking ports of Latin America.

The World Bank offers an interesting historical comment on Castillian ports. They note that in Medieval times British kings began to rely on landed gentry and merchants, even giving them power in Parliament. After a long struggle, Parliament in the late seventeenth century, acheived victory over the king, and individuals were free to form enterprises with few political restrictions. This set the stage for the Industrial Revolution and its flow to British colonized North America, even to Hong Kong and Singapore.

> " In Spain however, the Castillian kings were able to resist demands - expressed through the Cortes - for a better deal for commerce. This was partly because the kings continued to benefit from the riches offered by their colonies in the New World. In turn the demands of this large overseas empire led to the development of a vast centralized bureaucracy to administer it.
>
> According to one authority (Parry 1966), these

different paths of historical development go far to explain the evolution of a set of economic rights compatible with efficient markets in British colonized North America and Spain's legacy to Latin America of a tradition of bureaucratic centralization". (4.)

The point is important because a post war orgy of technical change, intermodalism and cut throat competition has left Latin American people with completely inferior maritime systems. Perhaps for different reasons the same must be said about India and most of Africa.

REVOLUTION AND DEPRESSION

In the last fifty years the shipping business has changed violently. Adding to the confusion has been a series of depressions caused by too many ships and shipyards.

Before World War II a standard freighter carried ores, oil and general cargo, and spent two thirds of her time in port. The first upheaval came with specialized tankers for oil and bulk carriers. These grew in size to the limits of the ports they serve and form with their ports a mainly private free enterprise system. Together with the four Asian "Tigers" (Singapore,Taiwan,So.Korea and Hong Kong) the rich OECD nations own or control most bulk carriers and tankers.

In the 1950s containerships appeared, and now along with their terminals and intermodal connections form capital intensive systems that grow more efficient every day. These serve East/West routes, concentrating on superports such as Rotterdam, New York, Los Angeles, Kobe, Kaioshung, Singapore and Hong Kong. Ships in main line rich country trades have daily costs at sea of a half cent per ton mile. Their terminals handle containers for two hundred dollars each.

By contrast ships in North/South third world trades (Europe/Africa and USA/Latin America) need one to three cents a ton mile, and ports cost four hundred dollars per box move. Even higher costs prevail in trades between Third World countries. Rich OECD plus Asian "Tiger" systems are mainly private while the rest tend to be government owned. Thus the pressure for privatization is in Latin America, Africa and India.

The costs and political powers of organized labour have been central in the growing gap between rich and poor country systems. In Brazil, for example ships and ports are overmanned and labour unions politically powerful. OECD systems avoid expensive ship labour by flying " Flags of Convenience " (Liberia, Cyprus et al.) A standard Panmax (Panama Canal maximum, 60,000dwt) tanker or bulk carrier has crew costs of a half million dollars a year. There may

be a few Norwegian or German officers, but the crew will be mostly from Pacific Islands, Asia, Poland or perhaps China. Highly automated Hapag Containerships carry only twelve multi skill people. Lloyd Brasiliero and the Shipping Corp. of India cannot play that game because their SOEs are politically committed to larger crews. The new Sealand terminal in Rotterdam will have a few highly paid crane operators, but practically every container move will be automated. Most Third World ports have strong waterfront unions, too many people and managers who only survive by nursing the status quo.

In Canada, the USA, the UK and Europe job losses due to the container revolution spawned a variety of redundancy and early retirement deals. The Dock Labour Scheme in England and the US North Atlantic ILA assesment plan are examples. In some cases these have completed their job, but still hang like millstones around the necks of big public ports. This situation has spawned private non (or different) union terminals throughout the USA South Atlantic and in such unlikely places as Pennsauken, New Jersey. An amusing variation on this theme may be seen in the tiny muddy port of Las Minas, a few miles north east of Panamma's Cristobal. There roll on vessels from the USA quietly load and discharge with almost no interference from unions or the National Port Authority. Similar ro ro beacheads have sprung up throughout the Arab world, Africa and Latin America. They are a form of ad hoc temporary privatization that helps to avoid established monopolies.

Since the early seventies there has been a series of shipping slumps with too many ships chasing scarce cargos. A root cause has the rise of low cost Asian yards, first in Japan, later in South Korea, and now in China. Some of these offered attractive financial packages that called for little or no ship owner money. Demand for shipping was unexpectedly reduced by the reopening of the Suez Canal, pipelines from Arab oil wells to the Mediterranean, and a slowdown in the flow of major bulks such as iron ore. Severe competition has produced greater efficiency. Crews are smaller and not from rich countries. Low speed diesel engines are super efficient, professional managers are skilled penny pinchers, and weak owners are bankrupt. Everything is automated and computerized. This is a climate in which well financed OECD cargo and shipowners survive. In contrast government owned third world lines have been able to ignore events under the cover of their subsidies and protection.

THE PUBLIC INTEREST - SHIPS

Public ownership, subsidies and protection are promoted by maritime lobbies worldwide for three reasons; defence, balance of payments, and national pride.

The third is valid. In defence merchant ships fought in World War I and carried troops in WW II. Since then technology has forced shipping and the military apart. To make money tankers and bulk carriers must be big and slow, say 16 knots. The military has little use for bulkers. Its tankers need to be small and fast enough to to stay with the fleet,- at least 20 knots. Big containerships are a problem in logistic support. About half of military hardware items, tanks, guns and missles wont fit into containers. Again the military needs small fast ships, preferably with ro ro capability. Merchant marines were once a training ground for navies, but the profitable ships of tomorrow will carry small crews, about 15 per ship. In the event of war these will be needed where they are. Once admirals were considered good shipping executives. The skills that keep a shipping president employed in the modern jungle are far removed from a Navy background.

Maritime lobbyists like to argue that absolutely all of freight payments benefit home flag accounts.This could be true for a nation that has competitive shipyards, skilled management, and spare cash to invest, - Taiwan for example. For the average African or Latin American shipping SOE less than twenty percent accrues to the home account. Stevedoring and port costs are constant regardless of flag, paid wherever a ship calls. These for general cargo are close to half of gross costs. A typical Liberian flag ship (30,000 dwt) has about the following operating costs in a year (1989).

Table I

Finance	$ 1,476,000
Crew	500,000
Fuel	1,200,000
Stores	110,000
Maintenance	130,000
Insurance	120,000
Overhead	35,000
Taxes	10,000
Total	3,581,000 (5.)

If this ship competes without subsidy or protection, she will be built in the best and cheapest yard, Japan or South Korea. Fuel is purchased where cheapest and most convenient. Most OECD tanker and bulk carrier owners hire professional managers who may be in Hong Kong, Singapore, London or Greenwich, Conn. Crew wages are the only substantial item gained by the home account. If profits are earned,

these would be plus entries in balance of payment books. However, by commercial accounting standards it would be difficult to find a Third World SOE that is profitable. The World Bank in their 1988 World Development Report (6.) touches on the many ways in which the books can of arranged. Subsidies are called revenues, ship values are juggled, inter agency transfers are not recorded, interest rates are not commercial etc. etc. In shipping it is easier to conceal irregularities than in other SOEs. This is true because so many disbursements are through overseas agents whose books are not auduted.

Sea transport consumes such a high percentage of bulk cargo values that honest open market conditions tend to prevail. However, for general cargo gains with home flag SOEs are counterbalanced by greater losses. This is true because most government ship lines avoid open market competition in a variety of ways and thus force their citizen exporters and importers to pay high freight rates for poor services. Since privately owned outsiders (American and European shipowners) carry a share at these high rates, they are the winners. Among the most popular devices for avoiding competition are;

1. Bilateral 50-50 cargo sharing treaties
   (USA and most Latin American countries, also China)
2. Strict enforcement of the UNCTAD 40-40-20 Code
   (Most of Africa/Europe trade
3. Banning of non conference line outsiders
   (Popular in Latin America)
4. Pools and consortia excluding non members
5. Prohibitions against transhipment
6. Favorible port and tax treatment

A 1987 study analysed and documented this situation, and the following are samples of its conclusions.

Table II

COUNTRY	Shipping Bal. Payt. GAINS	Percentage cargo Carried by outsiders	Resulting LOSSES
Argentina	$ 34 million	50 %	$ 98 mill.
Brazil	50	55	371
India	72	58	309
Indonesia	40	78	362
Pakistan	17	85	186

All figures in 1979 USA dollars

The point made here is not original. Studies by the U.S. Congress Budget Office (1984) and by a Task Force of Transport Canada (1985) reach the same conclusion. The latter included in its managing board presidents of four leading Canadian shipping companies.

THE PUBLIC INTEREST - PORTS

Ports depend upon public moneys, part of the gas tax in Louisiana (USA) land grants, police protection, tax exempt bonds almost everywhere, money grants, cheap loans also revenues from tunnels and bridges. From national governments they usually get free or cut price dredging, Coast Guard protection, lights and buoys. To persuade the public they do " Impact " studies. Lately these have come under fire, even from impartial Commissioners in the ports themselves.

The traditional port impact study is now suspect because port cities no longer enjoy the jobs that ship calls used to generate. New York lines have abandoned Manhattan Island for a dozen scattered New Jersey/New York country suburbs plus Greenwich and Stamford, Conn. The same has happened in London and other port cities. Forwarders shuffle papers and dock receipts in country towns, even on Caribbean islands , where taxes, food, services and labour are cheaper. On the docks traditional longshore gangs are slowly fading. Soon there will be only a few highly paid jobs for expert equipment operators. When warehousing and repacking is needed inland ports have sprung up, for example in Front Royal. Virginia, USA and in Nairobi, Kenya. This is a worldwide trend. Old time commercial waterfronts retreat before condominiums, shops and theatres. These offer more jobs and greater wealth than will docks of the future. Bitter debate over this issue explains the upheavals in port management. Practically every large port in the USA has a new manager.

YEAR 2000

Two hardly noticed changes may set the future course for shipping. First, the industry has become more visible. Ship costs (fuel,food, crew,etc.) are now found in papers and magazines. The same will soon be true for port costs. In developed countries it is no longer easy to hoodwink the customers with yarns about cash flow, subsidies and payment balances. The same will soon be true in developing nations.

Second, nationalities have almost vanished. Not long ago I chartered a Liberian flag ship from a Hong Kong owner whose office was in Bermuda. She had Pakistani officers and a crew from the Gilbert Islands. She was built in Korea, and a Swiss bank held the first mortgage. The deal was done by a London broker, and a New York lawyer vetted the details. The manager was in Singapore, and the cargos did not touch any of the nations or cities mentioned above. This is now normal.

Privately owned and managed ports will not come quickly. It will take a long time for the general taxpaying public to figure out who are the true beneficiaries of port investments. Nations with only one major port have clear

reasons for subsidizing. Perhaps the same could be said for states like New York. In the present era of bitter containership competition few lines can spare capital for dock building. Much depends on cargo flow patterns. In New York virtually all exports and imports originate of terminate within three hundred miles of the big city. The opposite is true for Halifax whose customers are mainly in the Montreal/Toronto/Detroit/Chicago range. However, a port that is efficiently operated by a government is a rarity. Thus, especially in the third world, general cargo and container ports will be leased to or operated by private contractors. This will not necesserily be the perfect cure. Private monopolies can be as evil as public ones. Much will depend on the arrangements and wise supervision.

At sea third world general cargo fleets must get better. The bulk cargo (dry and liquid) fleet is already competitive and largely private. The same is true for the East West OECD rich country containership system. But cargo owners in Africa, Latin America and India pay twice as much as their rich cousins for poor package freight shipping. The United Nations (UNCTAD) keeps track of the difference (S.),and they estimate that shipping to developing nations costs about ten percent of cargo values against five for rich countries. This looks only at freight rates. If full logistic costs (inventory, interest, overhead, insurance, storage etc.) are included, the spread is twenty versus ten.

A certain cure would be to throw third world shipping systems completely open. This however would quickkly bankrupt most home flag lines, public and private. Lines in Australia. New Zealand, Brazil, and the Philippines will prohably be sold to private owners at home. But this will cure only half their problems. These lines have few assets and small value apart from their built in subsidies and protections. In most cases the national interest would be better served if they were closed down. Progress towards good rates and services will be a function of the power and knowledge of the cargo owning customers.

The technological revolution is not over. Just over the horizon (9.) are forty knot catamaran containerships. These could render much of the present fleet obsolete. They could revive lost soul ports such as Portland, Maine, Hueneme , California, and Arica in Chile. Being smaller and with shallow drafts they will upset conventional wisdom about super load center ports such as Rotterdam and Hong Kong. They may with their cheap lateral handling systems make new four million dollar container cranes museum pieces.

Privatization is thus only a part cure for what ails the maritime industry. Ports will continue to get and need capital funding. But they are best operated privately. Ships are bad ship managers. But a private shipowner with subsidy

and protection is still insulated from the real world. Competition is what the customers need.

END NOTES

1. World Development Report, World Bank 1988, page 171

2. Re New Zealand, Journal of Commerce 13/1/89
Re Lloyd Brasiliero, Seatrade Week 11/3/88
Re Peru, Journal of Commerce 25/3/88
Others from various 1988/89 issues of the International Transport Journal published in Basle, Switzerland

3. Prof. Mary R. Brooks of Dalhousie University, Halifax provides background in her 1985 CTRF paper which draws upon her book entitled " Fleet Development and Control of Shipping in Southeast Asia". Inst. of Southeast Asian Studies, Heng Mui Keng Terrace, Pasir Panjang, Singapore 0511

4. World Development Report 1987,World Bank,page 61, Box 4.2

5. "A Ships Flag, Who Cares, paper for the McGill Law School published in Fairplay, by the author

6. As in 4. above the Bank discusses the various ways in which SOEs avoid auditing supevision, for example by "ghost" employees who are paid but never show up for work.

7. "Shipping Protectionism in 1990", a paper by the author for the 1986 Seattle convention of the TRF based on CBO, Canadian Task Force and World Bank studies.

8. United Nations UNCTAD Reveiw of Maritime Transport. Every year UNCTAD puts out an excellent report that stresses the difference between shipping rates enjoyed by developed and developing nations.

9. "Containerships of 1999" a report prepared by the author for the Permanent International Navigation Congress at their 1988 Baltimore meeting, later published in Maritime Policy and Management, UMIST, Taylor & Francis

ADDENDUM TO ABSTRACT ON MARITIME PRIVATIZATION

PRIVATIZATION ISSUES

This section focuses on issues related to implementing privatization in the maritime industry. Using the experience with privatization in shipping and ports as a point of departure, it then focuses on factors which influence the course of privatization efforts.

SHIPPING

As the preceding sections have pointed out, governments got into the business of shipping to serve the public interest in an area of vital importance to the economic well being and security of a country. Most governments now realize that these reasons by and large no long apply and that continued government involvement is proving costly both to the public treasury and to the country's importing and exporting sectors.

There is really little intrinsic reason why shipping should be in the hands of the government in the first place, given that it is basically a commercial activity and that the public interest could have been protected through means other than government ownership of the vessels themselves. This makes the rationale for privatization more compelling. However, governments, having entered the industry as owners, have created powerful vested interests and other forces which resist privatization.

Some governments have been successful in privatizing at least some of their holdings in shipping. Examples include Great Britain and

Malaysia. In both cases, the sale resulted in profitable private operations, as well as income to the government treasury. However, in many other cases, even willing governments face difficulties in privatizing their commerical fleets. Because of the worldwide glut of shipping capacity, buyers are few and offer little or require special protection or privileges. This situation is likely to deteriorate as aging vessels become more and more obsolete and governments lack the resources to renovate or replace them. Despite this gloomy assessment, governments are not without options if they sincerely want to ease their predicament. Our experience has shown that it is possible to minimize the financial drain by contracting out the management of shipping operations or entering into long-term leasing agreements perhaps with an option to buy. Such options can result in substantial reductions of elimination of subsidies and in some cases or might generate funds for sorely needed renovations, thus making the prospect of a future sale more attractive. These arrangements could give government some relief from the dilemma between maintaining some national presence in their seagoing trade (at great costs to their economies) or relinquishing it to foreign concerns.

A case of particular interest is marine transport service to remote islands or coastal areas. Governments have sought to maintain a certain minimum level of service to such areas by running state-owned vessels. They have justified their intervention on the premise that such service cannot be run on a profitable basis and they are often correct. Examples are Alaska's Marine Highway, and marine transport in the western Scottish islands. However, even in these cases the government could put up the service for tender, specifying the minimum service level required and selecting the bid which requires the least subsidy.

Dealing with maritime unions has been one of the thornier issues inhibiting privatization. Successful examples of privatization show that it is possible to deal with this problem through negotiation and limited short-term concessions. Not enough use has been made in shipping privatizations of employee ownership schemes which have been successful in other industries. Although some might dismiss this option as difficult to implement because of the nature of employment in the shipping industry, there are undoubtedly circumstances under which it could be successful.

Finally, government sensitivity relating to the need to use ships in time of war, to the extent that such concern is justified by today's wartime requirements, can be dealt with through "golden" shares or through legislation, giving the government the right to determine the ships' uses under certain conditions.

In general, privatization of shipping is a viable and even necessary option for ship-owning governments hard pressed by economic realities. There is a form of privatization which can address virtually all concerns of governments and maritime interests, provided that it is flexibly applied to deal with the particular circumstances of a nation. Although such solutions would in all probability not solve all the problems of a nation's shipping industry, the government could substantially ease some of them, especially those related to the adverse financial performance of state-owned shipping operations.

PORTS

Unlike shipping, ports have traditionally been controlled by governments, whether at the national, provincial or municipal level. This is because ports exhibit many of the characteristics of "national monopolies", i.e., a single, relatively indivisible source of benefits whose distribution may not be made

in accordance with the public interest unless the government intervenes. However, while government intervention has historically been equated with government ownership this does not have to be necessarily so. Private ports have existed for some time and private operation (as opposed to ownership) is an increasingly attractive form of privatization for ports.

As with shipping, the government has been an inefficient operator of ports, with the same adverse financial repercussions. Although, there have been several successful port sales to the private sector (an example is the recently privatized Association of British Ports which owns 19 port facilities), divestiture in the case of ports is not expected to be the privatization method of choice in the near future because of their natural monopoly characteristics and other problems, including land ownership rights, strong unions and increased competition by private terminals, inland terminals, the need for capital improvements, etc. which will affect sale values. However, control is more important than ownership and most of the benefits of private ownership can be gained by means of management contracts and leases. Here, as well as in the case of private ports, the role of the government can be limited to setting the rules, thus avoiding the pitfalls of inefficient management which characterizes government-run operations, and maximizing financial returns.

Union resistance can be dealt with, as in the case of shipping, through negotiated short-term concessions and employee ownership schemes, the latter being more easily implementable in the case of ports than shipping.

If privatization of existing ports is difficult, there is a reasonable expectation that the private sector will play a far more important role in ownership and/or

operation of future port facilities. Because of the magnitude of the capital investment which will be required, financially-strapped governments can be expected to increasingly turn to the private sector for both capital and management expertise. This is a far easier task than privatizing a facility which has been owned by the government for some time. In addition to avoiding financially adverse patterns and practices, these new facilities are likely to encounter less union resistance since such resistance is usually engendered by the prospect of losing privileges already enjoyed. An example of this type of development is the new port facilities on the Eastern seaboard of Thailand which the government is developing in partnership with the private sector. This is likely to be the pattern of the near future in port ownership and operation.

ESTABLISHMENT OF AIRPORT AUTHORITIES IN CANADA

Ron Gilbertson
Regional Airports Task Force Association

On April 9, 1987 Transport Minister John Crosbie announced a new policy which would allow the federal government to transfer management responsibility for Transport Canada airports to local, regional or provincial authorities. In making this announcement the Minister stated that the primary objective of the policy was to "make airports serve local community interests better and to allow our national airport system to operate in a more cost efficient and commercial manner".[1]

This policy announcement heralded what could represent a fundamental restructuring of the Canadian airport system. Under the terms of the policy all communities in Canada would be welcome to submit proposals to the federal government for the transfer of local airports, with those proposals ranging from a lease arrangement to a complete transfer of ownership. Although the federal government would retain its responsibility for regulating airports and ensuring that all airports are operated in a safe and secure manner, the responsibility for the day to day operation and the long term development of airports would be effectively transferred to the local community.

The announcement of the new airport management policy generated significant interest across Canada in the concept of airport authorities. By the latter part of 1988 proposals for the lease or purchase of local Transport Canada airports had been received from interested parties in at least four cities, including Calgary, Edmonton, Montreal and Vancouver. In addition, a number of other communities of different sizes had announced their intention to further investigate the concept and possibly proceed with a proposal.

The decision by the federal government to transfer the management of airports to local authorities, and the apparent willingness on the part of communities to accept this responsibility, raises the question of why communities would want to manage and operate airports. The communities' willingness to assume this responsibility is interesting given the fact that a majority of these airports have historically operated at a deficit. The positive response to the policy is even more intriguing considering the fact that over the last two decades at least two major airports in Canada were transferred to the federal government by communities no longer interested in or willing to operate those facilities.

---

[1] "New Management for Canadian Airports", Transport Canada Information, April 9, 1987, No. 61/87

To address the question of why communities would be willing to assume management responsibility for local airports, the following paper examines what are viewed as the benefits associated with the establishment of local airport authorities. In order to provide an understanding of the authority model, and how it is structured and operates, the paper begins with a brief overview of the concept of an airport authority. In considering the benefits of local airport management the paper also draws on the specific experience of the Edmonton region. Edmonton offers a unique viewpoint since the City of Edmonton owns and operates the only major airport in Canada which is not managed by Transport Canada, and as a region Edmonton was amongst the first in Canada to propose the formation of a local airports authority.

THE AIRPORT AUTHORITY MODEL

The airport authority is a management and organizational concept which has been successfully implemented in the United States and other countries around the world. The concept, particularly as it has been adopted in the United States, is characterized by the local ownership and management of the airport system. The airport authority model offers local control of the planning, development and operation of airports, and it is viewed as enhancing the use of airports as a tool for promoting local and regional economic growth.

Although the airport authority "model" has been widely implemented, it is important to recognize that this is a generic model only and that individual airport authorities tend to reflect the local political, business and community environment. Important differences have been noted between authorities in terms of the scope of their mandate, the structure and composition of the Board of Directors, the rights and responsibilities conferred upon the authority, and their financial structure.

Role of the Airport Authority

Airport authorities are generally viewed as fulfilling a dual role within the community. Typically, authorities have two primary objectives:

- **Airport Management and Operations:** the authority is responsible for managing and operating the local airport system in a safe and efficient manner, and on a financially self-supporting and independent basis.

- **Economic Development:** by promoting the growth and development of the airline, aviation and aerospace industries, the authority also promotes general economic growth throughout the community.

In order to achieve these objectives authorities tend to have a strong commercial orientation, with an emphasis placed on the efficient operation of facilities and the maximization of the revenue potential of the airports.

Legal Status

Under the authority concept ownership of the local airport system is vested in the community through what is commonly referred to as a public corporation. In the United States authorities are established through state legislation, while in Canada it is expected that provincial governments will pass the required enabling legislation.

One of the unique features of the authority model is that airport authorities are normally established as financially independent and self-supporting bodies. Typically authorities have no shareholders, or any other organization or individual with a direct financial interest in the authority. Although outside bodies such as business organizations and local and state governments may have the right to appoint members to the authority Board of Directors, these bodies have no ownership interest in the authority - they have no call on the revenues or assets of the authority, nor do they have any responsibility for its debts or liabilities.

Authority Structure

The typical airport authority is comprised of two principal components: a Board of Directors and a professional staff organization. The Board of Directors is responsible for establishing the overall goals, objectives and policies of the authority, while the staff organization is responsible for organizing and managing the operations of the authority and its airports.

The composition of the Board of Directors is generally dictated by the enabling legislation. The legislation normally specifies the number of directors, their terms, remuneration, and even in some instances the qualifications of directors. The legislation also specifies the different governments and organizations which have the right to appoint members to the Board, with the distribution of members reflecting the local political environment and the scope of the authority. In addition to its responsibilities in establishing authority objectives and overall policies, generally the Board of Directors is also responsible for approving capital programs, annual budgets, the acquisition and disposal of property, and airport master plans.

The day to day operations of the authority are typically carried out by a permanent staff organization headed by a General Manager or Executive Director. Staff organization varies by authority, although divisions are normally established for each of the major functional areas such as planning and engineering, operations, administration and legal affairs. The management structures are generally quite lean and often make use of contract services for specialist expertise or for periods of peak activity.

Financial Structure

The enabling legislation typically establishes airport authorities as independent financial entities with the power to enter into contracts, issue debentures, sue and be sued, and in some instances, even levy taxes. The capital requirements of

authorities are normally funded through the issue of debentures which may or may not be funded by airlines serving authority airports, as well as by capital assistance programs which may be available from different levels of government.

Operating revenues and expenditures at authority airports generally mirror those of other airports, although a number of authorities have developed an excellent reputation for their ability to generate revenues from new and innovative sources. The management flexibility inherent in the airport authority concept is viewed as playing an important role in enabling authorities to maximize the revenue potential from traditional sources, while also allowing for the development of new sources of revenue. On the cost side, the lean administrative and management structure of airport authorities has been an important factor in reducing the overall cost of airport operations.

BENEFITS OF THE AIRPORT AUTHORITY

Although the airport authority model has been widely implemented and has a number of attractive features, there still remains the question of why Canadian communities would wish to alter the status quo and assume responsibility for the management of their local airports. This is particularly true when one considers the fact that Canada is widely recognized as having a well developed national system of airports.

The impetus to re-examine the management of airports in Canada to a large extent originated from within Transport Canada itself. During the latter part of the 1970's Transport Canada established an internal task force to examine problems and issues which faced the national airports system. The task force reviewed the current management structure within Transport Canada, as well as management approaches which had been adopted in other countries around the world. Based on its investigations, the task force concluded that the concept of an independent airport authority was one which offered excellent potential for improving the effectiveness and efficiency of airport management. The airport authority was also considered to be one of the best options for maximizing the contribution which airports make to the local economy.

Responsiveness and Flexibility

One of the most important benefits of the airport authority concept is the improvement which is expected to result in the responsiveness and flexibility of airport management.

At the present time the Canadian air transportation system is faced with an important anomaly. In recent years the federal government has instituted a number of reforms which have largely deregulated airlines and introduced competition into what used to be a highly regulated industry. While the airline industry has experienced rather dramatic changes, the way in which Canada manages its national system of airports has remained largely unaltered. In the opinion of some, the current system of airport management is better suited to the

time when airlines and aviation in Canada were highly regulated than it is to the present deregulated environment.

The deregulation of airlines and the increase in competition have had a significant impact on the airline industry and the demands which it places on the airports system. Compared to a decade earlier, airlines in Canada have become more dynamic and more responsive to changes in market conditions and competition. In contrast to the lengthy approval process which was required during the era of regulation, decisions to enter and withdraw from markets, to alter capacity, and to offer new services are now made by airlines in a matter of weeks and months. If the airline industry is to effectively compete in this new environment, it is essential that airports also be able to react quickly to the continually changing needs of airlines and other airport users. It is important to appreciate that airports and the services which they provide are a critical component of the air transportation system, and that the airline and aviation industries simply cannot afford to be held back by an airport system which does not adequately respond to their needs.

One area where Transport Canada has been subject to criticism is in its ability to respond effectively to the requirements of airport users. Although important improvements have been made within the airports administration in recent years, the management of airports in Canada is still highly centralized and in many ways bureaucratic in nature. Furthermore, in spite of the efforts to increase the commercial orientation of the airports system, it must be recognized that Transport Canada remains a department of the federal government and is subject to the wide range of constraints which governments face. Transferring the responsibility for airport management from Transport Canada to local airport authorities is expected to address many of the specific criticisms which are now directed at the management of airports in Canada.

One of the most important advantages of an airports authority is its ability to respond quickly to changing market conditions and industry requirements. The compact organizational structure of the typical authority reduces the number of levels of management which must participate in decisions. As a result, even major policy or capital investment decisions can be dealt with by the authority within a relatively short period of time. This is an area where Transport Canada has been subject to a substantial amount of criticism. Because of the number of different levels at which decisions must be reviewed or approved, the planning, approval and development of capital projects can easily extend anywhere from 3 to 5 years under the current system. This type of development timeframe is often not acceptable to an airline industry which must respond much more quickly to changing demands and competitive pressures.

A second advantage of the airports authority concept is that it allows airport management to respond flexibly to local conditions and local requirements. While the operation of a national system of airports may offer certain advantages, it also places constraints on the ability of management to respond to unique local requirements. A policy which works well in Quebec City and Saskatoon, may not be appropriate in Victoria or in Yellowknife. Furthermore, while there may be a certain attraction to establishing national standards for the size and construction

of terminal buildings, these standards restrict the ability of a community to decide for itself what types of facilities and what types of services it desires. In some instances a community may decide to improve the service over what the national standard may allow, recognizing full well that they may impose additional costs of the travelling public (most of whom are its citizens). Under the present system of airport management, this is normally not possible - to paraphrase Henry Ford, a community can have any kind of airport it wants as long as it is the same as everyone else's.

A third important feature of the airport authority model is that it allows priorities to be determined on a local rather than national basis. There have been numerous examples in the past where airports have required an upgrading of facilities or an expansion of capacity, but have encountered delays because there were other national priorities which took precedence at that point in time. The airports in Edmonton and Calgary faced serious capacity shortages during the late 1970's, yet additional capacity could not be added because of previous commitments by the government to other regions in the country, or because of other projects were considered to have a higher priority. Under the authority model, if local airport management can satisfy itself and its financiers that there is a requirement for a capital improvement and that the project is financially viable, it can normally proceed with the project.

Greater Commercial Orientation

As noted earlier, one of the features commonly associated with the airport authority model is the strong commercial orientation which it brings to the management and operation of airports. Airport authorities tend to be operated in accordance with sound business principles and on a financially self-supporting basis.

It is difficult to make any definitive statement on the commercial success of airports operated in Canada by the federal government because of the wide variation in the size and type of airport, and because of the number of other factors which can have an important influence on financial performance. However, examining the annual financial statements for the nine largest airports in the Transport Canada system (referred to as the Self-Supporting Airports and Associated Ground Services Revolving Fund) provides some useful insights into the commercial viability of airports in the Canada. In fiscal year 1987/88 the nine Revolving Fund airports had total revenues of $343.1 million and expenses of $431.3 million, resulting in a loss from operations of $88.2 million.[2] These airports are by definition those which achieve the highest degree of financial self-sufficiency of the airports operated by Transport Canada, and yet on a fully allocated cost basis these airports were only able to recover approximately 80%

[2]Transport Canada, Airports Authority Group: "Self-Supporting Airports and Associated Ground Services Revolving Fund Financial Statements for the Year Ended March 31, 1988"

of their costs through direct airport revenues. Most other airports in Canada recovered an even smaller proportion of their costs through airport revenues.

Recognizing that most airports in Canada are not operated on a financially self-supporting basis, the issue to be addressed is whether airport authorities would be able to improve on the financial performance of airports presently operated by Transport Canada. Three areas which have a direct impact on financial performance are the efficiency of airport operations, the level of airport operating and capital costs, and the revenue generation capabilities of airports.

Beginning with the question of efficiency, a comparison of Transport Canada airports with those in other countries indicates that Canadian airports are reasonably efficient. Although direct comparisons are difficult because of differing operating procedures, climates and labour environments, it appears that at the site level the efficiency of Transport Canada airports is on a par with comparable airports elsewhere in the world. However, one area in which improvements do appear possible is in the size of the regional and headquarters bureaucracies. One of the direct results of having a multi-tiered decision making-process is that additional management and administrative staff are required at each level of the bureaucracy. While this type of management organization may improve political accountability and enhance the development of national programs and standards, it also increases the number of people required to administer the system.

Similar to the comments on efficiency, it appears that airports in Canada have direct operating costs which are generally comparable to those of airports in other countries. Relative to the airport authorities, however, Transport Canada airports do appear to incur certain costs which are a direct result of being part of a large national system. Although Transport Canada has in recent years been successful in significantly reducing the cost of regional and headquarters overheads, there still appears to be the potential for further savings.[3] In the case of Edmonton, it is estimated that the overhead costs of a regional airports authority would be roughly half the cost presently allocated to Edmonton airports by Transport Canada - the result would be a yearly cost saving of approximately $1 million, and a reduction in total operating costs of over 5% annually.

The identification of new sources of revenue, and increases in overall airport revenues, is the area in which an airports authority could have possibly the greatest impact in improving the financial performance of airports. One criticism which has been directed at Transport Canada in the past is that the department has been slow to capitalize on the revenue generating potential of its airports. There are examples around the world of innovative types of retail, commercial and industrial activity which have been attracted to airports and which have made an important contribution to the airports' revenue base. For example, many European airports have developed large scale retail operations designed to cater

[3]For Revolving Fund airports regional and headquarters overheads expressed as a percentage of total airport costs declined from 12.5% in fiscal year 1985/86 to 7.2% in fiscal year 1987/88.

European airports have developed large scale retail operations designed to cater to the needs of the travelling public. In the United States, a number of airports have promoted the development of the aerospace sector with the result being both a direct increase in revenues to the airport, and important spin-off benefits to other businesses located on the airport and to the local economy.

From the revenue standpoint it must also be recognized that in many instances the present schedule of airport rates and charges simply does not reflect the true cost of the service being provided. Airport authorities may well be required to rationalize airport revenue structures in order to more closely align the cost or the value of the service being provided, with the rate being charged to the airport user. While such a rate rationalization may result in the increase or reduction in certain charges to airport users, over the long term it will also lead to a more rational and equitable allocation of what is becoming an ever more scare commodity, namely airport capacity.

Improved Economic Development Potential

Directly related to the issue of increased airport revenues is what is considered by many communities to be the most important benefit of the airport authority model and that is the improved economic development potential of airports. With air transportation becoming an increasingly important element in world trade and industry, airports can play a vital role in stimulating economic growth within a community or region.

In announcing the policy for the transfer of federal government airports to local authorities, the Minister of Transport drew special attention to the increased contribution which airports could make to local economic development. The federal government is not renowned as an aggressive marketer, and generally it is believed that the government has not fully exploited the economic development potential of the airport system. There are a number of reasons this. First, as a government department Transport Canada's primary mandate has been to manage and operate the airport system. It is only recently that the department has had the incentive or the capability to actively promote commercial and business opportunities at its airports. Secondly, Transport Canada owns and manages virtually every major airport in Canada - in any effort to aggressively market individual airports, the department is effectively competing only with itself. A third reason for an apparent reluctance to aggressively market individual airports is that in doing so, the federal government would expose itself to criticism that it is showing preferential treatment for one community over another.

The experience in other countries has shown that the aggressive marketing of airports can make an important difference, both to the airport itself and to economic development within the community. In the United States a number of cities have successfully encouraged the development of airline hubs at their airports. Airports in cities such as Nashville, Dayton, Baltimore-Washington and Charlotte provide excellent examples of the impact which aggressive marketing can have on the development of an airport, and the beneficial impact which improved airline service can have on the economy. In Europe airports such as Schipol and

Frankfurt have been very successful in establishing themselves as gateway and connecting airports. The result has been a significant improvement in airline service to those points, and benefits which have extended to a number of different sectors of the economy.

It is important to appreciate that benefits of the authority concept are not restricted to the airline industry. Most airport authorities have a strong commitment to the continued growth of the general aviation and aerospace industries, and have established policies to encourage growth in those sectors. Many airports have an abundant supply of land which is ideally suited to the requirements of the aviation and aerospace industries and to firms dependent on air transportation.

Edmonton's Unique Situation

As the airport authority is largely a function of the local political, business and community environment, it can frequently be adapted to meet the special needs of the community. In the case of Edmonton, the airport authority is viewed as offering a solution to some unique problems and challenges faced by the Edmonton region.

The City of Edmonton and neighbouring municipalities are presently served by five major civil and military airports, each of which is managed by a different level or arm of government. The Edmonton International and Villeneuve Airports are both owned and operated by Transport Canada, with the International Airport reporting directly to national headquarters in Ottawa and Villeneuve Airport reporting to regional headquarters in Edmonton. Management responsibility for the three remaining airports is distributed amongst the three different levels of government: the Edmonton Municipal Airport is owned and operated by the City of Edmonton, the Cooking Lake Airport is the responsibility of the Province of Alberta, and CFB Namao is operated by the Department of National Defense. Under the proposal put forward by the Edmonton region, the four civil airports would be brought together under the management of a regional airports authority while CFB Namao would continue to be operated independently by the Department of National Defense.

Combining the four civil airports under one administration could significantly improve the present situation in Edmonton. With a single administration much of the confusion regarding the ownership and management of airports in the Edmonton region would be eliminated. A single authority would manage the local airports system in what it viewed to be the best interests of the overall region. It would establish policies and objectives which would enable the airports to be managed as a single cohesive system, and it would eliminate any duplication or overlap as well as any gaps in the services provided to the users of the airports. These overall system objectives would in turn serve as the basis for establishing the roles and the objectives of the individual airports within the system.

From a marketing standpoint, the establishment of a local airport authority would better enable Edmonton to market its airports as a "system" rather than as four

loosely connected civil airports. This approach to marketing offers important advantages, both to the airports and to the community. The "system" approach places the priority on attracting aviation industry and activity to the region, and avoids the possibility of counter-productive competition between the region's airports. It also allows the marketing effort to focus on the full range of facilities and services offered by the overall system, rather than on just those facilities and services available at one airport.

The formation of an airports authority would also make it possible to achieve certain economies in the management and operation of the local airports system. With the responsibility for four separate airports, the authority would be able to combine specialized functions which would be uneconomic if provided separately for individual airports. These include specialized operating functions such equipment maintenance and maintenance planning, as well as corporate functions such airport planning, finance and systems development.

THE LTL MARKET IN QUEBEC: A SECTORIAL APPROACH

Yvon Bigras
Département d'administration et d'économique
Université du Québec à Trois-Rivières

and

Jacques Roy
Département des sciences administratives
Université du Québec à Montréal

1. INTRODUCTION

The LTL market is very important to the trucking industry in Quebec as it generates roughly half of all motor carriers' revenues in that province. In recent years, this industry's particular environment has become much more competitive with the advent of the Motor Carrier Act of 1980 in the United States and of recent harmonizing legislation in Canada. As a result, the Quebec trucking industry is showing signs of increased concentration in a way similar to what happened south of the border. This is coupled with a price war that is not conducive to the satisfaction of a market which is demanding more effective services. Indeed, we are led to believe that, in a «Just-in-time» and deregulated environment, shippers will expect more reliable and efficient transportation services as part of their new global logistics strategy. This is why it is particularly important today to better understand the shippers' decicion-making process when using LTL motor carriers' services.

When studying the transportation mode and carrier selection process, the traditional approach calls for sending questionnaires to a representative sample of shippers in order to identify and then rank those decision criteria that are deemed important in the decision-making process. However we feel that this approach generally fails to recognize the influence of the particular exogenous and endogenous factors affecting the shipper in its choices. Now these environmental factors may vary significantly according to specific industrial sectors. This is why we have decided to study the LTL carrier selection process in a number of industrial sectors that are relatively important in the Quebec LTL market.

This paper studies the LTL market in Quebec using such a sectorial approach. First, we present an overview of this market and comment on some of the more recent trends that may be observed in the Quebec LTL market. Then we examine the transportation mode and carrier selection process with a global approach. We propose a conceptual framework that illustrates this process and explain the

influence of both exogenous and endogenous factors in the shipper's decision process. Next we introduce the industrial sectors selected in our study and then proceed with a brief analysis that illustrates how the carrier selection process may be influenced differently depending on the particular industrial sector under study. Finally, concluding remarks and further research suggestions are presented.

2. RECENT TRENDS IN THE LTL MARKET

Before looking at this market from a sectorial point of view, it is interesting to follow the recent global evolution of the Quebec LTL market. The Statistics Canada survey on For-hire Trucking will give us the information we need on the intercity (over a distance greater than 24 kilometres) and domestic (from a canadian origin to a canadian destination) shipments. We will use the Statistics Canada definition of a LTL movement, i.e. a shipment of less than 10,000 kg.

The first table shows the importance of this market, considering the shipments originating from Quebec. It shows a small but steady decline of this market in absolute values for the tonnage and the tons-kilometres, a significant drop in the number of shipments, and a progression in revenues explained solely by the progression of the price of this service. For nearly all of those years the rate of variation of these variables is negative, at the exception of the revenue. The last two years show some improvement in the performance of the LTL market, but it is not enough to stop the decline of this segment of the industry. Indeed, if we look at the 1981-1986 period, the revenue generated by this market has dropped from a 55.7% share of the total to a 51.9% share, a significant drop which appears to be steady year after year. The same situation can be found if we look at any of the other three indicators. The drop is more important when we look at the tonnage, where the share of LTL has regressed from 18.2% of the market to 12.2%.

Table 2 draws a parallel between the evolution of the LTL market in Quebec and that in the rest of Canada for the 1981-1986 period. Over this period, in Quebec, the tonnage dropped down 12,9%, the tons-kilometres 8.3%, the shipments 16.9%, and the 23.4% progression of revenues is offset by a 30.1% progression of the price index of trucking services. The data for the rest of Canada show a progression in revenue, tons, and tons-kilometres, but still a decline, although less important, in the relative part of the LTL market if we look at any of the four variables listed. For instance, the share of LTL measured by the tonnage fell from 12.7% in 1981 to 10.7% in 1986.

Finaly, Table 3 confirms this evolution towards heavier shipments as measured by the average weight of shipments originating in Quebec. From a low of 2,957 kilograms in 1981, this average has climbed to a high of 4,499 kilograms in 1985, before a slight drop to 4,352 the next year. For the whole period, this translates into a 47.2% rise. For the rest of Canada, the evolution is quite similar, a 43.0% rise, even though the average weight per shipment is higher.

This evolution of the Quebec LTL market should be of great concern for the industry. The reason for this decline is certainly not unique but it probably reflects some changes in the attitude of shippers who are now more aware than

ever of their transportation opportunities. In this contexte, it is certainly important to have a better understanding of how they purchase road transportation services, especially LTL services.

Table 1

The Quebec LTL For-hire trucking market.
Quebec origin movements
Class I and II

		Rate of variation	% of total For-hire
1981			
Revenue ('000$)	385,677	- - -	55.7
Tons ('000$)	3,578	- - -	18.2
Tons-km ('000$)	1,674,002	- - -	23.5
Shipments	5,990,863	- - -	90.1
1982			
Revenue	404,566	4.9	54.4
Tons	3,126	-12.6	15.3
Tons-km	1,522,074	-9.1	21.9
Shipments	5,529,588	-7.7	88.2
1983			
Revenue	420,240	3.9	55.2
Tons	3,009	-3.7	15.1
Tons-km	1,686,526	10.8	22.2
Shipments	5,082,414	-8.1	88.0
1984			
Revenue	420,478	0.1	53.0
Tons	2,926	-2.8	13.2
Tons-km	1,559,245	-7.5	21.1
Shipments	4,869,379	-4.2	86.0
1985			
Revenue	468,445	11.4	52.8
Tons	3,185	8.9	12.8
Tons-km	1,415,889	-9.2	18.6
Shipments	4,673,690	-4.0	84.4
1986			
Revenue	475,819	1.6	51.9
Tons	3,118	-2.1	12.2
Tons-km	1,535,055	8.4	18.8
Shipments	4,980,147	6.6	84.8

Reference: Statistics Canada, For-hire Trucking Survey

Table 2

Quebec and rest of Canada evolution of the
LTL For-hire trucking market
1981-1986

	Quebec		Rest of Canada	
	Rate of variation	% of total For-hire	Rate of variation	% of total For-hire
1981				
Revenue	- -	55.7	- -	49.9
Tons	- -	18.2	- -	12.7
Tons-km	- -	23.5	- -	21.2
Shipments	- -	90.1	- -	86.7
1986				
Revenue	23.4	51.9	28.5	48.5
Tons	-12.9	12.2	18.5	10.7
Tons-km	-8.3	18.8	6.1	18.0
Shipments	-16.9	84.8	-6.0	82.2

Reference: Statistics Canada, For-hire Trucking Survey

Table 3

Average wheight per shipment
Quebec origin and rest of Canada movements
(kilograms)

	Quebec	Rest of Canada
1981	2,957	3,759
1982	3,255	4,013
1983	3,460	4,588
1984	3,922	5,178
1985	4,499	4,623
1986	4,352	5,374

Reference: Statistics Canada, For-hire Trucking Survey

3. THE TRANSPORTATION MODE AND CARRIER SELECTION PROCESS

During the past fifteen years or so, many studies (La Londe and Zinszer 1976, Stock and Lalonde 1978, McGinnis 1980, Brunning and Lynagh 1984, Chow and Poist 1984) have identified various factors and criteria that are thought to be more or less important to shippers when deciding on a transportation mode, selecting a carrier or appraising their performance. These studies were generally conducted by sending questionnaires to a representative sample of

shippers in a given geographic area. And results almost invariably indicate that «speed and reliability of service» criteria clearly outweigh more economical factors such as tariffs. One important exception however can be found in a recent study conducted for the Council of Logistics Management (La Londe et al. 1988) which reports on the increased importance of price as an element of the marketing mix when comparing the perception of logistics managers in 1976 and 1987.

When discussing this matter with both shippers and motor-carriers, we have found that such results could be misleading because the traditional survey approach does not shed enough light on the particular exogenous and endogenous factors that affect shippers in their decision-making process. For example, we were told that tariffs will become more important during a recession period while service speed and reliability will dominate the carrier selection process when it comes to shipping furniture to the annual fair. It is important therefore to examine the carrier selection process with a more global approach.

Figure 1 provides a simplified illustration of the transportation mode and carrier selection process. Before designing its distribution network, a shipper will have to perceive and properly identify its market needs. Then a corporate decision will be made regarding what products will be manufactured or procured in order to satisfy the segments of the market the shipper wishes to serve. An important element of the shipper's marketing mix, along with product design and characteristics, price and promotion, consists of the level of service offered to the various segments of the market considered. These service levels may vary according to the products life cycle, market share, profitability profile and competitors behavior. As market needs evolve with time, shippers will have to revise and update their product design and service policy decisions which in turn will directly influence the design of their distribution network.

In designing a physical distribution network, the objective is to determine the number, size and location of facilities and to select the transportation modes and frequencies that will achieve the required service levels while maintaining costs at a minimum. These decisions are determining to a large extent the size of the LTL market. For example, a shipper may decide to improve customer service by opening a distribution centre in a given market area. Transportation costs are reduced as small shipments are consolidated into truckloads and service is improved as proximity to the market permits shorter order cycle time.

As long as the total cost of serving this market through a distribution centre including local delivery is less than the total cost of direct LTL shipments, the shipper's decision is economically justified and contributes to a reduction in the overall LTL market. It is therefore important for motor carriers to better understand the shippers distribution network design process when studying their own market. Some carriers have indeed redefined their role and expanded the range of services offered to their customers by performing such functions as warehousing and inventory control on behalf of the shipper.

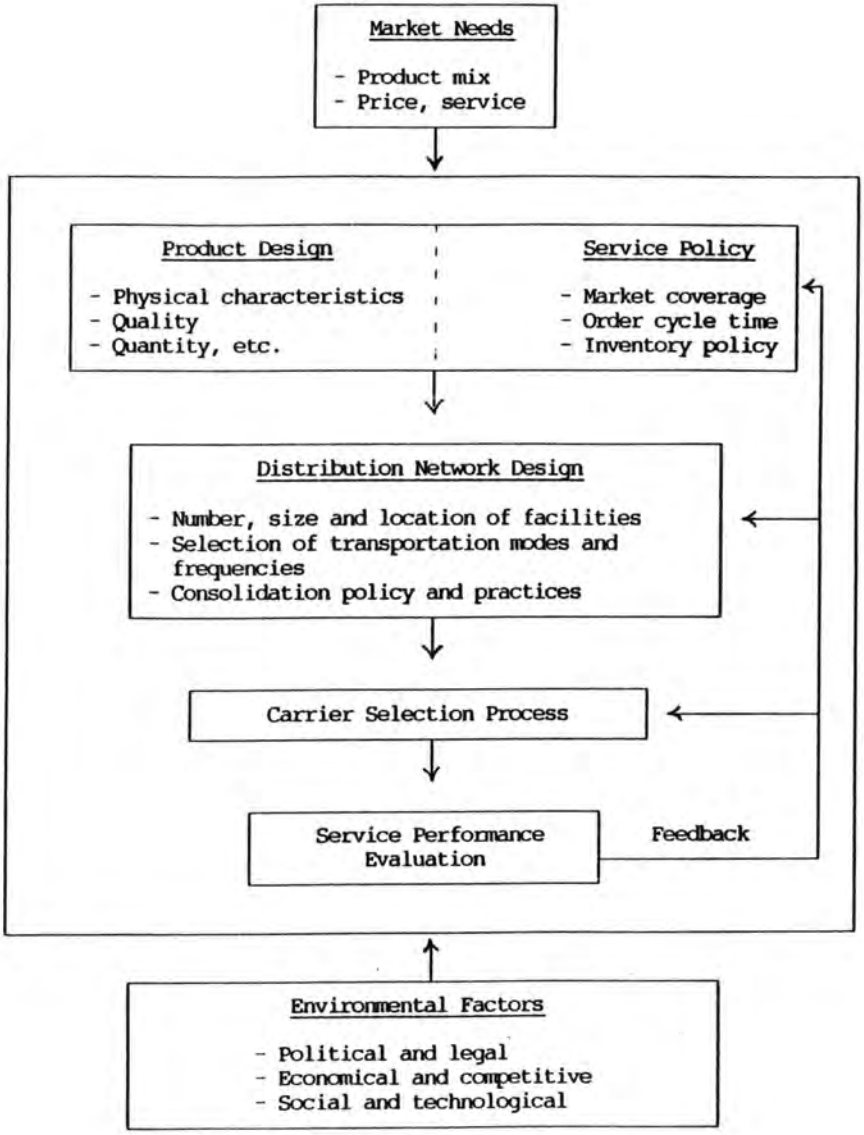


Figure 1: The Transportation Mode and Carrier Selection Process

Returning to Figure 1, we find that in designing its distribution network, the shipper will have made several decisions that will directly affect the carrier selection process. For example, the shipper will have a reasonable idea of the volume of freight to be moved over its network, where consolidation will occur and how frequently shipments will have to be made in order to achieve preset service standards. Necessary cost/service tradeoffs should have already been considered when selecting the required transportation modes and frequencies. Thus, most of the decision criteria used in selecting a carrier and appraising its performance will already be determined when it comes to choosing the most suitable carrier.

As mentioned earlier, several surveys have attempted to establish a ranking among those decision criteria. However, these results may prove to be disappointing to those carriers wishing to gain a better understanding of the LTL market. Indeed, survey results are usually reported without much concern for the shipper's particular environment and industrial sector. These results therefore provide only a limited and sometimes misleading explanation of the shippers decisions process when selecting a transportation mode or a carrier.

Environmental Factors

As illustrated in Figure 1, environmental or exogenous factors clearly influence the transportation mode and carrier selection process. These factors can be broken down into two categories: the general environment and the particular environment. The general environment consists of those exogenous factors that affect the performance of all industrial sectors, namely the political, legal, economical, social and technological factors. The particular environment is made of those factors that influence a specific organization in the industry, e.g. an individual shipper or carrier. Customers, suppliers and competitors are among the most important factors in an organization's particular environment.

Now let us illustrate how some of these exogenous factors can affect the shipper's decision-making process. First, when considering past modifications to the legal or regulatory environment in which both shippers and motor carriers operate, we find that this factor alone can explain much of the changes in shippers attitude as reported in general surveys. Indeed, under a strictly regulated environment (before 1980 in the USA), shippers were not placing much emphasis of the carrier selection and performance evaluation processes. Since tariffs were deregulated, service speed and reliability criteria were deemed more important than price in selecting a carrier. However this was not so much the case in the Province of Quebec where regulations were not as strictly adhered to anyway. Now with the advent of deregulation, two things happened.

First, more emphasis was placed on price negotiations. This is clearly indicated in the survey results obtained by La Londe et al. (1988). They report that price has become more important than service as a decision criteria used by shippers when selecting a carrier. Again, these results could be misleading (or at least surprising) if not accompanied with an explanation as to the nature of changes in the environment.

Second, new opportunities to reduce transportation costs generated more interest on the part of shippers to re-examine their distribution network design including the transportation modes selection process. Recent increases in contract and specialized trucking services indicate that shippers are now possibly more aware of the cost/service tradeoffs to be managed when selecting a transportation mode or a specific carrier service.

Another very important environmental factor is the economical situation. During a recession, shippers will strive at reducing costs by consolidating shipments and placing more emphasis on price as a criteria for selecting carriers. The 1981-82 recession in Canada could possibly explain, in part, the trend towards increased average weight per shipment reported in Table 3 of section 2.

Another economical factor is the abnormally high interest rates that were experienced in 1982. They have generated concern for the cost of keeping large inventories as a means of providing effective customer service. La Londe et al. (1988) report that shippers are now relying more and more on information technology for improved customer service and on efficient transportation services for emplementing Just-in-time practices and thus reducing inventories. But the use of JIT methods is still very limited in North America.

One cannot conclude this section without commenting on the impact of the competitive environment on a shipper's decision-making process. Indeed, a shipper's service policy will be directly influenced, if not conditioned, by its competitive environment. As competition increased, customer service may be used as a differentiation strategy. This is particularly true when product differentiation is minimal and price competition considered to be hazardous to a particular shipper's financial health.

La Londe et al. (1988) provide us with another reason for studying the LTL market with a more comprehensive and global approach. They report significant differences in their survey results according to various industrial sectors, thus emphasizing the need for taking both endogenous and exogenous factors into account when studying a transportation market. Therefore, we have decided to investigate the LTL transportation mode and carrier selection process in a number of industrial sectors chosen for their relative importance with regards to the Quebec and canadian LTL market.

4. SECTORIAL ANALYSIS

The survey

Our choice of the sectors to be analysed was based on their relative importance in the Quebec LTL market. We also considered the diversity of the products, their large spatial dispersion, and the possibility of handling and moving it without specialized equipments. The following five sectors were chosen:

- Motor vehicules engines and parts;
- Textile fabricated materials and clothing;
- Furniture, fixtures and home appliance;

- Foods and food preparations (dry);
- Pharmaceutical products.

Table 4 gives us the importance of those sectors in the Quebec LTL market. They represent 33.3% of the total revenue generated by this market, and 34.4% of the tonnage. Four of them are of comparable importance, the exception being the pharmaceutical products which is significantly smaller. Most of the products of those sectors are final goods, and this implies that they are distributed all over the province. If we were considering only those products which can be handled by general carriers, the importance of these five sectors would be a lot more significant.

Our exploratory approach made us meet a lot of people in the five sectors. We conducted personal interviews in most cases (over 80%), and the rest had given us informations by telephone or by answering to a questionnaire (in the textile and clothing sector). The number of individuals who collaborated to our survey and their functions are given in table 5 for all sectors.

Table 4

Revenue and tonnage of the 5 sectors surveyed
Quebec origin movements, 1984

	Revenue ('000$)	% of Total LTL Revenues	Tons	% of Total LTL Tons
Motor vehicules engines and parts	45,858	7.8	387,195	8.9
Textile fabricated materials and clothing	58,496	10.0	257,277	5.9
Furniture, fixtures and home appliances	44,392	7.6	406,263	9.3
Foods and food preparations	39,905	6.8	446,744	10.2
Pharmaceutical products	6,424	1.1	26,808	0.1

Reference: Statistics Canada, For-hire Trucking Survey.

Table 5

Details on the participants in the survey

	Number	Functions
Motor vehicules engines and parts	13	Distributors, wholesalers, manufacturers (parts and vehicules)
Textile fabricated materials and clothing	16	Individuals in charge of transportation in small to medium size businesses located outside Montreal
Furniture, fixtures and home appliances	40	Manufacturers, retailers, representatives of associations
Foods and food preparations	29	Manufacturers, wholesalers, distributors and associations
Pharmaceutical products	28	Manufacturers, wholesalers, distributors

Motor vehicules engines and parts

The most striking phenomenon in this sector in the last decade is the concentration occuring at every level of the logistic channel. It is particularly true and significant at the intermediate level (distributors and wholesalers), where mergers have taken this sector to an oligopolistic situation. The withdrawal of manufacturers from the distribution activities is also pushing in the same direction. In retailing some concentration was also experienced, but on a smaller scale. The do-it-yourself tendency in the market is one of the causes for this concentration at the final demand level.

This evolution in the structure of the industry has certainly led to a new configuration of the physical distribution network. The channel of distribution is long and almost all the production is now passing through these fewer distributors. The necessity to rationalize transportation costs is probably a major factor in these adjustements. It will result in a tendency for heavier shipments. From the manufacturers to the distributors the demand for LTL services will probably be lessened because of the possibility of shipping larger lots to fewer consignees. From the distributors to retailers, the substitution should be toward more private trucking.

Furniture, fixtures and home appliances

The major problem facing the shippers in this industry is the relative fragility of their products. For this reason the first criteria considered in their decision-making process is the minimization of damage. They also consider that common carriers are not giving an adequate service because the handling of their products

needs special care. Their dissatisfaction with the kind of service they can get from common carriers has led to specific adjustements.

We must first notice an important characteristic of the distribution network in this sector. There is no strong intermediate level between manufacturers and retailers. Contrary to most final demand products, furnitures are usually moved directly from the manufacturer to the retailer. One of the advantages of this system is to eliminate the handling of the product at the intermediate level, thus eliminating possibility of damage. The situation also led the manufacturers to promote their own freight forwarder. Specialized transportation in this sector is also becomming more and more important.

There is finally another way to solve the damage problem. It is possible at the product design stage to construct a product that can easily be carried and stored. Some maufacturers will market semi-finished products that require final assembly by the customers.

Foods and food preparation

In Quebec, the distribution of food products is dominated by four wholesalers who control 92% of the market. Also important is the role played by public warehouses in consolidating shipments originating from various manufacturers. From a motor carriers' perspective, these intermediaries clearly represent the major sources of competition as most of them do provide transportation services to their customers, with their own private fleet. Therefore, it seems like this important segment of the LTL market has escaped the For-hire trucking industry and passed under the control of a few large distributors.

It is interesting to note that this has not been the case everywhere. In France, for instance, some carriers have taken the lead in food distribution by offering warehousing facilities and managing inventories on behalf of their customers. In Quebec a few motor carriers have also specialized in food distribution but their effort represents a small proportion of the market.

Phamaceutical products

Wholesalers using their own private fleet also play an important role in the distribution network of pharmaceutial products. Public transportation modes are used mostly by manufacturers. They select carriers on the basis of speed and reliability of pick-up and delivery. Their shipments are typically small (less than fifty pounds) and sometimes of perishable products that must be delivered very rapidly. It is therefore easy to understand why these shippers will mostly use courier services as they provide both faster and cheaper transportation services than LTL carriers for the size of shipments.

Finally, it could be of interest to motor carriers to know that several shippers in both the Food and Pharmaceutical sectors have insisted on minimizing the number of carriers with whom they do business. In doing so, they want to increase their bargaining power with carriers and reduce congestion at their docks.

Textile fabricated materials and clothing

The situation in this sector is very different from one manufacturer to another. Many are small firms with very few customers to whom they sell a relatively large proportion of their production. In these cases, of course, the physical distribution decisions are very simplified. The environment, outside their major customers, is of limited interest in their decision-making process. They act as sub-contractors for larger firms of buyers and they usually don't have to take decisions at all, or very little, on transportation matters. The buyers impose their own conditions and their own carrier. In those cases, the carrier selection process is non-existent.

5. CONCLUDING REMARKS

This paper has proposed a more global approach to study the transportation mode and carrier selection process used by shippers. The Quebec LTL market was studied using a sectorial approach that sheds more light on the exogeneous and endogenous factors relevant to the shipper's decision-making process. We believe that the use of such an approach has provides us with a better understanding of the market under study. We must admit however that the qualitative nature of this approach may generate concern when it comes to validate conclusions drawn from an exploratory research. We therefore intend to complement our approach with quantitative research methods in order to further explore the evolution of the Quebec LTL market under a more competitive environment.

REFERENCES

Brunning, E.R. and P.M. Lynagh (1984), «Carrier Evaluation in Physical Distribution Management», Journal of Business Logistics, vol. 5, no 2, pp. 31-47.

Chow G. and R.F. Poist (1984), «The Measurement of Quality of Service and the Transportation Purchase Decision», The Logistics and Transportation Review, vol. 20, no 1, pp. 25-44.

La Londe, B.J. and P.A. Zinszer (1976), Customer Service: Meaning and Measurement, The National Councial of Physical Distribution Management, Chicago, Ill.

La Londe, B.J., Cooper, M.C. and T.G. Noordeweir (1988), Customer Service: A Management Perspective, Council of Logistics Management, Oak Brook, Ill.

McGinnis, M.A. (1980), «Shipper Atitudes Toward Freight Transportation Choice: A Factor Analysis Study», International Journal of Physical Distirbution and Materials Management, vol. 10, no 1.

Stock, J.R. and B.J. La Londe (1978), «the Purchasing Approach to Transportation Mode Selection», Journal of Purchasing and Materials Management, Spring.

RELATIONSHIP BETWEEN COSTS AND RATES IN THE LESS-THAN-TRUCKLOAD MARKET

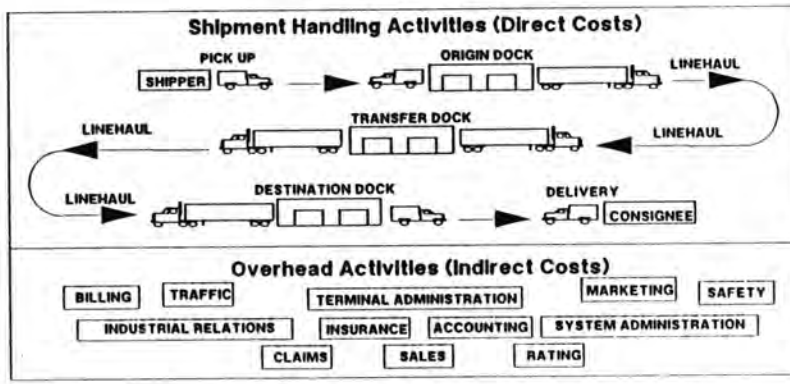
Bill Raney
Goods Distribution Systems Office
Ministry of Transportation, Ontario*

The purpose of this paper is to analyse the costs and rates in the Ontario less-than-truckload (LTL) segment of the for-hire trucking industry, in order to determine whether LTL rates are based on cost factors, market forces or other factors. To complete this analysis, LTL rates are compared to carrier costs for various weights, for various distances, and for various origins and destinations. The paper is organized into four main sections: 1) LTL Carrier Costing; 2) Implications of Costing Model; 3) LTL Rate Structure; 4) LTL Cost/Rate Comparison.

1. LTL CARRIER COSTING

The development of accurate LTL Carrier costing is dependent upon an understanding of the basic activities involved, as shown in Figure I below.

FIGURE I
MAJOR LTL ACTIVITIES



* The views expressed are those of the author and not necessarily those of the Ministry.

In order to analyse the costs associated with the functions shown in Figure I, an LTL costing model was developed using 1988 costs which groups the costs into those areas that carriers typically use to record their costs. The details of the model are best illustrated by referring to Table I below, which shows the costs calculated by the model for moving 23 kgs (50 lbs) and 967 kgs (2000 lbs) shipments from Toronto to Barrie and from Toronto to Thunder Bay.

TABLE I: LTL COSTING MODEL ELEMENTS

	TORONTO TO	BARRIE		THUNDER BAY	
		23 KGS	907 KGS	23 KGS	907 KGS
1.a	PICK UP & DELIVERY COSTS				
	Labour Cost / Hour	$19.37	$19.37	$19.37	$19.37
	Equipment Cost / Hour	$9.85	$9.85	$9.85	$9.85
	Pick-up Handling Time *	0.040	0.246	0.040	0.246
	Pick-up Fixed Time *	0.211	0.489	0.211	0.489
	Delivery Handling Time *	0.051	0.333	0.051	0.333
	Delivery Fixed Time *	0.258	0.555	0.258	0.555
	PICK-UP COSTS +	$7.33	$21.48	$7.33	$21.48
	DELIVERY COSTS +	$9.02	$25.95	$9.02	$25.95
1.b	DOCK COSTS				
	Labour Cost Per Hour	$18.88	$18.88	$18.88	$18.88
	Other Cost Per Hour	$8.42	$8.42	$8.42	$8.42
	Handling Time *	0.107	0.682	0.107	0.682
	ORIGIN DOCK COST +	$2.92	$18.62	$2.92	$18.62
	DESTINATION DOCK COST +	$2.92	$18.62	$2.92	$18.62
	TRANSFER DOCK COST +	$0	$0	$0	$0
1.c	LINE HAUL COSTS				
	Kilometres	90	90	1,389	1,389
	Equipment Cost per KM	$0.616	$0.616	$0.616	$0.616
	Labour Cost per KM	$0.264	$0.264	$0.264	$0.264
	Hours at Terminal(s)	1	1	1	1
	Labour Cost Per Hour	$18.84	$18.84	$18.84	$18.84
	Load Factor (kgs)	9,941	9,941	12,472	12,472
	Empty Factor (%)	37.4%	37.4%	16.6%	16.6%
	TOTAL TRIP COSTS	$98.04	$98.04	$1,241.16	$1,241.16
	LINE HAUL COST PER SHIPMENT+	$0.31	$12.29	$2.67	$105.24
	TOTAL DIRECT COSTS	$22.50	$96.96	$24.86	$189.91
1.d	OVERHEAD COSTS	$29.85	$31.87	$29.91	$34.40
	TOTAL COSTS	$52.35	$128.83	$54.77	$224.31

* Hours + Direct Costs

An explanation of the labour costs is found in Appendix 1, and equipment costs in Appendix 2.

1.a Pick-up and Delivery Costs

The model uses the following formula to calculate pick-up costs and delivery costs.

(LABOUR COST PER HOUR + EQUIPMENT COST PER HOUR) x (SHIPMENT HANDLING TIMES + SHIPMENT FIXED TIME)

For example, pick-up costs as shown in Table I for a 23 kg shipment are equal to ($19.37+$9.85)x(.040+.211), or $7.33.

Pick-up handling time is derived from an exponential equation that calculates the time it takes to move a shipment from the shippers loading facility onto the pick-up vehicle. The equation is based on shipment weight

and the number of shipment pieces.[1] Delivery handling time is calculated using a slightly different exponential equation which reflects the additional sorting time required for the delivery operation. Pick-up and delivery fixed time includes transit time between customers, customer delay time and non-productive time. The model calculates the number of possible stops and allocates fixed time equally to each stop. In this analysis shipment fixed time was then calculated by assuming 1.5 shipments per stop[2] for pick-up and one shipment per stop for deliveries.

1.b Dock Costs

City trucks pick up LTL shipments that could be destined for several different cities. The dock (platform) operation involves consolidating shipments for the same city into a single line haul trailer. For major corridors the line haul trailer will usually take the shipment directly to the carriers dock in the city were the shipment is to be delivered. Here it will be put into the appropriate delivery truck. For minor corridors, shipments may be moved to an intermediate point where the shipment will be consolidated with shipments from other locations. In this analysis, all shipments are assumed to move directly from the origin city to the destination city.

The model uses the same formula to calculate both origin and destination dock costs, namely:

(LABOUR COST PER HOUR + OTHER COST PER HOUR) x (SHIPMENT HANDLING TIME)

For example, origin dock costs shown in Table I for a 23 kg shipment are equal to ($18.88+$8.42)x(.107), or $2.92. Other cost/hour represent the terminal costs associated specifically with the dock operation. It is derived from LTL carrier data collected by Statistics Canada in 1986 as part of their Motor Carrier Freight Survey, and has been adjusted to reflect 1988 costs.

The exponential equations used to determine pick-up and delivery handling time form the basis for estimating dock handling time per shipment. A factor for non-productive time is incorporated into the calculations.

1.c Line Haul Costs

The first step in determining line haul costs is to calculate the trip costs in travelling from the origin to destination city. Trip costs are calculated as follows.

((KMS TRAVELLED)x(EQUIPMENT + LABOUR COSTS PER HOUR))+((TERMINAL TIME)x(HIGHWAY COST PER HOUR))

For example, trip costs from Toronto to Barrie are (90 kms x ($.616 + $.264) + (1 x $18.84) = $98.04. Trip

1. Shipments in the 50 lb weight category were assumed to consist of 1 piece, while other weight categories were assumed to be made up of pieces weighing approximately 75 lbs each.
2. 1.5 shipments per stop were used to reflect the fact that more than one shipment is often picked up from an LTL customer. LTL shipments are not usually combined for delivery.

costs are assigned to a particular shipment on the basis of shipment weight and shipment density. In this analysis no adjustment was made for shipment density as shipments were assumed to weigh a standard 10 lbs per cubic foot. Shipment loaded line haul costs were calculated by determining what percentage the shipment weight was of the total weight of the load. Then an additional cost was assigned to the shipment loaded line haul cost to reflect the shipment percentage share of empty kilometres driven.

From a 1987 Ministry of Transportation Ontario Truck Survey it was determined that the longer the trip the higher the load factor and the lower the percentage of empty return movements. Regression equations were developed from the survey data to estimate load and percentage empty factors for various corridors.

Loaded line haul shipment costs then, from Toronto to Barrie for a 23 Kg shipment are (23/9941) x (trip cost of $98.04)= $.227. Loaded and empty line haul costs are ($.227) + ($.227 x 37.4%) or $.31 as shown in Table I.

1.d Overhead Costs

Perhaps the most difficult aspect of developing an LTL costing model lies in the assignment of overhead costs. Overhead costs are assigned arbitrarily, and there are several different ways in which this can be done.

In this paper the average overhead costs as reported by 32 LTL carriers in the Statistics Canada 1986 MCF Survey form the basis for the overhead costs calculations. A wider base of carriers would have been used but unfortunately about 50% of the carriers failed to report detailed shipment information.

Table II shows the breakdown of overhead costs and the basis of cost allocation.

TABLE II: OVERHEAD ALLOCATION

OVERHEAD COSTS	METHOD OF ALLOCATION	1986 SURVEY RESULTS	1988 ADJUSTED
INSURANCE	% OF OTHER COSTS	2.18%	2.18%
CLAIMS	% OF OTHER COSTS	0.54%	0.54%
TRAFFIC & SALES	COST / SHIPMENT	$4.68	$5.10
TERMINAL ADMINISTRATION	COST / SHIPMENT	$7.34	$8.01
SYSTEM ADMINISTRATION	COST / SHIPMENT	$14.09	$15.35

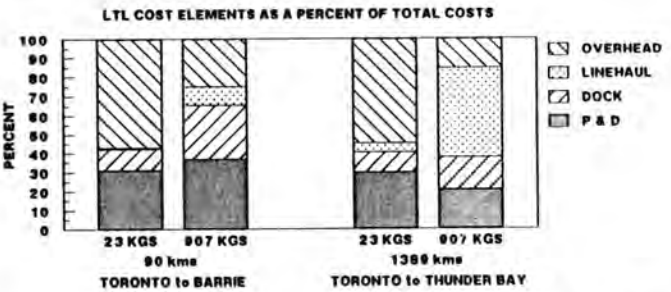
This method of cost allocation was used because it at least partially allocates overhead costs on the basis of work performed for overhead functions. From Table I it can be seen that by using this procedure, all shipments are assigned approximately the same overhead costs in terms of absolute dollars. It should be noted that some carriers may choose to allocate overhead costs as a percentage of

operating costs. Using the same 32 carriers that were used to develop the figures in Table II, overhead costs as a percent of operating costs amount to 30.8%. This method of allocating overheads results in higher weighted shipments that move longer distances being forced to absorb unrealistically high overhead costs. For example, the overhead costs for a 907 kg shipment from Toronto to Thunder Bay would increase from the $34.40 shown in Table I to $58.56, while overhead costs for a 2268 kg shipment would be $124.91.

2. IMPLICATIONS OF COSTING MODEL

It is worth pointing out that depending upon the length of haul and the shipment weight being handled, the importance of the various LTL functions changes considerably. Figure II illustrates that line haul costs become much more important with distance and the weight of the shipment. Overhead costs are more significant for lower weighted shipments while P & D and dock costs are relatively more important for a higher weighted shipment travelling a shorter distance.

FIGURE II



In this paper, only average carrier unit costs and average productivity factors are presented, since the objective of the paper is to provide an evaluation of the general relationship between carrier costs and carrier revenues. The impact on overall carrier costs of varying the assumptions about unit costs, productivity factors and shipment characteristics would be better discussed in a separate analysis.

3. LTL RATE STRUCTURE

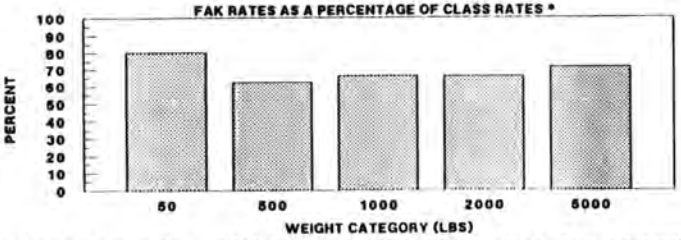
This section of the paper will specify the LTL rates used in the analysis and briefly outline how these rates relate to the overall LTL rate structure. Although not all for-hire carriers use tariff bureaus to publish their rates, the majority of LTL shipments are handled by carriers that use tariff bureaus. This paper will only deal with rates published by the Canadian Transport Tariff

Bureau Association (CTTB) which publishes rates for shipments within Ontario, between Ontario and the Western Provinces and between Ontario and Quebec.

When one considers the many different possible operating characteristics for handling LTL freight, it is not surprising that the LTL rate structure is quite complex. There is a significant range in prices charged, even for shipments weighing the same amount, moving between the same origin and destination. For example, an LTL customer could be charged, depending upon the carrier, 6 different levels of rates for the same shipment. There are three different levels of class rates and 3 types of commodity rates. Commodity rates include a Freight of All Kinds (FAK) rate for general merchandise, FAK named account rates and rates for specific commodities.

Class rates, which form the backbone of the Tariff Bureau rating structure, are based on the premise that goods with similar characteristics requiring similar handling procedures should be grouped together. The National Motor Freight Classification Tariff groups similar goods into the same class. Higher classed goods are charged higher rates. "Class 85" which generally falls in the mid range of classes typifies the majority of LTL shipments. In this analysis, the lowest "class 85" rate in effect as of November 1988, as well as the FAK rates specified in Appendix 2 were used for comparative purposes. Except for shipments under 500 lbs, for which a flat rate minimum or per-shipment rate is charged, LTL class rates are expressed in terms of $/100 lbs. Different rates are applied to 500 lbs, 1,000 lbs, 2,000 lbs, 5,000 lbs, and 10,000 lbs shipments. Since carriers often offer lower truck load rates than the 10,000 lbs LTL rate, 10,000 lbs LTL class rates are excluded from this analysis. It must be pointed out that the majority of freight is moved by FAK or commodity rates, which are significantly lower than class rates. Figure III below shows the differences that exist between class rates and FAK rates.

Figure III



* Based on average Class and FAK rates for all origin/destination pairs, as shown in Appendix 2

From a rate perspective, carrier profitability will be influenced by the extent to which a carrier is successful in maximizing its revenues by charging the higher class rates. As a consequence, the results of the analysis can not be used to evaluate overall carrier profitability. This paper focuses strictly on the "consistency" of the CTTB class rate and CTTB FAK rate structure.

4. LTL COST/RATE COMPARISON

This part of the paper will compare carrier costs to carrier rates. The first step is to calculate carrier revenues by applying the appropriate rate to the shipment weight being analysed.[1] The next step is to calculate "% contributions and % margins". "% Contributions" are calculated by using the following formula:

% CONTRIBUTION = (REVENUE - DIRECT OPERATING COST) / REVENUE[2]

An evaluation of "% contributions" allows a comparison of carrier costs to carrier revenues without having to be concerned about the effect that any arbitrary overhead allocation could have on the results.

"% Margins" are calculated by using the formula shown below.

% MARGIN = (REVENUE - DIRECT OPERATING COSTS - OVERHEAD COSTS) / REVENUE [3]

Despite the problems associated with including an arbitrary overhead cost, a comparison of "% margins" is also useful because it allows an analysis of total carrier costs versus carrier revenues.

Percent contributions and percent margins are calculated for 50 lb, 500 lb, 1000 lb, 2000 lb and 5000 lb shipments for each origin and destination pair in Appendix 3. The results will be compared and analysed for various weight categories, by distance travelled, and for major origins and destinations.

4.a Rate Comparison by Weight

In Figure IV "% Contributions" are plotted against weight category and rate type. Each point in the scattergram represents the "% contribution" for a single shipment. In other words, 36 separate "% contributions" for class rates and 27 separate "%contributions" for FAK rates are plotted for each weight category analysed.

---

1. For example, revenue generated from an FAK rate of $7.54 per hundred lbs for a 2000 lbs shipment between Toronto and Barrie would be ((2000)x($7.54))/100, or $150.80.
2. "% Contribution" for FAK rates for a 2000 lb shipment from Toronto to Barrie using costs from Table I would be ($150.80 - $96.96)/$150.80, equalling 35.7%.
3. "% Margin" for FAK rates for a 2000 lb shipment from Toronto to Barrie using costs from Table I would be ($150.80 - $96.96-31.87)/$150.80, equalling 14.6%.

Figure IV

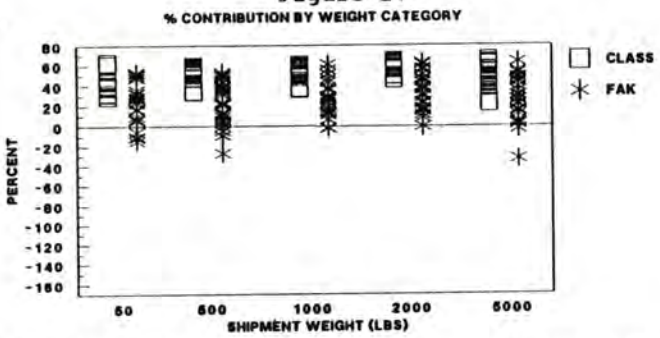
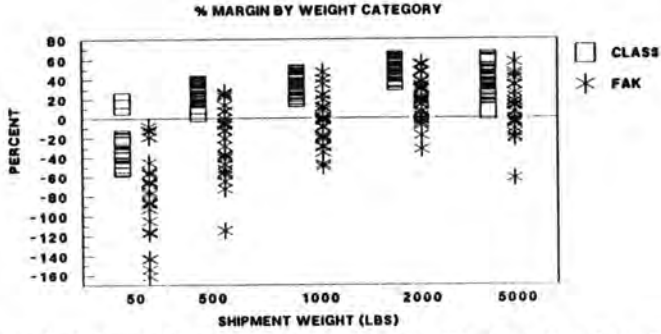


Figure IV shows that "% contributions" are not only higher for class rates, as would be expected, but that class rates also exhibit a much tighter range than FAK rates. It is also evident from this diagram that there is a wide range in "% contributions". Thus although carrier costs play a role in determining carrier LTL rates there can be little doubt that there must be other factors that have a significant bearing on determining carrier rates as well.

When overheads are added to direct costs and "% margins" are calculated as shown in Figure V, the variance between carrier cost and carrier rates becomes even more pronounced. With the additional overhead costs, many shipments now exhibit a negative margin, or loss. This does not necessarily mean that a carrier is losing money, because overall profitability will depend upon the mix of shipments being handled.

Figure V



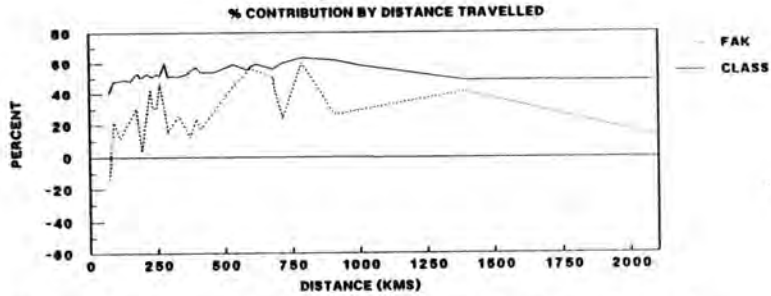
The same basic patterns apparent in Figure IV for "% contributions" is also seen in Figure V for "% margins". For example, it can be seen in Figure V that class rates still exhibit a much tighter range in "% margins" than do FAK rates.

As with "% contributions", "% margins" are lowest for shipments in low weight categories. This is not surprising when one considers that there is considerable competition from couriers for this market segment. It should be noted that if "% margins" are calculated by applying a percent for overheads to operating costs, the variance between weight categories is not nearly as exaggerated.

4.b Rate Comparison by Distance Travelled

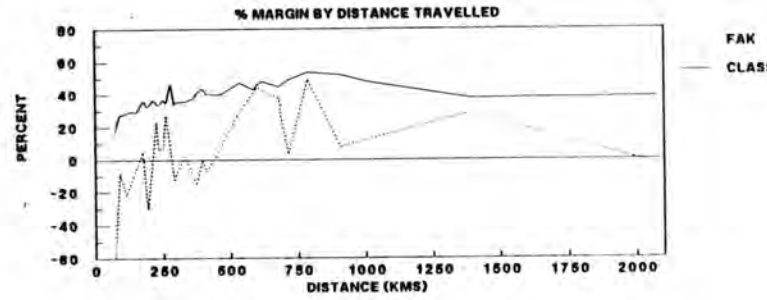
In Figure VI, "% contributions" are plotted against trip distance. Each point represents the weighted average of revenues and direct costs of the five different shipment weights examined for each origin/destination pair shown in Appendix 3. It should be noted that the results are influenced to some extent by the higher weighted shipments because of the higher revenues and higher direct costs associated with these shipments.

Figure VI



From Figure VI it can be seen that class rates exhibit a much tighter pattern of "% contributions" than FAK rates. Class rates are lower for shorter distances, gradually increasing to 800 kilometres and then declining slightly.

Figure VII



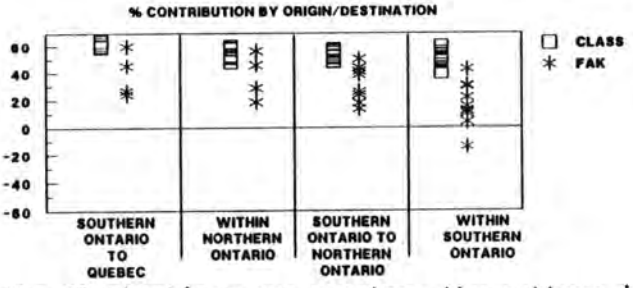
The same basic pattern is seen in Figure VII for "% margins" by distance travelled except that "% margins" are even lower than "% contributions" for shipments travelling shorter distances. This is particularly evident when examining "% margins" for FAK rates.

There is considerable pressure from shippers to keep rates relatively low for shorter distances. LTL shippers can afford to transport shipments for shorter distances themselves, if they perceive a rate to be too high. [1]

4.c Rate Comparison for Major Origins and Destinations

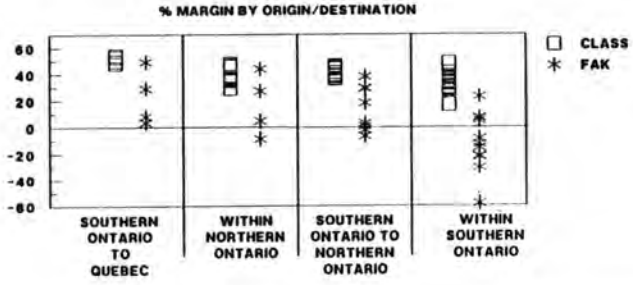
In Figure VIII, average "% contributions" are sorted by major origins and destinations. The specific origin-destination pairs included in each major area or corridor are outlined in Appendix 3. "% Contributions" for each point in the scattergram are calculated using the same method as for Figure VI.

Figure VIII



Although the fluctuations are greater, the pattern is similar for "% margins" in Figure IX below.

Figure IX



1. In a 1987 Ontario Ministry of Transportation truck survey, it was found that private carriers accounted for more movements for shorter distances than the for-hire carrier while the reverse was true for longer distances.

From Figures VIII and IX it can be seen that the "% margins" and "% contributions" are fairly similar for class rates for major origins and destinations except between Southern Ontario and Quebec where they are generally higher.

When "% margins" are examined for FAK rates, Southern Ontario to Quebec "% margins" continue to be the highest. This might be explained by the fact that, up until recently carrier entry was very strictly controlled by both Ontario and Quebec regulatory authorities. It will be interesting to see if the Motor Vehicle Transportation Act (1987) and complementary Ontario and Quebec legislation will result in lower rates for this segment of the market.

"% Margins" for FAK rates are generally lower within Southern Ontario. This is probably due to the shorter distances and the higher level of competition. "% Margins" for FAK rates within Northern Ontario and between Northern Ontario and Southern Ontario fall in the middle of the range. Possibly this can be explained by the fact that there is less LTL freight to be moved within and from Northern Ontario and as a consequence there is less competition to force the rates down.

4.d Factors Influencing Carrier Rates

It has already been suggested that competition, carrier costs, and regulatory constraints all have an influence on the level of LTL rates. There are several other possible factors which are also worth mentioning.

First of all, it must be recognized that it is expensive for carriers to set up costing systems to record costs for individual LTL shipments. As long as overall profits are satisfactory there will be some carriers that will establish rates on general cost levels and not be concerned that "% margins" are higher for some shipments than for others.

Secondly, once tariffs are established it is often very difficult to alter the basic structure even if an apparent problem exists. For example, an elaborate costing system is not required to recognize that costs from Toronto to Sault Ste. Marie, a distance of 681 kilometres should be less than those from Toronto to Thunder Bay a distance of 1389 kilometres. FAK rates, however, are 30.5% higher for a 500 lb shipment and 21.4% higher for a 1000 lb shipment going from Toronto to Sault Ste. Marie compared to the same shipments going from Toronto to Thunder Bay.

Finally, the costing model used in this analysis uses average unit costs and average carrier productivity factors. Circumstances for individual carriers will be different and it is possible that "% margins" that appear to be low or high as calculated by the costing model presented in this paper are quite appropriate when based on a carrier's specific operation.

5. SUMMARY AND OBSERVATIONS

In this paper it has been demonstrated that the many different factors of an LTL operation require the development of a fairly complex costing system. In order to be able to present a meaningful analysis, assumptions must be made that restrict the number of alternatives examined. Despite this limitation the assumptions in this analysis have been applied consistently and the results should reflect the basic costs to revenues patterns.

It has been shown in this paper that carrier rates are not entirely dependent upon carrier costs. Other factors such as competition, regulatory constraints, and traditional rate structures also influence LTL rates.

The results of this paper suggest several opportunities for LTL carriers. First of all, even if an LTL carrier does not base its rates entirely on costs, a sound understanding of costs will become increasingly important as competition increases with regulatory reform. As shown in this paper it could be very dangerous for a carrier to reduce all rates indiscriminately. On the other hand there are certain market segments that could be pursued actively in order to maximize profits.

There are also opportunities for carriers to work with shippers to improve the efficiency of an operation. If carriers focus on those areas that are critical cost contributors to an operation it might be possible to generate savings that could be shared with the customer. As has been pointed out in this paper, factors will vary in importance from one customer to the next.

There is a cost for carriers to maintain the wide variety of possible rates such as class, FAK, and specific commodity rates. There seems to be an opportunity to use a less complicated rate structure. For example, although class rates are not perfect, the class rate structure could be better utilized. Class rates better reflect carriers cost than do FAK rates as there is not such a wide range in "% margins" for class rates.

If discounts were applied to the class rate structure and those discounted rates displaced the commodity or FAK rates, it would not only be easier for carriers to update their rates but it would also be easier for carriers to keep track of both marginal and profitable accounts and to offer price incentives within attractive market segments or niches.

Finally, from a government perspective it would be useful to conduct a similar analysis in a few years to see the extent to which regulatory reform has influenced the relationship between carrier costs and carrier LTL rates, as demonstrated in this paper.

ACKNOWLEDGEMENTS

1. Carrier costs were based on a modified version of Trimac's "Operating Costs of Trucks in Canada - 1986". Trimac Consulting provided the necessary information to make the modifications.

2. Shipment handling time formulas were based on formulas developed in a "1977-1978 Motor Carrier Platform Study" produced by the United States Interstate Commerce Commission.

3. Peter Skorochod and Don Borrows, Ministry of Transportation, Ontario for their assistance in the rate analysis.

4. Karen Siwak, Ministry of Transportation, Ontario for her assistance in preparing the charts and tables.

APPENDIX 1
LABOUR COSTS

LABOUR COSTS	P&D	DOCK	HIGHWAY HOURLY	HIGHWAY DISTANCE
Base Rate	$14.13	$13.83	$14.13	$0.198
Overtime % of Base	4.29%	1.98%	3.27%	3.27%
Fringe % of Base	22.61%	24.09%	19.75%	19.75%
Vacation % of Base	6.38%	6.38%	6.38%	6.38%
Stat Holiday % of Base	3.89%	4.09%	3.98%	3.98%
TOTAL COST	$19.37	$18.88	$18.84	$0.264

NOTES

Labour costs are based on average union wages for a mid-sized to large firm.
Overtime: P&D and Dock based on hours in excess of eight hours; highway overtime based on hours in excess of ten hours.

Fringe: includes workers' compensations, unemployment insurance, government and union pension, government and union health; highway fringe percentage is lower because the costs are spread over a larger base.

Vacation: Fifteen days of regular hours and average overtime hours.

Statutory Holidays: Ten days of regular hours.

APPENDIX 2
EQUIPMENT COSTS

	P&D STRAIGHT TRUCK[1]	LINE HAUL TRACTOR[2]	LINE HAUL TRAILER[3]
CHARACTERISTICS			
Annual Kms	30,813	150,313	150,313
Annual Hours	1861	----	----
Purchase Price	$43,700	$88,350	$25,400
Salvage Value[4]	$8,740	$17,670	$3,048
Loan Period	4	4	4
Equipment Life	5	5	8
Equipment Ratio	1	1	3.45[5]
Fuel Cost/Litre	$0.45	$0.45	----
Fuel Km/Litre	3.54	2.58	----
ANNUAL FIXED COSTS			
Depreciation	$6,992	$14,136	$9,640
Interest[6]	$1,846	$3,732	$2,405
Other	$1,357	$4,135	$7,590
ANNUAL VARIABLE COSTS			
Fuel	$3,917	$26,174	----
Maintenance	$3,297	$14,205	$4,134
Tires	$924	$3,608	$2,856
Equipment Cost / KM	$0.595	$0.439	$0.177
Equipment Cost / Hour	$9.851	----	----

NOTES
1. Cost for straight truck based on a new truck with a van box mounted on a 7.3 metre chassis, powered by a diesel engine and equipped with a 5 speed transmission and power steering.
2. Cost for a new tractor powered with the equivalent of a 315 diesel Cummins engine and equipped with a 9 speed transmission and 40,000 lb. rear axle.
3. The trailer costs are based on a new 48' 102" tandem axle van trailer.
4. It was assumed that the salvage value would be used as a down payment.
5. Trailer costs are 3.45 times higher than the cost of an individual trailer, reflecting the tractor/trailer ratio used.
6. Annual interest costs are spread over the life of the equipment.

APPENDIX 3
CTTB RATES USED FOR ANALYSIS

CORRIDOR			TARIFF REFERENCE		ORIGIN/DESTINATION
ORIGIN	DESTINATION	KMS	CLASS 85 *	FAK **	CODE
TORONTO	MONTREAL	533	CTTB10	CTTB3020	1
LONDON	MONTREAL	715	CTTB10	CTTB3020	1
TORONTO	QUEBEC	787	CTTB10	CTTB3020	1
WINDSOR	MONTREAL	908	CTTB10	CTTB3020	1
TORONTO	COLBORNE	132	CTTB1001		4
OTTAWA	PEMBROKE	151	CTTB1001		2
PETERBOROUGH	KINGSTON	180	CTTB1001		4
NORTH BAY	PEMBROKE	212	CTTB1001		2
NORTH BAY	OTTAWA	364	CTTB1001		2
NORTH BAY	KINGSTON	462	CTTB1001		3
SUDBURY	KINGSTON	586	CTTB1001		3
KINGSTON	WINDSOR	616	CTTB1001		4
TORONTO	HAMILTON	72	CTTB1001	CTTB1091	4
TORONTO	BARRIE	90	CTTB1001	CTTB1091	4
TORONTO	ST. CATHARINES	114	CTTB1001	CTTB1091	4
TORONTO	BELLEVILLE	174	CTTB1001	CTTB1091	4
TORONTO	LONDON	187	CTTB1001	CTTB1091	4
LONDON	WINDSOR	193	CTTB1001	CTTB1091	4
TORONTO	PARRY SOUND	222	CTTB1001	CTTB1091	3
CHATHAM	HAMILTON	225	CTTB1001	CTTB1091	4
LONDON	OWEN SOUND	232	CTTB1001	CTTB1091	4
TORONTO	KINGSTON	249	CTTB1001	CTTB1091	4
NORTH BAY	KIRKLAND LAKE	259	CTTB1001	CTTB1091	2
TORONTO	SARNIA	290	CTTB1001	CTTB1091	4
SUDBURY	SAULT STE MARIE	298	CTTB1001	CTTB1091	2
TORONTO	NORTH BAY	330	CTTB1001	CTTB1091	3
TORONTO	WINDSOR	372	CTTB1001	CTTB1091	4
TORONTO	OTTAWA	394	CTTB1001	CTTB1091	3
TORONTO	SUDBURY	411	CTTB1001	CTTB1091	3
NORTH BAY	HEARST	597	CTTB1001	CTTB1091	2
TORONTO	SAULT STE MARIE	681	CTTB1001	CTTB1091	3
TORONTO	TIMMINS	684	CTTB1001	CTTB1091	3
SUDBURY	THUNDER BAY	1006	CTTB1020		2
TORONTO	THUNDER BAY	1389	CTTB1020	CTTB1045	3
SUDBURY	TIMMINS	278	CTTB1020	CTTB1091	2
TORONTO	WINNIPEG	2076	CTTB1020	CTTB1400	3
TOTAL ORIGIN/DESTINATION PAIRS ANALYSED			36	27	
WEIGHT CATEGORIES ANALYSED			5	5	
TOTAL SHIPMENTS ANALYSED			180	135	

* Lowest class tariff as of Nov. 1988
** As of Nov. 1988, primarily named accounts

ORIGIN/DESTINATION CODES
1. Southern Ontario to Quebec
2. Within Northern Ontario
3. Between Southern and Northern Ontario
4. Within Southern Ontario

THE ROLE AND CONTRIBUTION OF THE TRUCKING INDUSTRY IN ONTARIO:

ONTARIO MOVES BY TRUCK

January, 1989

Authors

John Farrow
Bill Empey
Paul Inglis
Anthony Koh

Presenters

David Bradley
Jerry Brown

ONTARIO MOVES BY TRUCK

Ontario's transportation network is the ultimate regulator of provincial economic activity. If the network is blocked, even in one place, ripple effects will quickly bring the system down. Ontario's transportation network for the movement of freight is dominated by trucking. Government policy decisions that do not fully take into account the vital role of trucking can block the system just as surely as accidents, traffic congestion or bad weather.

Rapid growth and technological change have altered the role of trucking; adding to its overall importance. This carries with it the need for government policy that recognizes this importance. A report that explains the current role of this industry is long overdue. The following pages are intended to highlight the growing, complex linkages between trucking and the Ontario economy. The main theme is "Ontario Moves By Truck".

THE TRUCKING INDUSTRY'S RAPID RISE TO DOMINANCE

In a short period of three decades since the 1950's, trucking has risen to become the most dominant mode of freight transportation in Canada and Ontario. In the 1920's, trucks were no more than converted passenger cars and water and rail were the main modes of transportation:

1. Water transport dominated the transportation system until the middle of the nineteenth century because it provided the only route into Central Canada at a time when the development of resources in the vast interior was the major source of economic activity in the country;

2. Rail transport was the second major development in transportation in Canada. It replaced water as the most dominant mode of transportation because of a number of advantages that it had over water transport -- it was faster, operated year-round and stretched further inland. The railway industry held a dominant position in Canada until the 1950's.

Since the 1950's, trucking has become the key mode of freight transportation.

WHY TRUCKING IS THE PREFERRED CHOICE OF ONTARIO SHIPPERS

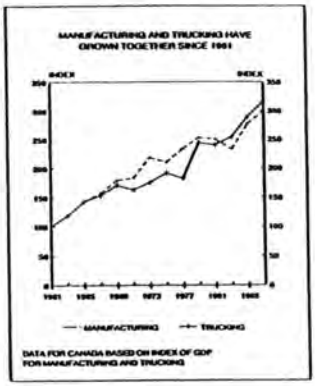
The trucking industry has a number of natural advantages that have contributed to its growing market share;

1. The first is the emergence of the truck as a safe, reliable, flexible and efficient vehicle for moving freight. Innovations such as the diesel engine and tractor trailer combination gave the trucking industry a vehicle that could provide transportation services that the other modes of transportation either cannot duplicate, or provide as effectively, such as highly flexible and frequent scheduling, cost-efficient short-haul transportation services, specialized services, convenient door-to-door service and speed. These innovations, which continue to this day, make trucking the preferred choice of Ontario shippers;

2. The second is the construction of an extensive road and highway system throughout the country that made trucking the most accessible mode of transportation. One major benefit of Ontario's investment in its highway and road infrastructure has been to make trucking services available to all communities in the infrastructure network. Consequently, the trucking industry serves virtually every community in the province. This cannot be said of the other modes of transportation;

3. The rapid growth of manufacturing and the relative decline in the importance of the primary resource sectors, particularly in Ontario, have contributed to an increasing reliance on trucking. Manufacturing industries require fast and flexible shipping, requirements that trucking is ideally suited to fill. As a result, the growth of trucking has moved in close tandem with the growth in manufacturing (see Exhibit 1). Although data in Exhibit 1 for Ontario is not available, it is believed that since the province is the centre of manufacturing in Canada, the close relationship between manufacturing and trucking should be even stronger here than anywhere else in the country;

Exhibit 1



4. The rapid growth of inter-modalism has also solidified the importance of the trucking industry. This is because of trucking's indispensable role in the initial and final distribution phases of the inter-modal transportation process. All the other modes must, of necessity, depend on trucking at some point in the transportation chain. Trucking is the only mode that can operate on a stand-alone basis.

Current trends suggest that trucking will continue to grow in importance in the future.

THE IMPORTANCE OF TRUCKING TO ALL SECTORS OF THE ONTARIO ECONOMY IS OFTEN OVERLOOKED

In spite of the remarkable success achieved by the trucking industry over a short period of three decades, it appears that the public and government, in general, do not fully grasp the vital role and contribution of the trucking industry. There is a definite concern among many industry observers that trucking is being taken for granted. Support for the industry so it can operate more effectively will have positive benefits in most sectors of the economy and most parts of the province. By extension, support for the trucking industry can be translated into support for Ontario's manufacturers and the provincial economy as a whole.

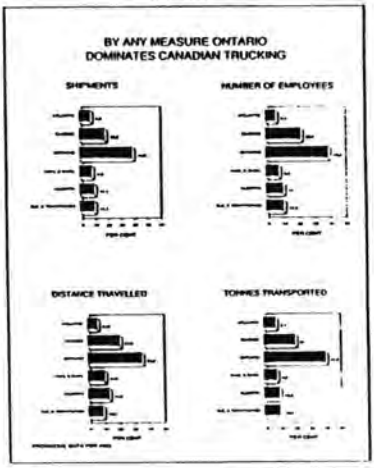
TRUCKING - THE LIFEBLOOD OF THE ONTARIO ECONOMY

Trucking is a regulator of the Ontario economy in the literal sense that it sets the pace for the vital flow of goods. It is also an important barometer of economic change. The Ontario trucking industry spends over $5 billion each year to employ over 220,000 workers and maintain 200,000 vehicles. Over $390 million in provincial taxes from trucking companies in Ontario flow out of this process. These complex linkages cause trucking to move with Ontario and play a vital role in the success of the provincial economy.

ONTARIO IS THE TRUCKING CAPITAL OF CANADA

Viewed from any angle, Ontario's trucking industry is the largest and most dominant in Canada. Ontario's trucking industry accounts for almost half (40.5 per cent) of the total number of shipments made by the total trucking industry in Canada. This is more than double the number for the next largest province, Quebec[1] (see Exhibit 2).

Exhibit 2



1 The trucking industry in the other provinces is relatively small compared to that of Ontario and Quebec. The ranking is as follows: Ontario, Quebec, Alberta, B.C., Manitoba, Saskatchewan, Nova Scotia, New Brunswick, Newfoundland, Prince Edward Island and The Territories.

Ontario also employs more people in the trucking industry than any other province in a wide variety of occupations such as drivers, mechanics, computers, marketing and accounting. Ontario's share of 40.4 per cent of the total trucking employment for Canada is almost double Quebec's share of 22.6 per cent (see Exhibit 2).

In terms of output measures for the transportation industry, (such as tonnes transported,[2] distance travelled and tonne-kilometers[3]), the Ontario trucking industry is once again the most dominant in Canada. It is responsible for moving the largest amount of freight over the longest distance, accounting for 41.5 per cent of the total amount of freight transported and 36.6 per cent of the total distance covered by trucks in all provinces (see Exhibit 2).

Ontario's share of the total number of tonne-kilometers transported in Canada, (the industry's overall measure of output), also ranks well ahead of other provinces. It accounts for 34.3 per cent of the total for Canada, or more than double the share of the next largest province (see Exhibit 3).

Exhibit 3



The trucking industry is also a major contributor to other sectors of the economy through the goods and services that it consumes. A measure of this contribution is the operating expenses incurred by the trucking industry. Out of the total operating budget of $12.3 billion in 1986 for Canada as a whole, Ontario's trucking industry accounted for 40.5 per cent or more than double that for Quebec (see Exhibit 3).[4]

---

2 Measured based on the amount of freight originating from each province. Tonne is a metric weight which is equivalent to 0.9842 (long) tons.

3 Defined as the multiplication of goods transported measured in tonnes and distance travelled in transporting the goods measured in kilometers.

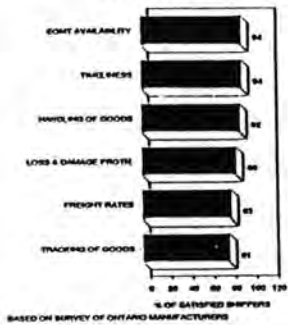
4 The estimate of $12.3 billion significantly understates the total operating budget of the trucking industry because it is based on a survey of only the larger trucking establishments (defined as those with at least $100,000 in revenue for firms in the for-hire sector or at least 15 vehicles for those in the private sector). If smaller establishments are included, the operating budget rises sharply to about $23.3 billion.

In line with Ontario's status as the province responsible for moving the largest amount of freight over the longest distance, the Province's trucking industry maintains the largest vehicle fleet in Canada. Over 218,000 trucks, tractors, trailers and specialized vehicles are available for meeting the numerous types of transportation needs demanded by Ontario's highly diversified economy.[5] This fleet of vehicles is more than double the size of the next largest province (see Exhibit 3).

In addition to being the largest and most dominant in Canada, the trucking industry in Ontario has also proven to be effective in satisfying its customers. In a survey of manufacturers in Ontario by the Ministry of Transportation, an overwhelming majority of those surveyed indicated that they are highly satisfied with most aspects of the trucking industry in Ontario (see Exhibit 4).

Exhibit 4

SHIPPERS REPORT A HIGH LEVEL OF SATISFACTION WITH VARIOUS ASPECTS OF TRUCKING



TRUCKING IS THE DOMINANT MODE OF TRANSPORTING ONTARIO'S GOODS

All modes of transportation have a vital role in the Canadian economy. However, since the 1960's, trucking has been the most dominant mode of transportation in Canada and, particularly, in Ontario. All comparative measures confirm trucking's overwhelming dominance in Canada and Ontario.

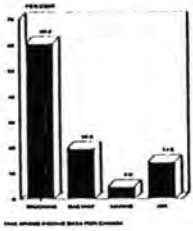
For example, trucking generates more gross income than all the other modes of transportation combined. Its share of 60.8 per cent in 1986, or $23.7 billion, was over three times the gross income generated by the railway industry. The shares attributable to air and marine were 14.5 and 4.9 per cent, respectively (see Exhibit 5).

---

5 Estimation of fleet size based on data supplied by the Ontario Ministry of Transportation and Communications.

Exhibit 5

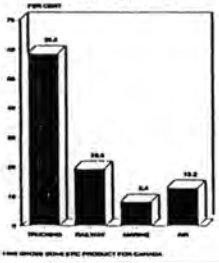
TRUCKING GENERATES
MORE INCOME THAN ALL
THE OTHER MODES COMBINED



The gross domestic product (GDP) is commonly regarded as the most reliable measure of the size of a sector. This is because the GDP measure "nets out" the contribution from the rest of the economy leaving only the value-added by the sector in question. On the basis of GDP, the trucking industry is once again larger than the other three modes combined (see Exhibit 6).

Exhibit 6

TRUCKING GENERATES MORE VALUE
ADDED THAN ALL THE OTHER
MODES COMBINED

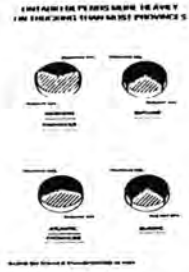


While data on gross income and GDP are available only for Canada as a whole, it is most likely that the conclusions reached here would apply to Ontario even more strongly. This is because of Ontario's status as the trucking capital of Canada and because, compared to other provinces, it is more dependent on trucking than any other mode of transportation.

ONTARIO IS ESPECIALLY DEPENDENT ON TRUCKING

Trucking is even more dominant in Ontario than in most other provinces. In the Western Provinces, where the transportation of bulk and crude commodities dominates, rail carries more freight than trucking (see Exhibit 7). In Ontario (and Quebec), where the transportation of manufactured goods dominates, the opposite is true -- trucking carries about two and a half times more freight than rail. For the Atlantic Provinces, where the abandonment of branch lines by rail is most widespread, trucking is also significantly more important than rail.

Exhibit 7



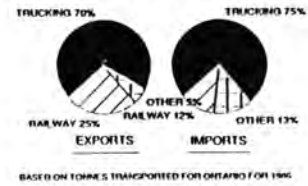
TRUCKING IS ESSENTIAL TO THE NEW ECONOMIC POLICY DIRECTION OF THE PREMIER'S COUNCIL

Trucking is essential to the success of the new objectives outlined by the Premier's Council emphasizing high value manufacturing and international trade. Trucking and manufacturing have always enjoyed a close historical relationship. Indeed, the rapid growth of the trucking sector has come on the heels of the growth of the manufacturing industry in Canada and, in particular, Ontario. (The strong relationship between trucking and manufacturing has already been demonstrated in Exhibit 1.)

Another important dimension in the strong relationship between trucking and manufacturing is the vital importance of trucking in shipping manufactured goods to export markets. For example, trucking is used for shipping 70 per cent of Ontario's $56.1 billion exports to the U.S. and 75 per cent of Ontario's $48.1 billion imports from the U.S. (see Exhibit 8).

Exhibit 8

TRUCKING HAS DOMINANT ROLE IN ONTARIO'S TRADE WITH THE U.S.



BASED ON TONNES TRANSPORTED FOR ONTARIO FOR 1986

Even more significant is that trucking is the preferred mode of transportation for trade in high-value manufactured products (such as automobile and parts and electrical goods), which were emphasized by the Premier's Council and also in traditional goods (such as live animals, food, feed, beverages and tobacco -- see Exhibit 9). Surprisingly, even for trade in products that have been the historical strongholds of railways and water transport -- namely, crude materials (mostly semi processed raw materials) -- trucking has, in recent years, gained a significant lead.

Exhibit 9

TRUCKING DOMINATES TRADE
IN ALL TYPES OF GOODS



The close relationship between trucking and manufacturing will be strengthened by the industry's on-going efforts to enhance the level of its services. The resulting enhancement in trucking services will better enable the Ontario economy to move in the direction laid out by the Premier's council. The improvement in services will further boost trucking's current cost-effectiveness relative to other modes of transportation in shipping high-value and time-sensitive manufactured goods. Although air transportation is also sometimes capable of serving these needs, its usefulness is greatly limited by its costliness and scope relative to trucking.

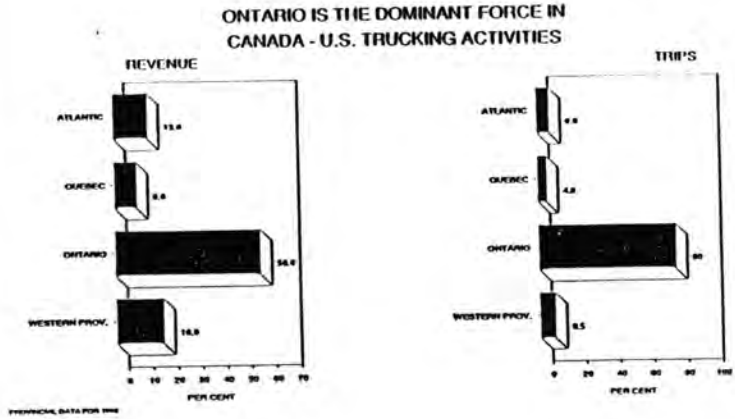
A strong trucking sector is also consistent with another aspect of the new emphasis in Ontario's industrialization policy, namely, the promotion of service sector exports, including trucking services.

More than in any province, Ontario has a solid foundation from which to build a competitive trucking sector capable of competing for business in the U.S. Already, Ontario enjoys the largest share of revenue generated by Canadian trucking firms involved in trans-border activities. At 58.6 per cent, Ontario's share is greater than all the other provinces combined (see Exhibit 10).[6]

---

6 Available information understates the level of trans-border activities because it does not include for-hire firms earning less than $1 million in revenue from international operations.

Exhibit 10



Ontario's dominance in trans-border trucking activities is even more pronounced based on provincial share of the total number of trans-border trips. In 1985, Ontario's trucking firms made a total of over 700,000 trips to and from the U.S. or 80 per cent share of the total (see Exhibit 10). Clearly, trucking firms in Ontario have the experience to expand their presence in the U.S. and, hence, contribute to boosting Ontario's service exports.[7]

---

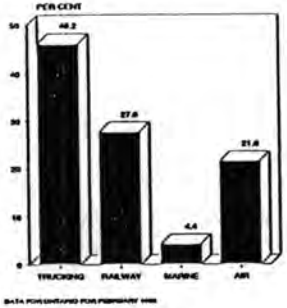
7 A concern regarding competitiveness of Ontario's trucking industry relative to that in the U.S. is the recent sharp appreciation of the Canadian dollar. In 1986, the average hourly wage rate of workers in the U.S. trucking industry was slightly higher than in Ontario (C$15.75 versus C$15.24). In 1988, however, the U.S. wage rate has fallen to C$13.80 due almost exclusively to the stronger Canadian dollar.

THE TRUCKING INDUSTRY IS A LARGE EMPLOYER

As many as 228,000 people in Ontario,[8] or about 5 per cent of the provincial labour force are employed in the trucking industry. This makes the trucking industry one of Ontario's larger employers. Compared to other modes of transportation, the number of workers employed in Ontario's trucking industry is far in excess of those in rail, air and water transport (see Exhibit 11).[9]

Exhibit 11

TRUCKING EMPLOYS ALMOST HALF OF TRANSPORTATION WORKERS IN ONTARIO



THE INDUSTRY PAYS ABOVE-AVERAGE WAGES

Workers in Ontario's trucking industry earn wages that are significantly higher than the provincial average. The latest (March 1988) data show that wages in the trucking industry are 16.6 per cent higher than the average for all workers in Ontario and 27.3 per cent higher than the average for all service sector employees (see Exhibit 12).

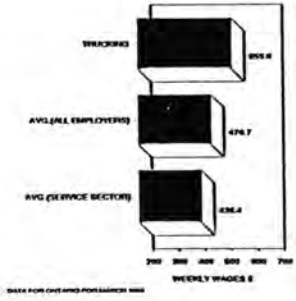
---

8 Estimates of the number of people employed in the trucking industry in Ontario vary widely. Based on a Statistics Canada survey of larger establishments, the trucking industry in Ontario employs a total of 73,332 in 1985. However, this survey significantly understates the number of employees because it does not include smaller establishments as well as the owner-operators and couriers. According to a methodology reported in a background document to the Ontario Task Force on Hours of Work and Overtime (1987), page 41, (The Donner Commission), there are about 228,000 workers (208,000 drivers and 20,000 non-drivers) employed by trucking.

9 The data provided by Statistics Canada used to calculated the above modal shares underestimates the size of the trucking industry in Ontario by an even larger margin than the estimate referred to in the previous footnote. In addition to being limited to large establishments, this particular survey does not include private trucking firms unless these are identifiable as establishments separate from their parent companies, and if their principal activity is trucking. If these private trucking firms are included, the trucking industry's share of total employment in Ontario's transportation sector would probably rise to over 60 per cent, that is, more than all the other modes combined.

Exhibit 12

ONTARIO TRUCKING PAYS
ABOVE-AVERAGE WAGE



TRUCKING CONTRIBUTES THE MAJOR SHARE OF ONTARIO GOVERNMENT REVENUE FROM FREIGHT TRANSPORTATION

The three major ways that the trucking industry contributes to government revenue in Ontario are via provincial corporate income tax, tax on diesel fuel consumption, and vehicle license fees. In 1987, the trucking industry contributed a total of $396.7 million in revenues (not counting the personal income taxes of those employed in trucking) to the Ontario government. These revenues not only go toward road building and maintenance but also to other important social objectives of Ontario such as health care and education.

In terms of modal share, trucking contributes an overwhelming proportion of the total. For example, trucking has an 80.0 per cent share of the corporate income taxes of $23.9 million that Ontario collected from the four major modes of transportation. Contributions from rail, water transport and air paled in comparison -- 2.0, 12.0, and 6.0 per cent, respectively (see Exhibit 13).

Exhibit 13

A MAJOR PORTION OF
TRANSPORTATION SECTOR'S
PROVINCIAL CORPORATE INCOME
TAX COMES FROM TRUCKING



Trucking contributes an even larger proportion of the diesel fuel tax that the Ontario government collects. In 1987, the trucking industry contributed an estimated $238.5 million, or 90 per cent of the total, compared to only $26.5 million for the railway industry or 10 per cent of the total (see Exhibit 14).[10] Finally, the Government of Ontario collected $135.0 million in 1987 in the form of license fees from trucking.[11] No license fees are assessed for the railway industry.

Exhibit 14

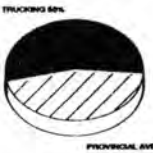
A MAJOR PORTION OF ONTARIO DIESEL FUEL TAX REVENUE COMES FROM TRUCKING



On a per worker basis, the trucking industry's tax contribution to the Ontario government was $1,740. These figures would be much higher if the personal income tax of those employed in trucking and retail sales tax are included. On a comparable basis, the amount of tax the Ontario government collects per worker for the province as a whole would be $1,343 or about 23 per cent lower than for trucking (see Exhibit 15).

Exhibit 15

TRUCKING CONTRIBUTES MORE GOVERNMENT TAX REVENUE PER WORKER THAN THE AVERAGE FOR ONTARIO



"An integral part of our economic growth and development has been the forging of a vast and efficient transportation network. The trucking industry plays a significant role in maintaining this network."

-The Honourable David Peterson, Premier of Ontario

DATA FOR ONTARIO FOR 1987

The federal government also collects a sizeable amount of revenue from the trucking industry. In 1986, trucking firms across Canada contributed $65.2 million in federal corporate income tax.[12] This is about one and one-third times greater than the amount collected from rail, water and air

10 An important reason for the much larger contribution of the trucking industry is because it is assessed at a much higher tax rate than the railway industry (9.9 cents per litre versus 3.1 cents).

11 Information on Ontario government's commercial vehicle licensing revenue was provided by the Ministry of Transportation.

12 Information provided by Statistics Canada in a special tabulation.

combined. The Ontario industry also contributed $174 million in federal sales and excise taxes on the diesel fuel that it consumed. None of this federal government revenue is spent on roads and highways in Ontario.

ALL MANUFACTURERS AND MOST OTHER INDUSTRIES DEPEND ON TRUCKING IN SOME WAY

Every conceivable type of good produced in Ontario is moved by trucking ranging from bulk commodities (such as sand, gravel and lumber), to delicate products requiring special care (such as fresh fruits, meat and vegetables, to major products (such as automobiles and steel), and to the most intricate (such as scientific instruments, computers and sophisticated machinery). An indication of how widely trucking is used lies in the fact that the top ten commodities moved by trucking account for only 28.1 per cent of total freight revenue.

In addition, several major industries maintain and operate significant private fleets such as manufacturing, construction, wholesale and retail trade, and the government. Thousands of vehicles and workers are directly involved in meeting the trucking needs of these industries (see Exhibits 16 and 17).

Exhibit 16

MANY INDUSTRIES OWN LARGE PRIVATE TRUCKING FLEETS

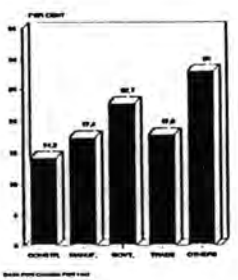
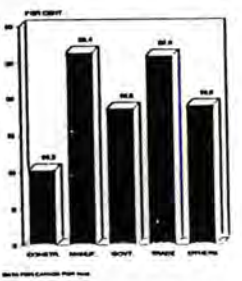


Exhibit 17

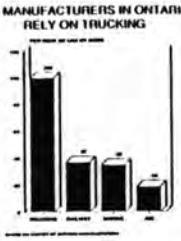
MANY WORKERS ARE EMPLOYED IN PRIVATE TRUCKING FLEETS



It is interesting to note that governments in Canada are also major consumers of trucking services. In 1986, among industries that operate their own private fleets, governments in Canada have one of the largest. Clearly, even governments have found trucking indispensable to carrying out their day-to-day business of serving the public. Government departments that are major users of trucks include mail delivery and garbage disposal. In fact, the federal government recently switched almost all transportation of mail from rail to truck.

A closer look at Ontario's manufacturing industry's heavy demand for trucking is provided in a recent survey conducted by the Ministry of Transportation. The survey showed that all manufacturers, regardless of size and location, use trucking at one point or another in shipping their goods to market compared with 37 per cent for rail, 35 per cent for air, and 19 per cent for water (see Exhibit 18).

Exhibit 18

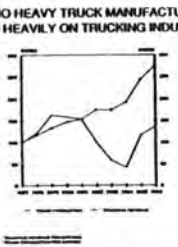


THE HEAVY TRANSPORTATION EQUIPMENT INDUSTRY DEPENDS, TO A LARGE EXTENT, ON A HEALTHY TRUCKING INDUSTRY

Manufacturers of heavy trucks employing over 3,500 workers in Ontario in 1985 (representing 44.2 per cent of the total for Canada) are heavily dependent on the trucking industry for their survival.[13] Consequently, so are the Ontario communities where these manufacturers are based.

Indeed, the trends in the are usually amplified in their effects on the heavy equipment industry. This was forcefully demonstrated in 1982 and 1983 when a slowdown in trucking activities led to a sharp decline in the sales of heavy trucks (see Exhibit 19). Not surprisingly, the subsequent recovery in trucking activities in 1985 was responsible for snapping the heavy equipment industry into life.

Exhibit 19



Other important equipment and material suppliers of Ontario's trucking industry are the tire manufacturers (employing over 8,500 workers in Ontario or 55.5 per cent of those employed in the industry in Canada in 1985) and petroleum products producers (employing over 13,100 workers in Ontario or 55.3 per cent of the industry in Canada in 1985).[14]

---

13 See Statistics Canada, "Transportation Equipment Industries: Truck and Bus Body Industry", catalogue number 42-251 (B 3241) and "Transportation Equipment Industries: Commercial Trailer Industry", catalogue number 42-251 (B 3242).

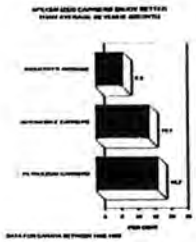
14 See Statistics Canada, "Rubber and Plastic Product Industries", catalogue number 33-250 (B 1598) and "Refined Petroleum and Coal Products Industries", catalogue number 45-250 (B 3611).

SPECIALIZED TRUCKING FIRMS ADD DEPTH AND FLEXIBILITY TO MEET THE NEEDS OF ONTARIO'S HIGHLY DIVERSIFIED ECONOMY

While the specialized trucking firms are a relatively small segment of the trucking industry, they occupy an unusual niche. Specifically, they give the trucking industry the depth and flexibility that it needs to meet the unique requirements of Ontario's highly diversified economy.

A prime example of these specialized firms are the automobile carriers. These carriers are indispensable to Ontario's huge automobile industry. Also, the automobile carriers have been growing more rapidly than the trucking industry as a whole and Ontario follows this trend (see Exhibit 20).

Exhibit 20



Another example of the specialized carriers are the providers of courier services. This is a rapidly growing industry with annual revenue estimated at $500 million in Canada. Couriers are also major users of trucks, with a fleet size of about 60,000 in 1988.[15]

Other specialized trucking firms include tank truck or bulk petroleum carriers, dump trucks, livestock carriers, etc. Each of these carriers operate highly specialized vehicles providing transportation services that are critical to the smooth functioning of the industries that they serve.

These specialized firms have also tended to enjoy more rapid growth than the trucking industry as a whole. This indicates that the trucking industry is responsive to meeting any new and special needs that may emerge in the province.

THE TRUCKING INDUSTRY SUPPORTS A STRONG AND GROWING FORCE OF SMALL TRUCKING ENTREPRENEURS (OR OWNER-OPERATORS)

An important characteristic of the trucking industry is the presence of a large number of self-employed owner-operators with a flair for entrepreneurship. It is estimated that there may be as many as 15,000 owner-operators in Ontario. Another measure of the size of the owner-operator sector in Ontario are the payments made to them. In 1986, payments of $687.7 million or 35.2 per cent of the total for Canada were made to the independent owner-operators in Ontario, which is more than double that for the next largest province, Alberta (see Exhibit 21).

---

15 Information on the courier industry is scarce. Estimates reported here are based on discussions with senior industry experts.

Exhibit 21



The owner-operators are a ready pool of talent that can be called upon on short notice to complement the services provided by larger carriers, hence, increasing the industry's flexibility in meeting the needs of shippers. This is an important role and the trucking industry is dependent on these highly entrepreneurial, independent owner-operators. There is, therefore, a lot of pride involved in becoming an owner-operator and it is a position that many drivers strive to attain. A source of great concern to both owner-operators and carriers are the recent policy suggestions made by bureaucrats at both the federal and provincial levels of government that could temper with the independent status of the owner-operators.

TRUCKING HAS AN ABOVE-AVERAGE MULTIPLIER EFFECT

Trucking is one of the most essential services in Ontario. There is no sector in the economy that does not use trucking services to some degree in performing its functions. As a result, trucking activities have higher-than-average multiplier effects in Ontario --a $1 increase in trucking activities is estimated to generate about $2 worth of goods and services in other sectors of the provincial economy.

An example of the way trucking contributes to the well-being of other industries is its connection to the large number of suppliers of equipment and materials such as manufacturers of heavy transport equipment, motor vehicle tires, and petroleum products. Another group of industries in Ontario that benefit from trucking activities are those whose activities are supported by the wages of workers employed in trucking (such as the construction industries) and the vast array of manufacturers of consumer goods.

The trucking industry's above-average multiplier effects are shared more widely across Ontario than any other mode of transportation because it is the most well-dispersed mode of transportation in the province. This means that the economic benefits of increases in trucking activities are shared by many, including many small Ontario towns.

This section of the report has highlighted the vital importance of the trucking industry to the Ontario economy. As the dominant mode for transporting Ontario's goods, trucking is the lifeblood of the provincial economy. Trucking sets the pace for how efficiently and quickly goods flow within the economy. As a result, it is inevitable that growth of the Ontario economy will be severely constrained if, due to policy or other reasons, the ability of the trucking industry to provide transportation services is impeded. In addition, the thousands of jobs in trucking and other industries would be in serious jeopardy.

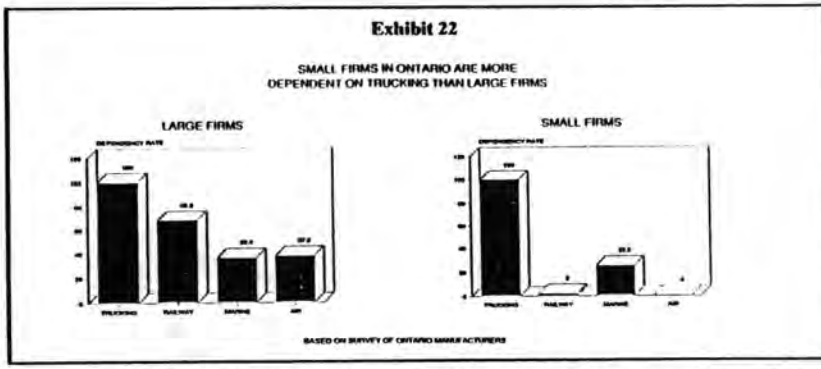
TRUCKING IS THE ONLY TRANSPORTATION OPTION FOR MANY SMALL TOWNS AND SMALL BUSINESSES IN ONTARIO

Ontario's small towns are often located on the regional extremities of the transportation system. When events disturb the viability of the system, it is the regional extremities that first feel the effect. A recent example of this is the pattern of abandonment of railway lines. Trucking has forged a special relationship with small communities that draws on operational flexibility, service and safety. Government policies that improve the trucking industry's flexibility help to improve the viability of small towns.

SMALL TOWNS AND SMALL BUSINESSES ARE HEAVILY DEPENDENT ON TRUCKING

A recent survey conducted by the Ministry of Transportation indicated that small towns and small businesses in Ontario are far more dependent on trucking than on other modes of transportation. Although larger firms in urban areas are also highly dependent on trucking, these firms stated that the other modes of transportation are also important to them (see Exhibit 22). In contrast, very few small firms are dependent on other modes of transportation with the exception, to some extent, of air transport.

Exhibit 22



The survey also indicated that, in all regions of Ontario, firms of all sizes are more dependent on trucking than on any other mode of transportation. Even in Northern Ontario, where railways are more prominent than in other regions,[16] trucking is still the most frequently used mode of transportation (see Exhibit 23).

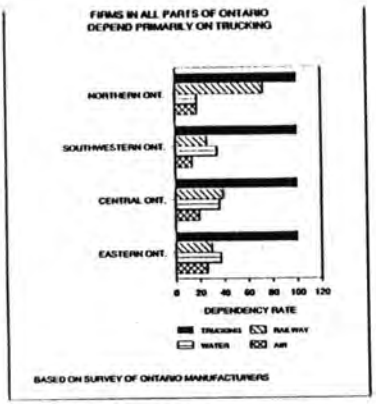
To meet the transportation needs of small towns and small businesses, the trucking industry in Ontario offers over 7,500 small and competitive trucking firms that are widely scattered throughout the province.[17] These firms (together with their counterparts in the medium and large categories)

16 Railway's dominance in Northern Ontario is due to the type of industries located there, namely, wood and paper products which are bulky and suited for rail transport and, in some instances, also due to the lack of road access.

17 Small trucking firms are defined as those with revenue of between $10,000 and $100,000.

provide a network that consists of an estimated 33,000 truck stops in 3,700 communities in Ontario.[18] Consequently, regardless of where they are located on the road network, small towns and small businesses in Ontario clearly enjoy convenient access to trucking services.

Exhibit 23



"SMALL REGIONAL CARRIERS ARE PROVIDING EXECELLENT SERVICE. ONE CAN EXPECT DELIVERY IN SOUTH/CENTRAL ONTARIO THE NEXT DAY"

MR. IAN SUTHERLAND
DISTRIBUTION MANAGER
CHEESEBOROUGH-PONDS

NEW CHALLENGES AND OPPORTUNITIES OF SMALL TOWNS AND BUSINESSES REQUIRE TRUCKING SERVICES

The special relationship between trucking and small towns and small businesses in Ontario will likely increase in importance in view of the difficult challenges posed by:

1. The migration of manufacturing from larger cities to small towns and the fierce competition among small towns to attract these migrants and their entourage of suppliers. The most prominent among the newcomers are the Japanese automobile companies such as Honda (Alliston), Toyota (Cambridge) and Suzuki (Ingersoll);

2. The emergence of small indigenous businesses and the need to encourage these as an alternative source of economic activity;

3. The continuing need for small towns in Ontario to diversify away from resource-based industries.

18 Estimate is based on the official 1987 Ontario directory and buyer's guide which contains a detailed list of all truck stops in Ontario.

Trucking is most suited to meet the special transportation needs of small towns and small businesses characterized by many small loads at irregular frequencies dispersed over a wide area. Trucking has a relatively low capital and operating cost structure which is able to operate economically under conditions that are frequently hostile to the railway and airline industries.

Given the trend towards further abandonment of branch lines by the railway and airline industries, trucking is the only transportation option for many small towns and businesses in Ontario. Its availability will ensure that small towns and small businesses will not be further handicapped by the lack of an essential, cost-effective system of transportation.

Support for trucking is consistent with the approach of supporting small towns and regions which, as a general rule, are experiencing slower economic growth and have fewer economic development options.

ONTARIO TRUCKING - THE HUMAN IMPACT

Ontario trucking plays a critical role in sustaining the cycle of activities that gives residents access to essential goods and services. Without trucking, it would be impossible for key establishments in the life and health cycle (such as hospitals, food and grocery stores, drug stores and automobile service stations) to operate. Trucking keeps these establishments supplied. A withdrawal of trucking support from these establishments would cause serious disorder in just a few days. In the 1950s trucking was able to fill in this role as the railways failed. There is no equivalent substitute for trucking.

Consequently, a complete withdrawal of trucking support from hospitals would result in a sharp deterioration in the quality of health care services as hospitals would be forced to operate on an emergency basis due to shortages of essential medical supplies: some patients requiring medical attention would have to be turned away. The quality of food that residents in Ontario can enjoy would deteriorate as grocery stores run out of fresh food. The initial inconvenience of conducting day-to-day activities would become an economic crisis as the mobility of the system fails.

THE HEALTH AND FOOD CYCLE NEEDS A STRONG TRUCKING INDUSTRY

Trucking's critical role as a sustainer of the economic cycle is highlighted in Exhibit 24. It shows that key establishments in the health and life cycle hold a limited supply of inventory. This means, for example, that many residents in Ontario would have to operate without automobiles within just a few days of the withdrawal of tanker truck supplies to gas stations. The loss of this essential means of transportation would have a crippling effect on all day-to-day activities. Life threatening circumstances would most likely arise.

Other establishments in the health and life cycle would also be severely affected. The supply of fresh food and vegetables at grocery stores would dry up in about a week. It is likely that the supply situation would be much worse. Fears that the food supply is in danger would trigger a run on grocery stores as people seek to stock up. Food would most likely be unobtainable within 72 hours.

It is also important to note that hospitals and pharmacies would not be able to operate at full efficiency for the 15 and 35 days, respectively indicated by the supply of inventory (see Exhibit 24). This is because the days of supply is an average, shortages of individual items may occur. Most likely, items that have a high rate of use or are costly, would experience shortages well ahead of others.

Exhibit 24

CRITICAL SHORTAGES WILL ARISE IF
TRUCKING SERVICES ARE NOT AVAILABLE

LIFE AND HEALTH CYCLE ESTABLISHMENTS	DAYS OF SUPPLY*
FOOD STORES	6
AUTOMOBILE SERVICE STATIONS	2
HOSPITALS	15
PHARMACIES	35

* ASSUMES NO HOARDING

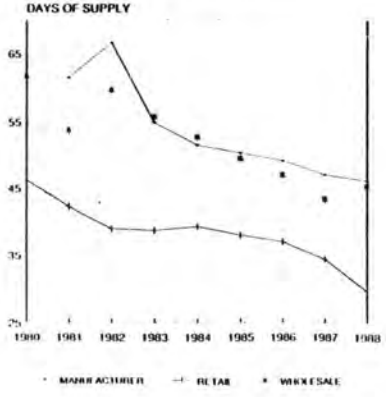
DATA FOR CANADA FOR MARCH 1988

THE TREND TOWARDS MORE EFFICIENT MANAGEMENT OF INVENTORY HEIGHTENS THE VITAL ROLE OF TRUCKING

Ontario's critical dependence on trucking is not confined to establishments in th[11]cle. The number of days of inventory held in all establishments, in general, and at all levels (manufacturer, wholesale and retail) has been on a downward trend (see Exhibit 25). For example, retailers as a whole in 1980 held more than one and a half months of inventory compared to less than a month today. This is a decline of about 35 per cent in the number of days of supply of inventory. The same shift has been observed at the manufacturer and wholesale levels. As a result, Canadian establishments are now much more dependent on trucking than just eight years ago to keep their distribution network well-oiled.

Exhibit 25

DEPENDENCE ON TRUCKING RISES
AS INVENTORY LEVEL FALLS



DATA FOR CANADA

This section illustrates the importance of trucking to Ontario in a way that touches on every resident in the province. A withdrawal of trucking services would, within a short time, have a severe impact on the quality of health care and life of residents in Ontario.

THE FUTURE OF THE ONTARIO TRUCKING INDUSTRY

The trucking industry is at the centre of a multiplier/accelerator process that is driving the Ontario economy into the future. A process of industrial development, already well established, will be pushed ahead by changing technology and a move to a global focus for production and marketing. An enhanced trading relationship with the U.S. will accelerate the change.

For at least twenty years, economic growth has been led by trade: exports and imports growing more rapidly than other sectors. This process is not only international but inter and intra-provincial as well. It reflects a continuing tendency to specialization and increased competition. Lower transportation costs are helping to fuel this process. All available forecasts for the future of Canada and Ontario capture this process. It means trucking will continue to become increasingly important.

THE DEMAND FOR TRUCKING SERVICES WILL INCREASE

Factors that will result in a high and growing level of demand for trucking services in Ontario include:

1. Strong growth prospects for Ontario's economy. The Ontario economy has led the nation in six years of unprecedented growth and is expected to continue to perform strongly due to its highly diversified nature. As the dominant mode of transportation in the economy, the trucking industry will play an important role in ensuring that transportation will not be a bottleneck in moving goods and supplies to where they are required, both here in Ontario, and elsewhere;

2. Ontario's new policy emphasis on high value-added manufacturing and service exports requires service by an efficient trucking industry. The enhancements in services being actively pursued by the trucking industry will ensure that it will effectively support the manufacturing sector as it becomes more competitive;

3. The trend towards developing greater trade links with the U.S. will place greater demands on Ontario's transportation network. Trucking will likely absorb most of any increase in activity because trade enhancements are expected to be in manufactured goods where trucking is well-entrenched, and also because trucking is currently the preferred and dominant mode of transportation. Another area of enhanced trade with the U.S. is in trade in services. As noted above, more than in any other province, Ontario has a solid foundation from which to build a competitive trucking industry capable of competing for business in the U.S.;

4. The trend towards abandonment of branch lines by the railways and air transport services to small towns in Ontario will lead to an even greater reliance on the trucking industry. Motor carriers are well-equipped to fill the gap that will be left by rail and air transport;

5. The increasing trend towards "just-in-time" (JIT) manufacturing strategies requires trucking to deliver within demanding time requirements. Effective trucking will allow Ontario's industries to shorten lead times and reduce order fill cycles.

A STRONG TRUCKING INDUSTRY IS GOOD FOR ONTARIO

The increase in trucking activities in response to future increases in demand is expected to produce highly favourable income and employment effects on the rest of the economy in Ontario. For example, a 10 per cent increase in the activities (measured in terms of operating expenses) of Ontario trucking firms, phased in gradually over a seven year period between 1989 and 1995, will enable the provincial economy to reap the following economic benefits:

1. The gross domestic product (GDP) would increase by a total of over $3.3 billion or a multiplier of slightly over 2 times the increase in trucking activities;

2. The benefits of the increase in GDP would be widely dispersed across major sectors of the province. In the first instance, job creation in the economy would increase by a total of 11,220 person-years or an average of over 1,600 jobs a year.

3. Housing starts would increase by a total of slightly over 5,000 or about 700 units a year.

4. Consumers in Ontario would benefit from an increase in real disposable income of over $2.5 billion which would, in turn, boost real consumption by almost a billion dollars.

As the demand for trucking services increases, growth in trucking must keep pace if major bottlenecks are to be avoided. In this regard, consideration must be given to increasing investment in the highway infrastructure. A major fear of both shippers and truckers alike is the potential for reduced dependability as the highways and streets of our larger metropolitan areas become congested, resulting in major delays. A 10 minute delay represents a $10 cost to a trucker and, therefore, a $10 cost to the shipper. When multiplied by the tens of thousands of trucks on the roads every day, the annual costs soon accumulate into the tens of millions of dollars.

Investment in road network is also vital for small communities. Speedy access to larger markets is necessary for the industries in these communities.

Moreover, public policy should be developed to encourage the use of productive truck technologies, such as the controlled introduction of combination vehicles. Future sensitivity to the impacts of regulatory reforms on cost and tax competitiveness relative to U.S. trucking companies will also be necessary.

"Government policy must adjust to help Ontario's industry compete. These new policies must reflect the need for a healthy trucking industry."

Maureen Farrow, Partner,
Coopers & Lybrand Consulting Group[19]

---

19 Mrs. Farrow is currently serving a two year term as the President of the C.D. Howe Institute.

Increasing the Rate of Technological Innovation Within the Transportation Industry

By
L. B. Ayers
Department of Civil Engineering
University of Saskatchewan

Introduction

In an increasingly global economy it will be necessary to implement technological innovations in all facets of our economy to remain competitive. The constraints that have impeded innovation must be identified and removed if we are to compete successfully in the global village.

The transportation industry must be cost competitive. In the global market place it matters little if Canada's trucking, airline or rail industries are more profitable when compared to other countries. It does not help our balance of trade to simply have a profitable transportation industry. All that matters is whether we can deliver Canada's products to the world more economically than our competitors. It only helps to have more exports.

Technological Change Not Advancement

One way of lowering costs to consumers which has been very successful in other industries is to encourage technological **innovation**. Innovation is not necessarily the same thing as

technological advancement. In fact industries which have undergone radical improvements in performance/cost benefits have usually done so by changing their technology, not advancing it.

The computing industry is an excellent example of an industry which has improved performance by adopting new technologies. Initially computers were mechanical devices. Their performance was limited by the physical laws of mechanical devices. The commercial need for increased performance far outstripped what further research on mechanical devices could deliver. This led some electronics specialists to apply existing vacuum tube technology to computers. The performance and reliability was drastically increased. The old mechanical computers and the old mechanical technology became obsolete as did the companies which did not adopt the new technology, as IBM did.

The introduction of the new technology completely revolutionized the industry because the innovation did not bring about improvements in one small area of the computer alone. It brought with it an immediate body of knowledge about many areas pertaining to electricity which provided for immediate performance increases in many areas of the computer. It also raised the physical limits to improvement so that new electronic computer research could proceed, guaranteeing the obsolescence of mechanical computers.

Commercial Innovation Follows Technological Innovation

In addition, innovation that introduces new existing technologies in this manner often brings with it commercial benefits as well. The introduction of the personal computer

allowed new consumer product companies such as Sony, NEC, Toshiba and Radio Shack to enter the market. Their experience with consumer manufacturing and mass marketing allowed them to drastically reduce the cost of a computer and still make handsome profits. To compete the existing companies have had to change their manufacturing and marketing strategies. In some cases the old companies abandoned their manufacturing technology and had their products manufactured for them by consumer product companies in Japan or Korea. In some cases the existing companies had to abandon their traditional marketing channels and market through other independent retail companies. In the personal computer market IBM has marketed through independent retailers. IBM survives today. IBM is willing to innovate.

Hallmark of High Performance Innovation

The hallmark of high performance innovation is the introduction of new technology that brings multiple benefits, often with the effect of rendering the existing technology completely obsolete. Unlike scientific advancement which usually proceeds linearly building on and increasing existing knowledge, innovation moves laterally replacing the old technology with the new. It therefore relies on development expertise as opposed to fundamental research.

In competitive industries lateral innovation is a potent strategic weapon. It gives the innovator an advantage while crippling competitors which rely on the old technology. But it is like a doomsday weapon in non-competitive industries where the participants agree not to use it.

Innovation in Passenger Travel

A transportation example is the passenger travel business. Prior to World War I long distance passenger travel was dominated by the ship and railroad industries. With the development of military aircraft technology, passenger air travel became feasible. Using technology paid for by the military, companies could develop passenger aircraft that offered substantial performance and cost advantages to the traveller. Improvements came at little cost to the air traveller as the military had funded and continues to fund research into jet power, materials, aerodynamics, electronics and aircraft operations.

Passenger travel became dominated by an entirely new technology with its own way of handling cargo and passengers, advertising and marketing its product. New companies with aircraft backgrounds entered the industry, driving the old technology out. Companies which wanted to stay in the passenger business adopted the new technology. Companies which did not want to change had to focus on the leisure traveller and sell travel as recreation. All that exists of ocean liners are cruise ships. Train travel is either for the discount traveller or for the recreational traveller. The business traveller and most recreational travellers choose to fly.

Competition in High Performance, Innovative Industries

The pattern of competition in high performance innovative industries is a recurring chain of innovation, obsolescence and innovation again. The companies that are the most successful innovators are those that excel at turning new ideas and research into practical solutions to customers' problems.

Competition is intense. The players focus on innovation for their customers' benefit in order to maintain or increase their market share. Market share is the key to survival in a competitive industry. Customer approval is the source of market share. Market share is responsible for cash flow. Cash flow funds future innovations. Future innovations are essential for future customer approval. The competitive flow chart appears in Figure 1.

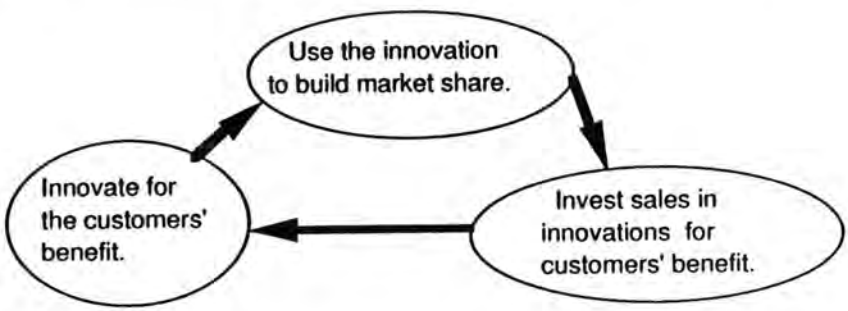


Figure 1.

The decision faced by competitors in an innovative arena appears below in Figure 2.

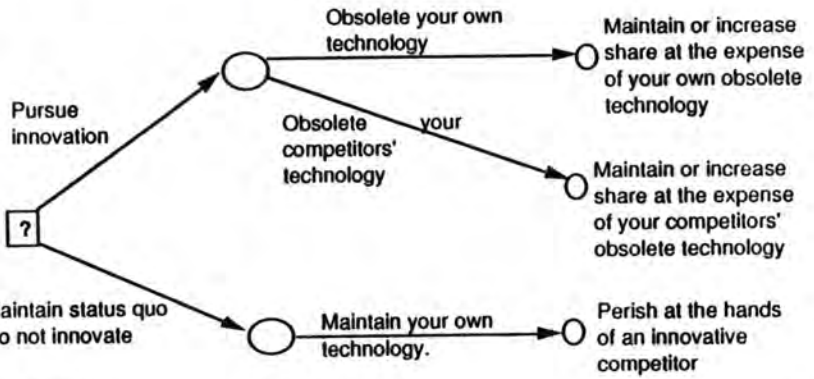


Figure 2.

The only rational choice is to innovate.

Competition in a Low Performance, Conservative Industry

We should contrast the above model with that which prevails in industries where there is little innovation. For example an industry occupied by a duopoly generally does not foster competitive innovation for the customers' benefit. In a duopoly structure of the industry presents a different set of outcomes for the players.

The results of the decisions are not the same. In an innovative industry the decision not to innovate is equivalent to a decision to vacate the industry or perish. The competitor's response to a failure to innovate is given. It is a certain assumption that someone inside or outside the arena will introduce an innovation in order to secure market share at your expense.

In a duopoly, however, this assumption is not correct. In fact the competitor's response to one player's decision to maintain the status quo, will be agreement - maintain the status quo.

Innovation carries with it the high cost of research, development and obsolescence. The returns are uncertain. In a duopoly, the competitor will retaliate to a decision to innovate by copying the innovation, possibly at a lower research and development cost. The advantage may well fall to the second mover. While incurring the certain, high costs of introducing an innovation, the innovator will not likely realize any substantial reward in the form of an increase in market share. The decision tree appears in Figure 3.

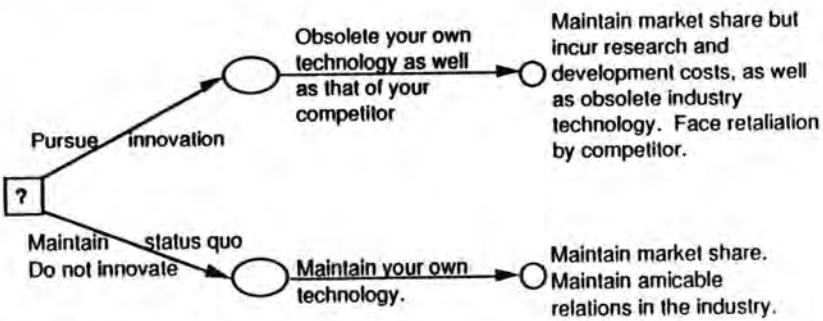


Figure 3.

The rational competitor in a duopoly will decide not to innovate and will respond in kind to a competitor's decision not to innovate.

The Prisoners' Dilemma

Those who follow game theory will immediately recognize this scenario as a classic example of the Prisoners' Dilemma. Two

prisoners have the choice of squealing on the other or maintaining silence. If neither squeals, both go free. If both squeal, both are hanged. If one prisoner squeals but the other doesn't, the squealer gets off, collects the reward, and sees the other hanged. The prisoner faces a dilemma. Clearly both are better off if they don't squeal. But one can profit from squealing, if the other does not have the same plan.

In an industry duopoly there is one more condition. If one squeals and the other, when confronted with the evidence, squeals also, then both spend life in prison. Clearly now, neither will squeal. Both will co-operate with the other to confound their jailers.

The model would suggest that innovation, at least the type that benefits the shipper, is a function of the competitive nature of the industry, which in turn is a function of its structure. It suggests that those industries which allow easy entry and exit will be most innovative. In those industries companies can enter freely and compete for market share and they can be easily forced out of the market by existing and entering competitors. Those industries are where market share is not guaranteed and customers have choice.

It also suggests monopolies, duopolies and other industries with high entry and exit barriers would not be innovative in reducing costs to the customer. In those industries market share is not up for grabs. Customers seldom have choice.

Extension of the Model to the Transportation Industry

Within the transportation industry we have both types of industries. The trucking industry has low entry and exit barriers. The rail industry is a duopoly.

If we look at innovation in the trucking industry we see a good deal of experimentation going on and many changes occurring. The industry has introduced new trailer configurations, lightweight trailers, specialized trailers and aerodynamic tractors. All designed to increase the payload or reduce costs. Many of these innovations occurred within days of regulations being changed to accommodate them. The industry is also active in changing vehicle weight and dimension regulations to accommodate these innovations. Most importantly we see the benefits passed on to the customer in the form of rate reductions.

The trucking industry is very competitive. It has used the benefits of its technological improvements to attack the railroad industry. It now dominates all short haul markets and most long haul non-bulk markets. The railroads have retreated to those markets where its old technology still has a relative advantage, the long haul of bulk commodities.

If we look at recent developments in the railroad industry we should note that a new tunnel has been built. This is a perfect example of a technological advancement as opposed to an innovation. It obsoletes nothing. It does not produce any benefits elsewhere in the rail system. It will not upset the competition.

An examination of the airline industry will also prove illustrative. Following deregulation there were new entrants in the air passenger business. Different planes were introduced to specialized routes. The pricing policies which were very innovative produced seat sales and reduced rates. There was a scramble for market share. Now we have the winners of the market share battle swallowing up other competitors. There is a natural duopoly emerging. Will seat sales disappear? What will happen to innovation.

Summary

The above has identified that revolutionary increases in productivity are usually associated with technological innovation, not technological advancement. Implementation of technological innovation is a function of the industry structure. That is, industries in which the competition is keen (ie. the trucking industry) are highly innovative whereas industries that lack competition (ie. the railroad industry) are not likely to innovate. Competition for market share is the source of innovation.

Bibliography

Porter, Michael E.. *Competitive Strategy: Techniques for Analyzing Industries and Competitors;* New York: The Free Press, Mcmillan Publishing Co., Inc., 1980

Rapoport, Anatol. *Two Person Game Theory: The Essential Ideas,* Ann Arbor: The University of Michigan Press, 1966

STRATEGIC CHOICE OF TRANSPORTATION TECHNOLOGY

E.G. Frankel

Introduction

Management of transportation technology deals with decisions of choice, timing, method of approach, rate of change and commitment or investment in the new technology and its development. These decisions must usually be made under conditions of uncertainty of the performance of the new technology.

There are also various internal and external constraints or regulations imposed, including the drive towards and need for technological change which today, more than ever before, determines the success of individuals, firms, and nations. This drive is largely imposed by external demands.

Each technological decision alternative is usually assumed to have an expected outcome which may require subsequent or conditional decisions (decisions conditioned by the outcomes of the first decision). A typical simplified transport technology change decision problem is shown in Figure 1.

Technological decision change may consist of many sequential stages where decisions at each stage have one or more possible outcomes. These outcomes have a conditional probability of occurrence (conditioned on the prior decision). There are usually a number of different outcomes from a decision which depend on possible uncontrollable futures (such as the reaction of competitors, actions of government regulators, chance discoveries, and more) and/or a known/assumed probability distribution of the outcome.

Outcomes from technological change decisions have different utilities for decisionmakers. If, for example, a change in transport technology results in a large increase in initial costs too large to be sustained, then this outcome may have little utility even though the new technology offers huge savings later in time. The utility of early cost savings may be much greater than that of later cost savings, particularly if lack of such saving, or worse each cost increase, drive the firm out of business. In transportation, there are usually different parties or decisionmakers involved, each with a unique objective which he attempts to maximize. As a result, technological change decisions are usually multi-objective problems which require a hierarchial or simulation approach for their solution.

In this paper the use of an analytical hierarchial process is described.

Alternative Transportation Technology Choice Decisions

Assume cumulative output Q_1 have been produced by technology 1 and there is a need to produce another q units of output, but the additional units could be produced by the same transport technology which has a learning curve cost $C_1(Q)$

$$C_1(Q) = a_1 Q^{-b_1} \qquad a_1 > 0 \qquad b_1 > 0$$

or by another transport technology 2 which has a learning curve cost $C_2(Q)$

$$C_2(Q) = a_2 Q^{-b_2} \qquad a_2 > 0 \qquad b_2 > 0$$

The cost of producing q more units using technology 1 is

$$C(Q_1, q) = \int_{Q_1}^{Q_1+q} a_1 Q^{-b_1}\, dQ$$

$$= \frac{a_1}{1-b_1}\left[(Q_1+q)^{1-b_1} - Q_1^{1-b_1}\right]$$

but

$$\left[(Q_1+q)^{1-b_1} - Q_1^{1-b_1}\right] = \frac{Q_1+q}{(Q_1+q)^{b_1}} - \frac{Q_1}{Q_1^{b_1}}$$

If $q \ll Q$, or for

$$q/Q_1 \to 0, \text{ then } (Q_1+q)^{b_1} = Q_1^{b_1} \text{ and } C(Q_1, q) = \left[\frac{a_1 Q_1^{-b_1}}{(1-b_1)}\right] q$$

If instead of producing the next q units of output using technology 1 we transfer to technology 2, then the cost of producing these q units is

$$C(0,q) = \int_0^q a_2 Q^{-b_2}\, dQ = \frac{a_2}{1-b_2}\left[q^{1-b_2}\right] = \frac{a_2 q^{1-b_2}}{(1-b_2)}$$

and if and only if

$$\frac{a_1 Q_1^{-b_1} q}{(1-b_1)} < \frac{a_2 q^{1-b_2}}{(1-b_2)}$$

should use of technology 1 be continued.

Let us next assume that we want to rationalize the use of two available technologies 1 and 2. Assume Q_1 and Q_2 are the cumulative outputs achieved by each at t, and that the cost of each follows a learning curve

for technology 1 $\quad C_1(Q) = a_1 Q^{-b_1}$

and

for technology 2 $\quad C_2(Q) = a_2 Q^{-b_2}$

Then if q is the additional output required of which q_1 and q_2 are produced by technology 1 and 2 respectively, then the total cost of producing $q = q_1 + q_2$ more units

$$TC(q; Q_1, Q_2) = \int_{Q_1}^{q_1+Q_1} C_1(Q)\,dQ + \int_{C_2}^{q_2+Q_2} C_2(Q)\,dQ$$

$$= \frac{a_1}{1-b_1}\left[(Q_1+q_1)^{1-b_1} - Q_1^{1-b_1}\right] + \frac{a_2}{1-b_2}\left[(Q_2+q_2)^{1-b_2} - Q_2^{1-b_2}\right]$$

To minimize $TC(q; Q_1, Q_2)$ consider

$$C_1(Q_1 + q_1) = a_1 (Q_1 + q_1)^{-b_1}$$

and

$$C_2(Q_2 + q_2) = a_2 (Q_2 + q_2)^{-b_2}$$

There are three cases of interest.

a. $C_1(Q_1 + q_1) < C_2(Q_2 + q_2)$ when it pays to use technology 1 and the cost saving is $C_2(Q_2 + q_2) - C_1(Q_1 + q_1 + 1) > 0$ when using technology 1 is always superior.

b. $C_1(Q_1 + q_1) > C_2(Q_2 + q_2)$ when technology 2 is always superior.

c. $C_1(Q_1 + q_1) = C_2(Q_2 + q_2)$ in which case either $C_1(Q_1+q_1) > C_1(Q_1+q_1+1) < C_2(Q_2+q_2+1) < C_2(Q_2+q_2)$ or $C_1(Q_1+q_1) > C_1(Q_1+q_1+1) > C_2(Q_2+q_2+1) < C_2(Q_2+q_2)$ but not both.

We must therefore use one or the other technology exclusively and

$$TC(q,Q_1,Q_2) = \text{Min}\ \left(\frac{a_1}{1-b_1}\left[(Q_1+q)^{1-b_1} - Q_1^{1-b_1}\right],\ \frac{a_2}{1-b_2}\left[(Q_2+q)^{1-b_2} - Q_2^{1-b_2}\right]\right)$$

$$TC(q,Q_1,Q_2) = \text{Min}\ \{TC_1(q,Q_1),\ TC_2(q,Q_2)\}$$

Considering Figure 2, we assume that the learning curves of two alternative technologies cross. In that case there is a cumulative output level Q at which the costs of production of the two technologies are equal.

Similarly if Q_T is the total output required, then there is an output level Q_E at which the cost of producing the remaining $(Q_T - Q_E)$ units of output is the same for either technology or

$$C(Q_T - Q_E) = \int_{Q_1+Q_E}^{Q_1+Q_T} a_1 Q^{-b_1} dQ = \int_{Q_2+Q_E}^{Q_2+Q_T} a_2 Q^{-b_2} dQ$$

and

$$\frac{a_1}{1-b_1}\left[(Q_1+Q_T)^{1-b_1} - (Q_1+Q_E)^{1-b_1}\right] = \frac{a_2}{1-b_1}\left[(Q_2+Q_T)^{1-b_2} - (Q_2+Q_E)^{1-b_2}\right]$$

Therefore under circumstances where both technologies have monotonically negative exponentially decreasing costs, and cross with $b_2 > b_1$ (i.e., the learning curve of technology 2 has a steeper slope), then the cost of producing Q_T is lower using technology 1 if $Q_E > 0$ but higher if $Q_E < 0$.

Looking at this problem differently, if Q_1 and Q_2 have been produced at a certain instant in time, there may be an additional output Q_{EQ} which can be produced by both technologies at the same costs, if the learning curves cross as shown. Similarly for any type of learning curves, including non-crossing learning curves, there are values of Q_1 and Q_2 at which the production of another Q_{EQ} units of output costs the same or

$$TC_1(Q_{EQ}, Q_1) = TC_2(Q_{EQ}, Q_2)$$

or

$$\frac{a_1}{1-b_1}\left[(Q_1+Q_{EQ})^{1-b_1} - Q_1^{1-b_1}\right] = \frac{a_2}{1-b_2}\left[(Q_2+Q_{EQ})^{1-b_2} - Q_2^{1-b_2}\right]$$

(The above does not always have a solution, except for the trivial solution $Q_{EQ} = 0$.)

Strategic Choice Among Transport Technology Alternatives

Selection among transport technology alternatives usually involves many different factors. At the technological level there is the choice among technological alternatives, the timing of adoption, introduction or acquisition of a chosen technology, and the scale as well as rate of introduction of the chosen technology. There are usually a number of measures of performance which affect the selection of technology, each of which has a different bearing on the different alternative technologies. Finally, there are usually a number of decisionmakers involved in the process of selection who in turn are influenced by exogenous and endogenous factors, such as government regulation, company finances, firm's market position, environmental rules, and more, as shown in Figure 3.

The structure of such a management problem is similar to a decision tree model, with the difference that alternatives or factors at different levels must be ranked or weighted to assure consideration of their respective influence, and also the interdependence of the interacting factors at the different levels of the hierarchy.

Decision tree models consider the outcome of alternative decisions in terms of the expected value to the decisionmaker and often use his utility function to rank the desirability of alternative decisions. In a strategic choice or hierarchical decision model, we assume knowledge of the relative weights of different factors (decisionmakers, areas of concentration, objectives, etc.) at the highest levels of the hierarchy, and the relative importance of factors at the level below.

This structural approach to choice making by priority setting and resource allocation was developed by Saaty [1] as the "analytic hierarchy process". The method uses paired comparisons to order priorities at each and sequential levels of hierarchy. It is particularly applicable to technological choice problems in transportation, as these are normally formulated in hierarchical terms, and involve multi-objective and multi-criteria decisions.

Technological choice problems, once formulated and structured as a hierarchy, can be decomposed into levels of factors (which are usually assumed to be independent across their level) and affect factors or elements at the next level. These effects are then again measured by paired comparison.

It is interesting to remember that hierarchical structuring, decomposition, and recomposition of problems, are a normal way in which most people present and resolve complex problems. The method really consists of three basic steps:

1. formulation of the hierarchy of the problem;
2. development of the weighing of the factors or elements at each level with regard to contribution of factors at the next level, using weights and paired comparison;
3. set the priority weight of the top level actors or factors; and,
4. repeat level by level until composite weight for each technological choice is obtained.

Problems of technological choice usually involve decisionmakers or actors, objectives, and alternative choices among technologies, their timing, and rate of introduction. The decisionmakers in such problems often plan various roles and have different weights in the decisionmaking process. For example, technological decisions in a small firm may involve technical, financial, marketing, and production managers, each of which has objectives or criteria that he employs in his decisionmaking. Also there is usually some ranking among such decisionmakers. Some, if not all, of the objectives are considered by

each decisionmaker, but each will usually put a different weight on a particular objective. Finally, each of the objectives has a different weighing in relation to each of the alternative technological choices.

the above is a typical technological choice decision problem, though quite often several levels of decisionmakers, objectives, and choices may exist and interact. In fact, most decisionmaking involves hierarchical structures of interdependent and interacting decisionmakers, criteria (or objectives) and choices. It requires planning, the development of a decision structure, the identification of decisionmakers, objectives, and alternatives, as well as the setting of weights and priorities. It may also involve selection of measures of performance, system design, and resolution of any conflict in interrelationships or interactions.

This type of three-stage hierarchical decision problem (Figure 4) can be solved by

- Pairwise comparison of the different actors in terms of their influence or weights on a scale of 100 - say technical/operating director 30%, financial director 20%, marketing director 10%, and operations manager 40%.

- Next the relative importance of the different objectives to each of the actors is compared. In other words, we determine the relative weights of the actor's influence on each objective so as to obtain the relative objective weights.

- Finally, we compare the alternative technologies with respect to their relative contribution to the achievement of each objective and weigh the impact priorities by the weighed objectives.

As shown in the Appendix, an eigenvalue approach is used to assure effective weighing of the factors. Similarly, methods can be used at discrete time intervals to obtain weighed time varying impact factor estimates. Considering the above three level problem, we would, in addition to the relative weights of the actors or first level weights or priorities

$$W_1 = [0.3,\ 0.2,\ 0.1,\ 0.4]$$

have the weights each actor places on each of the objectives. For example, the production manager may value productivity 3 times as highly as investment or capital cost and twice as high as quality, while valuing quality twice as important as capital cost. His weighing matrix would then be

	I	Q	P	Row Sums	Eigenvector
Investment I	1	1/2	1/3	1 5/6	.162
Quality Q	2	1	1/2	3 1/2	.309
Cost P	3	2	1	6	.529

and the eigenvector (corresponding to the maximum eigenvalue) is approximated by: $W_{Prod\ max} = (W_{PI}, W_{PQ}, W_{PP}) = (.162, .309, .529)$.

Using similar matrixes for each actor and performing a pairwise comparison, we can now determine the relative importance of each objective weighed by the priority weighing of each actor. At the next level we now use weighing matrices for each of the alternative technologies with respect to the preceding level factors, objectives, and repeat the procedure until we obtain the final weight of the alternative technologies.

The use of the hierarchical analytical technological choice method, obviously requires prediction of the performance, availability, and other characteristics of the alternative technologies. Cross-impact forecasting analysis is used as the most useful method available.

Quantitative Model for the Evaluation of Technological Alternatives

The major problem in the evaluation of technological alternatives is that the factors of concern in such an analysis are qualitative as well as quantitative. These factors can be considered separately, ignoring the other, jointly or integratively.

Integrating the results of qualitative and quantitative analysis appears to be the most effective approach. A model designed to integrate qualitative and quantitative factors by producing a unified technology performance measure for each technology alternative under consideration has been proposed by Sharif and Sundararajan [6] and is discussed here.

Technological evaluation usually requires:

1. identification and outline specification of technological alternatives;
2. determination of all qualitative and quantitative factors that influence the choice of a technology;
3. classification of all identified factors;
4. design and formulation of a general model; and,
5. evaluating using the selection model which permits effective comparison of alternative technologies identified for the defined purpose.

Selection from among technological alternatives involves identification of both exogenous (social, political, economic, etc.) and endogenous factors (productivity, technical performance, skill requirements, noise, etc.) that influence the choice decisions.

These factors can usually be identified by technical, operating, management, and other experts. Once they are identified it is necessary to divide these factors into (1) qualitative factors and (2) quantitative factors.

We usually find that such a strict classification is inadequate, as there are many qualitative factors which can be quantified even if not on an absolute scale, while there are quantitative factors which have qualitative characteristics which should also be considered. Furthermore factors should be grouped by their dominance as well as their type or category classed by Sharif and Sundararajan as

1. dominant factors which preclude or advance us of a technology;
2. objective or quantifiable factors; and,
3. subjective or qualitative factors.

The proposed model integrates the above factors with objective factors measured in some quantitative units (which need not be compatible) and subjective factors in qualitative terms.

The authors suggest use of an index or technology measure for technology i,

$$TM_i = DFM_i \left(\sum_{j=1}^{m} (A_j * OFM_{ij}) + A_o * SFM_i \right)$$

where

DFM_i = dominant factor measure for technology i ($DFM_i = 0$ or 1)

OFM_{ij} = jth objective factor measure for ith technology

$(0 \leq OFM_{ij} \leq 1)$

$i = 1,\ldots,n$ = number of alternative technologies

$j = 1,\ldots,m$ = number of objective factors

A_0, A_j = constants or relative weights with $\sum_{j=0}^{m} A_j = 1$

The dominant factor measure for technology i is computed as the product of all the dominant factor indices of that technology or

$$DFM_i = \prod_{\text{all } 1} [DFI_{i1}]$$

where

DFI_{i1} = dominant factor index for technology i with respect to factor 1.

It is important to note that DFM_i is a zero-one factor and therefore $TM_i = 0$ if $DFM_i = 0$.

Considering the objective factors in quantitative terms

$$OFM_{ij} = [OF_i / \sum_{i=1}^{n} OF_{ij}]$$

where

OF_{ij} = value of jth objective factor for ith technology

and

$$\sum_{i=1}^{n} OFM_{ij} = 1$$

Finally, to quantify subjective technology factors, the hierarchical analysis approach, developed by Saaty and discussed before, is proposed by the author as follows:

1. As in the AHP, a hierarchy of the problem is formulated by stages of actors, objectives, and alternatives.
2. Each element is weighed at its level in the hierarchy with respect to the contribution expected to elements or factors at the next level in the hierarchy by means of paired comparison.
3. The procedure is repeated until a composite weight is obtained for each technology alternative which represents the overall measure of that technology with respect to all subjective factors under consideration.

The result as in AHP is a normalized eigenvector whose elements are the relative weights of each technology relative to all the subjective factors considered.

The coefficients or weights A_j can be determined by factor analysis as follows:

$$Y_i = \sum_{j=0}^{m} a_{ij} F_j + b_i U_i$$

where

$i = 1,\ldots,n$

F_j = common factor, a function of some unknown variables

a_{ij} = weight for factor F_j and technology i

U_i = a unique factor of technology i

b_i = unique factor weight

and

$$\lambda_1 = \frac{a_{11}}{\sum_{all\ j} a_{1j}}$$

that is the weights are constructed from the first factor loadings.

The procedure is to subject all objective factors OF_j (j=1,...m) to normalization to obtain OFM_j. Simultaneously subjective factors SF_r (r=1...k) are subjected to eigenvalue analysis to obtain SFM_i or the subjective factor measure for each of the ith technologies.

The resulting subjective and objective factor measures (SFM and OFM_j's) are multiplied by the dominant factor measure DFM (obtained by multiplying all the dominant factors DF_i's) to obtain the final technology measure TM_i for technology i.

Summary and Conclusions

The use of the Analytic Hierarchical Process for the strategic choice of transportation technology from among alternatives is an effective approach which permits consideration of both qualitative and quantitative factors so essential in public service planning.

References

1. Saaty, T. L., "The Analytic Hierarchy Process - Planning, Priority Setting, Resource Allocation". McGraw-Hill Book Co., New York, 1985.

2. Saaty, T. L. and Vargas, L. G., "Estimating Technological Coefficients by the Analytic Hierarchy Process", Socio-Economic Planning Science, Vol. 13, 1979.

3. Saaty, T. L. and Vargas, L. G., "Hierarchical Analysis of Behavior in Competition: Prediction in Chess", Behavioral Science, 1980.

4. Alexander, J. and Saaty, T. L., "The Forward and Backward Processes of Conflict Analysis", Behavioral Science, No. 22, 1977.

5. Ramanjuan, V. and Saaty, T., "Technological Choice in the Less Developed Countries: An Analytic Hierarchy Approach", Technological Forecasting and Social Change, Vol. 10, 1981.

6. Sharif, M. N. and Sundararajan, V., "A Quantitative Model of the Evaluation of Technological Alternatives", Technological Forecasting and Social Change, Vol. 24, 1983.

Appendix - Analytic Hierarchical Process Methodology

Formulation of the Decision Problem

It is the central feature of the AHP that decision problems are structured in a hierarchical manner. The alternatives are placed in the lowest level (Figure A-1). The purpose of the method is to compute "total weights" for the alternatives and then choose that with the highest weight.

The idea is to work our way from the top to bottom in the hierarchy, computing the relative weights of all modes of a level with respect to all modes of the previous level taken one at a time. Then we combine these weights to get the "total weights" for the nodes of the level. For the structure of Figure A-1 we have

Level 0 - weight of node S : $W_s = 1$

Level 1 - W_{As}, W_{Bs}, W_{Cs} : weights of A, B, C with respect to S. $W_{As} + W_{Bs} + W_{Cs} = 1$

- Total weights + $W_A = W_{As}\ W_s$, $W_B = W_{Bs} \cdot W_s$, $W_C = W_{Cs} \cdot W_s$

Level 2 - W_{DA}, W_{EA} : weights of D, E, with respect to A : $W_{DA} + W_{EA} = 1$

- Similarly W_{DB}, W_{EB} with $W_{DB} + W_{EB} + 1$ and W_{DC}, W_{EC} with $W_{DC} + W_{EC} + 1$

- Total weights :
$W_D = W_{DA} \cdot W_A + W_{Dg} \cdot W_g + W_{DC} \cdot W_c$
$W_E = W_{EA} \cdot W_A + W_{EB} \cdot W_B + W_{EC} \cdot W_c$
where $W_D + W_E = 1$

Level 3 - In the same manner we have
W_{FD}, W_{ED}, W_{HD} and $W_{FD} + W_{GD} + W_{HD} = 1$
W_{FE}, W_{GE}, W_{HE} and $W_{FE} + W_{GE} + W_{HE} = 1$

and

$$\left.\begin{aligned} W_F &= W_{FD} + W_D + W_{FE} \cdot W_E \\ W_E &= W_{GD} \cdot W_D + W_{GE} \cdot W_E \\ W_H &= W_{HD} \cdot W_D + W_{HE} \cdot W_E \end{aligned}\right\} \text{ It holds: } W_F+W_G+WH=1$$

The W_F, W_G, W_H are the total weights of the alternatives. We choose the alternative with the highest weight. There is no limitation on the number of levels a hierarchy may have. The procedure continues similarly until the bottom level of the hierarchy is reached.

In the next section we discuss how to compute the relative weight W_{ij} (for example, W_{FD}, W_{GD}, W_{HD}).

Computation of Relative Weights

To calculate the relative weights of a set of nodes (i.e., factors, actors, alternatives) with respect to a mode (i.e., factor, actor) of the just higher in the hierarchy, we construct the pairwise comparison matrix of the nodes to be weighed. Then the eigenvector corresponding to the highest eigenvalue contains the desired weight (for more details and a justification of the method, see Reference 2 or bibliography 2, 3, 4, 5).

The elements (a_{ij}) of the pairwise comparison matrix (A) are evaluated as follows:

a_{ij} = how much more important is node i to node j only with respect of the node from the higher level.

For example,

a_{FG} = how much important alternative F is to G with respect to criterion D

The complete matrix looks like

Comparisons with respect to D

$$\begin{bmatrix} a_{FF} & a_{FG} & {}_aFH \\ a_{GF} & a_{GG} & a_{GH} \\ a_{HF} & a_{HG} & a_{HH} \end{bmatrix}$$

The following conditions apply:

$a_{ii} = 1$, for all alternatives
$a_{ji} = 1/a_{ij}$

The a_{ij}'s take on values in a scale from 1/9 to 9 defined as follows:

1 - i and j are equally important
3 - is moderately more important than j
5 - i is strongly more important than j
7 - there is a demonstrated importance of i over j
9 - there is an absolute dominance of i over j

while

2, 4, 6, 8 - are intermediate values.

Approximate Calculation of Eigenvectors

To facilitate the computations, approximate ways to calculate eigenvectors can be used. In a very simple approach they are assumed to be the eigenvectors corresponding to the maximum eigenvalue for the type of matrices involved in AHP (doubly stochastic matrices) which are given by the normalized row sums of the matrix, such as:

$$w = (1, \ldots, w_i, \ldots) \quad w_i = \frac{\sum_j a_{ij}}{\sum_i \sum_j a_{ij}}$$

Other approximating techniques also exist.

Consistency Measures

In a pairwise comparison matrix of dimensions mxm, a number of m(m-1)/2 comparisons are made (upper diagonal elements of the matrix). Where judgements in comparison perfectly consistent only (m-1) comparisons would be necessary. Consequently the excess number of pairwise comparisons makes the system overdetermined. Alternatively we can use averaging (as in the eigenvalue solution) to incorporate all information but we have to concede the requirement of a fully consistent set of judgements. There have been developed indices which can be used to evaluate the degree if inconsistency of a pairwise comparison matrix and assess its acceptability or not. This consistency index (CI) is based on the observation that for a fully consistent matrix all eigenvalues are zero except one (λ_{max}) which is equal to m (dimension of the matrix). Then CI is defined as

$$CI = \frac{\lambda_{max} - m}{m-1}$$

λ_{max} is always greater than or equal to m for a reciprocal matrix. Obviously CI = 0 for a fully consistent matrix.

The consistency ratio (CR) is defined as the ratio of the CI (the matrix under consideration) to the expected value of CI for the same size reciprocal matrix, if judgements were generated at random (within the scale 1/9 to 9). The following table shows the average CI's for different size matrices.

Table A-1 - Average CI for Randomly Generated Reciprocal Matrices

Size of Matrix	1	2	3	4	5	6	7	8	9	10
Expected CI	0	0	.58	.90	1.12	1.24	1.32	1.41	1.45	1.49

Matrices with a CR less than .1 are generally acceptable. In some cases we may accept judgements with a CR less than .20. Above that level though we should review the judgements.

Approximate Computation of λ_{max}

λ_{max} can be found by first finding the eigenvector corresponding to it (as discussed in a previous section) and then solving the equation $A \cdot W = \lambda_{max} \cdot W$. Since there are m equations for one unknown we can approximate λ_{max} by

$$\lambda_{max} = \frac{1}{m} \sum_i \sum_j \frac{a_{ij} \cdot w_j}{w_i}$$

(Note that for CR = 0 all m equations are identical.)

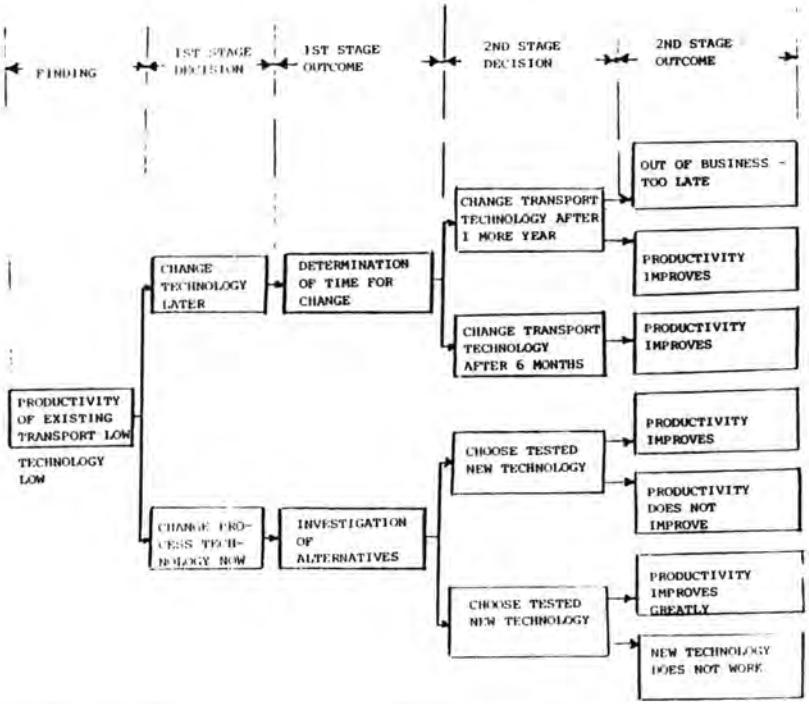


FIGURE 1 - SIMPLIFIED TRANSPORT TECHNOLOGY CHANGE DECISION PROBLEM

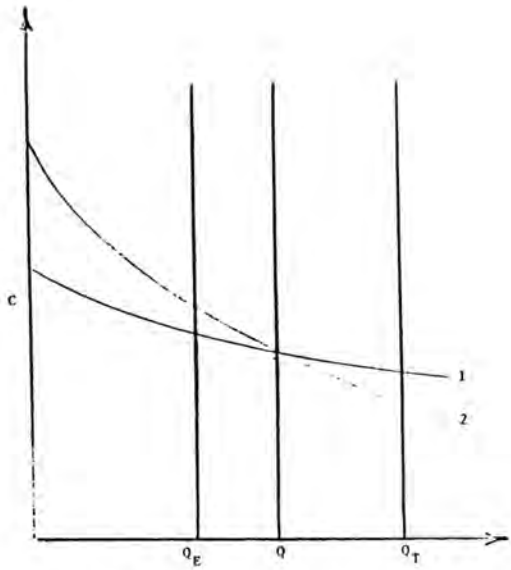


FIGURE 2 - LEARNING CURVES OF ALTERNATIVE TECHNOLOGIES

Axes start at Q_1, Q_s respectively.

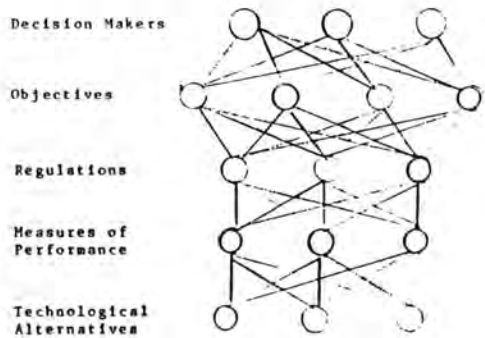


FIGURE 3 - HIERARCHIAL MANAGEMENT OF TECHNOLOGICAL CHANGE

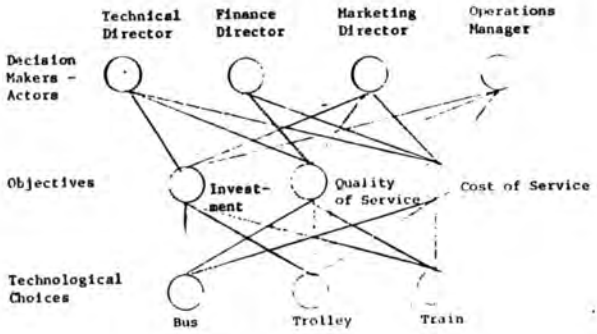


FIGURE 4 - THREE-STAGE TRANSPORT TECHNOLOGY CHOICE MODEL

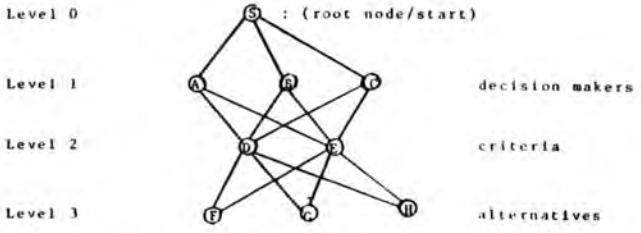


FIGURE A1 AHP - BASIC STRUCTURES OF PROBLEM

INDICES DE PRIX DU CAMIONNAGE POUR COMPTE D'AUTRUI AU CANADA

Par Bruno Jacques

Direction de l'analyse économique
Politiques et coordination
Transports Canada

RÉSUMÉ

Cet article propose une méthodologie pour mesurer objectivement les variations de prix du camionnage au Canada par la construction d'indices de prix. Un court survol théorique situe la méthode proposée, celle de Törnqvist, dans l'ensemble des méthodes courantes. L'application de cette méthode au camionnage canadien est ensuite examinée plus en détail et présentée en comparaison à la méthode utilisée récemment par M. Boucher dans le cadre d'une étude sur le camionnage québécois. Cette comparaison illustre l'importance du choix de la pondération, par les revenus ou par les tonnes-kilomètres, car les résultats obtenus diffèrent sensiblement selon la méthode utilisée. En effet, la pondération par les tonnes-kilomètres semble sous-évaluer la hausse des prix par rapport à la méthode originale de Törnqvist utilisant les revenus comme facteurs de pondération.

1. Introduction

La loi de 1987 sur les transports routiers prévoit qu'un examen complet de la réglementation devra être fait en 1992 et que des examens annuels devront être faits avant cette date. L'une des variables au centre de ces examens devra être les prix demandés pour le service de camionnage. Or, il n'existe pas actuellement de moyen pour mesurer objectivement les variations de prix du camionnage au Canada.

Mesurer objectivement les variations de prix est l'une des activités à la base de l'analyse économique. Elle implique que l'on observe les prix de transactions à différents moments et que l'on mesure les changements survenus. On utilise ensuite les résultats de différentes façons. Par exemple, lorsque cette mesure s'applique à un secteur particulier tel le camionnage,

elle permet d'évaluer l'effet de l'évolution de la concurrence dans ce secteur sur les variations du coût de ce service pour les usagers.

Cependant, bien que la mesure objective des variations de prix est un exercice courant en économique, il n'y a pas de méthode universellement préférée pour y parvenir. En effet, le degré de précision de la méthode et la crédibilité des résultats sont souvent proportionnels au coût de son application. En définitive, on se voit donc généralement contraint d'opter pour un compromis qui soit assez économique pour être applicable et, en même temps, suffisamment crédible pour être utile. Ainsi, on reconnait que l'utilisation d'indices permet de déterminer rapidement le sens et l'importance des changements de prix. Dans cet ordre d'idées, cet article propose une méthodologie spécifiquement adaptée à la situation au Canada, i.e. où le gouvernement se doit de faire le suivi de l'industrie du camionnage sur le plan économique tout en réduisant au minimum les contraintes de fonctionnement pour les transporteurs.

2. Arrière-plan théorique

De nombreuses recherches ont été faites dans le domaine des indices de prix afin d'identifier la méthode appropriée. Elles ont démontré, entre autres, que les indices de Laspeyres et de Paasche sont biaisés pour mesurer les variations de prix d'un ensemble de biens ou de services car ils ne prennent pas en compte les substitutions entrainées par les variations de prix [e.g. G. Stigler, 1942]. En effet, l'indice de Laspeyres utilise un panier de biens qui représente les quantités transigées durant la période de base, pour pondérer les variations de prix au cours des périodes subséquentes. Or, dans la mesure où les quantités transigées évoluent d'une façon non-proportionnelle avec le temps, l'utilisation d'un panier fixe biaise les résultats. En fait, les poids rattachés aux éléments qui deviennent relativement moins importants devraient diminuer tandis que l'inverse est également vrai en ce qui concerne les éléments qui accroissent leurs parts des transactions. Sachant que les éléments dont les prix s'accroissent le plus rapidement ont tendances à diminuer leurs parts de marché, l'indice de Laspeyres a tendance à surévaluer les hausses de prix. Un raisonnement semblable peut être appliqué à la méthode de Paasche qui utilise un panier de pondération issue des transactions de la période courante. L'indice de Paasche a donc tendance à sous-évaluer les hausses passées des prix.

I. Fisher [1922] a tenté d'identifier l'indice "idéal" qui ferait l'unanimité en répondant à un ensemble de critères souhaitables pour les indices. Sa contribution

fut appréciée surtout pour l'identification de ces critères puisque la "moyenne géométrique des indices de Laspeyres et de Paasche" qu'il proposa comme indice idéal ne répond pas à son propre ensemble de critères [voir Brian & Cape, 1982, p.8].

Un indice de prix devrait tenir compte continuellement des changements des prix et des quantités pour n'être pas biaisé. Par conséquent, la théorie économique suggère l'utilisation d'un indice intégral Divisia. Cependant, il n'est pas applicable en pratique car la cueillette systématique de l'information requise et son traitement seraient trop coûteux. L. Törnqvist en 1936 suggéra une approximation discrète de cet indice Divisia. Plus récemment, Diewert [1978] démontra que l'indice proposé par Törnqvist est un *indice numérique superlatif* et qu'il possède donc les qualités rattachées à ce type d'indice. Par exemple, étant chainé, il tient compte à la fois de l'évolution des prix et des quantités. La méthode de Törnqvist telle que proposée serait donc souhaitable pour la construction d'indices de prix. Toutefois, elle peut s'avérer fastidieuse dans son application à cause de la nécessité de connaitre les prix des transactions et leurs importances relatives pour chaque période concernée. Malgré ses inconvénients, la supériorité théorique de la méthode de Törnqvist pesa suffisamment lourd pour que l'on examine la possibilité de l'appliquer au camionnage pour compte d'autrui.

3. Application au camionnage

L'application de la méthode de Törnqvist à l'industrie canadienne du camionnage exige que l'on puisse relier aux transactions découlant de l'achat de services semblables de transport des prix et des revenus pour toutes les périodes incluses dans la période étudiée. L'application de la méthode débute donc par la classification des services de camionnage afin de former des groupes assez homogènes, c'est-à-dire dont les éléments sont comparables tout en étant pas trop spécifiques pour pouvoir comparer leurs prix et leurs quantités d'une période à l'autre. Cette définition des groupes est une opération clé et demande une connaissance approfondie de l'industrie. Idéalement, on devrait utiliser lors de cette classification des services toutes les variables qui influencent la fixation des prix à un moment donné, et partant, les variables qui déterminent l'évolution des prix du camionnage dans le temps. L'étude de la structure des taux de fret dans l'industrie a permis d'identifier clairement des variables dont il faut tenir compte [voir V. Wei, 1983].

Dans cette étude, le prix est exprimé par le "coût de l'expédition" divisé par le produit du "poids de la marchandise" par la "distance pancourue", l'unité est donc le cent par tonne-kilomètre. Cette façon d'exprimer les prix est maintenant largement répandue en transport car elle permet de comparer les coûts pour l'expéditeur entre des expéditions de distances et de poids différents mais comparables. Malgré cet état de fait, étant donné la présence d'économies d'échelle différentes pour ces deux variables (poids et distances), une classification demeure nécessaire.

Ainsi, dans une étude récente, M. Boucher [1988] suggère l'utilisation de quatre classes de distances et de trois classes de poids pour classifier les expéditions interurbaines à l'intérieur du Québec. De plus, pour chaque classe de transport ainsi définie, il utilise la description de la marchandise par le code S.C.C. à deux chiffres pour définir les éléments de base au calcul. Pour sa part, l'étude de V. Wei montre, entre autres, que le contexte réglementaire et d'autres conditions économiques diffèrent suffisamment d'une province à l'autre pour devoir en tenir compte.

De plus, certaines variables plus qualitatives telles la fiabilité et la rapidité du service pourraient aussi être incluses dans le processus de classification. Pour ces dernières variables, cependant, les difficultés de mesures et la non-disponibilité de données historiques sont des obstacles majeurs à leur prise en compte même si sur le plan théorique elles pourraient se justifier.

La base de données idéale pour l'application de la méthode de Törnqvist à l'industrie canadienne du camionnage devrait donc être assez désagrégée pour offrir la possibilité de classifier chacune des expéditions en tenant compte au moins des principales variables déjà nommées:

- **poids** de l'expédition
- **distance** parcourue
- **provinces** d'origine et de destination
- **marchandise** transportée

Si on connait en plus les revenus générés par chacune de ces expéditions, on peut calculer les prix implicites de ces expéditions car:
prix = revenu / (poids x distance)
ainsi que les quantités, car:
quantité = poids x distance.

Au Canada, aucune source ne peut fournir l'ensemble de ces données pour toutes les expéditions par camion. Toutefois, l'enquête de Statistique Canada sur l'origine

et la destination du camionnage au Canada (TOD) permet d'obtenir par échantillonnage des approximations relativement fiables de toutes ces variables en ce qui concerne le transport par camion pour le compte d'autrui par les entreprises ayant un revenu de plus de $350 000 à l'intérieur des frontières canadiennes. Aussi, les données de l'enquête TOD ont servi de base pour le calcul des indices. La période couverte par les indices débute à l'année de base, 1981, et se termine avec la dernière année pour laquelle les données sont disponibles: 1986.

Il est à noter que l'indice de Törnqvist est chainé. Cette qualité rend cette méthode mieux adaptée à l'utilisation de données recueillies par échantillons. En effet, le chainage atténue les variations brusques d'une année à l'autre qui peuvent être associées à l'échantillonnage.

4. Aspects méthodologiques

4.1 Source des données

Une enquête origine-destination typique recueille l'information sur environ 600 000 expéditions qui ont eu lieu au cours d'une année donnée. La méthode actuelle permet de traiter les données sur bande magnétique environ quinze mois après la fin d'une année. Par contre, une nouvelle méthodologie permettra dans quelques années d'obtenir des données trimestrielles préliminaires quelques mois après le trimestre. Ainsi, d'ici à quelques années les indices de prix pourront être calculés sur une base trimestrielle dans de plus courts délais.

4.2 Classification

Une fois classifiés, les expéditions ne forment plus qu'environ 8 000 groupes. Ces groupes se caractérisent par un "lieu", un poids, une distance et une marchandise semblables.

Concrètement, le lieu se défini selon, d'une part, que le trajet est intra-provincial ou inter-provincial et, d'autre part, selon les provinces concernées. Premièrement, on distingue pour se faire six "segments géographiques" intra-provinciaux: Atlantique, Québec, Ontario, Manitoba-Saskatchewan, Alberta et Pacifique. La distinction des trajets à l'intérieur d'une même province des trajets extra-provinciaux est principalement motivée par les différences dans les environnements réglementaires. Cette différence a aussi fait que l'Alberta se distingue des autres provinces des Prairies pour son segment intra-provincial. De plus, la petite taille et l'homogénéité relative des provinces de

l'Atlantique ont entrainé leur regroupement. Deuxièmement, on distingue onze segments géographiques inter-provinciaux: i.e. huit paires de trajets (vers l'est et vers l'ouest) entre les cinq grandes régions (Atlantique, Québec, Ontario, Prairies, Pacifique); deux segments entre les provinces d'une même région (Atlantique et Prairies) et, enfin; un dernier segment regroupe les trajets dits de "longues distances" car réalisés entre deux provinces n'appartenant pas à des régions limitrophes.

Signalons la présence de la distinction faite en rapport à la direction générale (est et ouest). Cette distinction permet de tenir compte du déséquilibre potentiel de la demande entre les cinq grandes régions dans le trafic interprovincial. Par conséquent, on tient compte implicitement du phénomène des "cargaisons de retour" qui pourrait en découler et qui influence les prix.

Au sein de ces dix-sept segments géographiques, la classification des expéditions se poursuit à l'aide de trois classes de poids et de quatre classes de distances. Les définitions de ces classes sont les mêmes que pour l'étude de Boucher [1988]. Il s'agit, pour les classes de poids, d'isoler les lots brisés (LTL) des charges complètes (TL). Ainsi on a séparé les expéditions de moins de 2272 kg (LTL1) et de plus de 4545 kg (TL) de la catégorie intermédiaire (LTL2) pour former deux catégories LTL et une dite de charge complète (TL). Les distances permettent de distinguer les expéditions selon qu'elles se situent entre 0 et 49 km, entre 50 et 199 km, entre 200 et 499 km ou, enfin, de plus de 500 km.

Les figures 1 et 2 montrent la répartition en pourcentage de l'ensemble des expéditions canadiennes au cours des deux dernières années (1985 et 1986 prises ensemble) pour les revenus et les tonnes-kilomètres respectivement pour les catégories de distances et de charges. Les pourcentages différents pour la même catégorie (ex. 500 km et +: 50% des revenus et 61% des tonnes-kilomètres) montrent que les prix sont différents en moyenne au sein des différentes catégories.

Comme prévu les prix ont tendance à diminuer plus le poids de l'expédition est élevé et plus la distance est grande. On remarque également que les catégories ayant les prix les moins élevés (les charges complètes et les distances de plus de 500 km) dominent la "production" canadienne avec respectivement 88% et 61% des tonnes-kilomètres. Le sous-ensemble défini par les charges complètes de plus de 500 km a accaparé 28% des revenus tout en représentant près de 52% de la production totale évaluée en tonnes-kilomètres. La classification par ces

LE CAMIONNAGE CANADIEN POUR LE COMPTE D'AUTRUI 1985-86

FIGURE 1

PARTS DES GROUPES DE DISTANCES

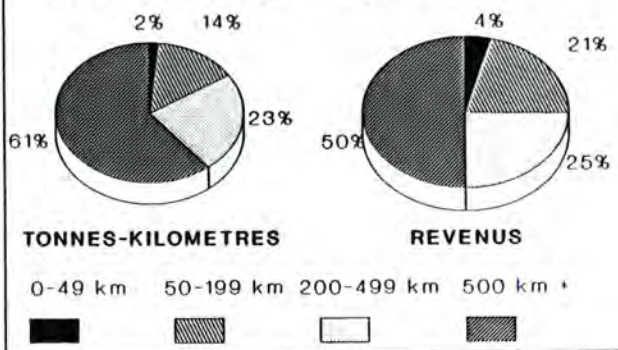
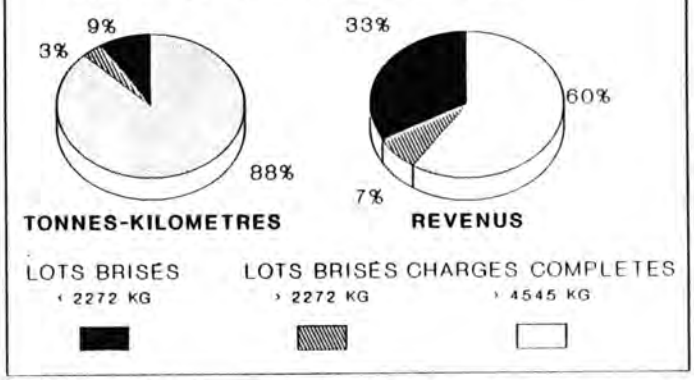


FIGURE 2

PARTS DES GROUPES DE POIDS



SOURCE: ANALYSE ÉCONOMIQUE, TRANSPORTS CANADA

variables est donc justifiée empiriquement puisque, d'une part, ces variables influencent les prix et que, d'autre part, les différentes classes n'ont pas la même importance.

4.3 Calcul des indices

Le calcul des indices de prix se fait sur la base des segments de l'industrie définis par les trois variables: trois classes de poids, quatre classes de distances et dix-sept segments géographiques. Théoriquement, il y a donc 204 segments possibles. Cependant, une analyse quantitative détaillée des segments ont permis d'éliminer ceux dont l'importance était si faible qu'elle ne permettait pas l'application de la méthode choisie. Par exemple, le nombre des expéditions de moins de 50 km entre deux provinces étant trop peu élevées, cette catégorie a été éliminée des onze segments géographiques extra-provinciaux. Ainsi, le nombre de segments qui entrent dans le calcul des indices a donc été réduit à 151. Malgré ces retraits, plus de 98% de la production canadienne de camionnage, évaluée en tonnes-kilomètres et faite par les firmes de classes I et II, entre dans le calcul des indices de prix.

La formule de Törnqvist prend la forme mathématique suivante:

$$c(p^1)/c(p^0) = \prod [p_i^1/p_i^0]^{\frac{1}{2}[s_i^1 + s_i^0]}$$

Selon DIEWERT [1976 p. 123].

Toutefois, une transformation algébrique a été appliquée dans nos calculs informatisés, soit:

$$c(p^1) = c(p^0) \times \exp \tfrac{1}{2} \Sigma \left([\ln (p_i^1) - \ln (p_i^0)] \times [s_i^1 + s_i^0]\right)$$

Dans les deux cas on a:

$c(p^t)$: l'indice des prix au temps t,

p_i^t : le prix de l'élément i au temps t,

s_i^t : la part de l'élément i dans les revenus au temps t.

Au sein des 151 segments, les éléments i de base sont définis par le code de la marchandise transportée (code à deux chiffres S.C.C.). Évidemment, si un code de marchandise n'est pas présent durant la période courante

(1) ou précédente (0), l'élément correspondant n'est pas utilisé dans le calcul de l'indice. Il n'y a donc aucun prix d'imputé nul dans le calcul.

La variable de pondération suggérée par Törnqvist est la part en pourcentage de l'élément dans les revenus, plus exactement la moyenne des parts courantes et précédentes. Toutefois, Boucher [1988], dans son application au camionnage intra-provincial québécois, utilisa plutôt comme facteur de pondération la part de l'élément dans la production mesurée en tonnes-kilomètres. Afin de comparer les deux méthodes, tous les calculs ont été fait en utilisant comme facteur de pondération les tonnes-kilomètres puis les revenus.

4.4. Agrégation des indices

L'interprétation des 151 séries d'indices de prix n'est pas aisée sans leur agrégation. Aussi, un ensemble d'agrégations ont été réalisées en distinguant tour à tour les segments géographiques, les classes de poids et les classes de distances. La méthode utilisée pour l'agrégation s'inspire de la pondération entrant dans la méthode de Törnqvist soit une moyenne mobile sur deux périodes, la présente et la précédente. Algébriquement, l'agrégation des séries d'indices est faite à l'aide de la formule suivante:

$$c(p^1) = \Sigma\, c(p^1)_i \times \tfrac{1}{2} [s_i^1 + s_i^0]$$

où: $c(p^1)$: l'indice agrégé au temps 1,

$c(p^1)_i$: l'indice du segment i au temps 1,

s_i^t: la part du segment i dans l'ensemble à agréger, mesurée selon les revenus (ou selon la production en tonnes-kilomètres) dépendamment des séries d'indices à agréger.

D'aucuns prétendent que les calculs des indices appliqués à des secteurs précis de l'industrie pourraient être souhaitables à partir des éléments de base au lieu de faire l'objet d'agrégations de séries. Une analyse comparative des séries obtenues par les deux approches devrait toutefois faire l'objet de recherches empiriques approfondies avant d'arriver à une conclusion définitive.

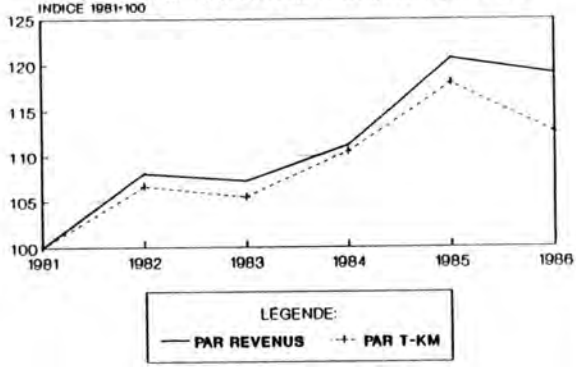
5. Principaux résultats

La figure 3 permet de suivre les indices de prix pour l'ensemble du camionnage pour compte d'autrui au Canada selon le type de pondération. Elle permet de constater que la méthode de pondération par les tonnes-kilomètres a tendance à sous évaluer de façon significative la hausse des prix du camionnage par rapport à la pondération d'origine par les revenus. Il est notable cependant que le sens des variations sont identiques pour les deux types d'indices. Les deux méthodes illustrent que la hausse annuelle moyenne des prix a été relativement faible au cours de la période (entre 3,4% et 2,4% selon la méthode utilisée).

La figure 4 montre l'évolution des prix selon la pondération par les revenus pour les trajets intra-provinciaux et extraprovinciaux de façon séparée. La croissance des prix aurait été semblable au cours de la période 1981-86 sur ces deux grands segments de l'industrie. Toutefois, l'amplitude des variations semble avoir été plus importante sur le segment le moins réglementé, i.e. l'extraprovincial.

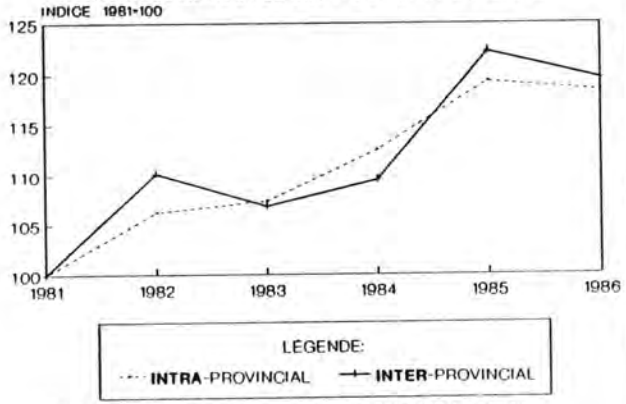
Ces deux exemples illustrent brièvement le genre d'analyse que la méthode proposée pour construire les indices de prix permet d'accomplir. Le tableau 1 contient les séries d'indices par segments géoraphiques telles que calculées par la méthode de Törnqvist d'origine, i.e. avec la pondération faite à partir des parts de revenus.

FIGURE 3
INDICES DE PRIX
PONDÉRATION COMPARÉE DU TORNQVIST
CAMIONNAGE POUR LE COMPTE D'AUTRUI AU CANADA



SOURCE: ANALYSE ÉCONOMIQUE, TRANSPORTS CANADA

FIGURE 4
INDICES DE PRIX PONDÉRÉS PAR LES REVENUS
INTRA-PROVINCIAL ET INTER-PROVINCIAL
CAMIONNAGE POUR LE COMPTE D'AUTRUI AU CANADA



SOURCE: ANALYSE ÉCONOMIQUE, TRANSPORTS CANADA

TABLEAU 1
INDICES DE PRIX PAR SEGMENTS GÉOGRAPHIQUES
Méthode de Törnqvist, pondéré par les revenus
Camionnage pour compte d'autrui
1981 à 1986
1981 =100

	1981 cents/t-km	1982	1983	1984	1985	1986
INTRAPROV.	10.0	106.2	107.4	112.5	119.4	119.0
ATL.	9.6	114.5	109.6	119.7	114.0	116.2
QUE.	10.3	111.5	110.8	119.5	121.8	120.8
ONT.	10.8	105.3	106.1	110.1	118.5	119.3
MAN/SAS	9.3	110.3	109.2	113.5	114.9	110.8
ALTA	8.6	99.8	102.3	108.3	125.6	120.9
PACIF.	10.2	104.0	110.6	111.0	116.4	113.8
INTERPROV.	8.1	110.2	106.9	109.5	122.2	119.6
ATL.	9.9	113.9	122.1	124.1	124.0	124.8
ATL/QUE	5.3	121.7	120.8	122.1	124.8	134.1
QUE/ATL	9.2	105.3	111.1	105.6	126.5	119.6
QUE/ONT	10.0	110.5	105.5	109.8	115.8	120.3
ONT/QUE	10.9	109.6	99.8	102.4	113.6	113.4
ONT/PRAI	8.2	116.7	110.6	115.2	132.8	126.2
PRAIRIES	7.2	110.0	106.3	115.2	132.8	126.2
PRAI/ONT	6.6	111.2	114.2	118.3	123.3	124.5
PRAI/PAC	7.1	109.0	102.1	105.9	107.4	106.4
PAC/PRAI	6.6	107.1	104.8	105.2	110.3	114.4
LONG.DIST.	7.7	108.2	105.7	107.4	133.7	124.8
NATIONAL	8.9	108.0	107.2	111.2	120.6	119.0

Source: Analyse économique, Transports Canada.

Dans ce tableau, pour l'année 1981, au lieu de la valeur de l'indice qui est évidemment égale à 100 pour toutes les séries, le prix moyen exprimé en cents par tonne-kilomètre est présenté pour donner une idée du **niveau** des prix pour les différents segments géographiques. Cette information permet de nuancer l'analyse puisque, par exemple, le segment où la hausse des prix a été la plus élevée de 1981 à 1986, sur les trajets de l'Atlantique vers le Québec, avait aussi les prix moyens les plus bas en 1981. Il peut donc s'agir que d'un ajustement conjoncturel et non d'une hausse anormale.

Le tableau 2 présente les indices nationaux segmentés

selon les classes de charges et de distances. Ces séries d'indices permettent de suivre l'évolution des prix dans des segments qui sont très différents sur ce plan comme le révèle les prix moyens de 1981. Ce tableau montre que les prix moyens ont en général augmenté plus rapidement dans la catégorie des longues distances et pour le groupe de poids intermédiaires.

TABLEAU 2
INDICES DE PRIX PAR CLASSES DE DISTANCES ET DE POIDS
Méthode de Törnqvist, pondération par les revenus
Camionnage pour compte d'autrui
1981 à 1986
1981 = 100

	1981	1982	1983	1984	1985	1986
	cents/t-km					
1-2271 kg	28.4	109.8	107.9	112.4	129.2	129.9
0-49km	190.1	104.8	98.2	106.4	113.9	112.8
50-199km	91.4	108.0	106.5	110.6	117.0	126.3
200-499km	42.7	107.6	109.1	114.9	123.4	130.8
500km +	20.8	111.5	108.3	112.0	136.6	131.5
2272-4544kg	16.5	112.4	117.5	119.1	126.3	130.9
0-49km	54.8	119.8	125.9	125.9	112.9	133.6
50-199km	39.1	108.2	115.2	111.2	119.6	129.2
200-499km	21.3	118.3	121.6	124.7	129.1	135.3
500km +	13.3	111.1	116.2	118.6	127.5	129.7
4545kg +	6.1	106.4	105.5	109.6	115.2	111.4
0-49km	16.2	107.5	105.1	112.9	122.1	122.6
50-199km	9.9	104.2	102.8	107.6	111.9	108.0
200-499km	6.5	107.2	109.8	109.4	115.2	110.1
500km +	4.9	107.0	104.8	110.3	116.2	112.7
NATIONAL	8.9	108.0	107.2	111.2	120.6	119.0
0-49km	22.1	107.5	104.6	112.1	120.0	120.9
50-199km	14.1	105.5	104.5	108.6	113.7	114.2
200-499km	9.7	108.0	109.9	112.2	118.8	118.6
500km +	7.4	109.0	107.0	111.7	124.5	121.0

Source: Analyse économique, Transports Canada.

6. Conclusion

Dans la mesure où l'enquête de Statistique Canada sur l'origine et la destination des marchandises transportées par camion (TOD) reflète la réalité de l'évolution des prix du camionnage pour compte d'autrui au Canada, la méthode de Törnqvist telle que présentée ici peut fournir des outils efficaces de mesure des variations de ces prix. La méthode de pondération par les revenus est probablement préférable à la pondération par les tonnes-kilomètres puisque l'indice ainsi calculé répond aux critères d'un indice numérique superlatif. Par contre, la formation de séries d'indices pour de grands segments de l'industrie par la simple agrégation des indices de ses composantes devrait faire l'objet d'une vérification empirique plus poussée pour étayer sa validité.

BIBLIOGRAPHIE

BOUCHER, Michel. Les indices de prix en transport routier des marchandises: problématique et pertinence. ENAP, CREP. 31 mars 1988.

BRYAN, Ingrid A. et CAPE, David M. Indice des taux de fret des conférences maritimes pour les exportations canadiennes. Commission canadienne des transports, cahier de recherche no.1982/01F.

DIEWERT, W.E. "Superlative Index Numbers and Consistency in Aggregation", *in* Econometrica Vol. 46 No. 4(juillet, 1978) pp. 883-900.

_____"Exact and Superlative Index Numbers" *in* Journal of Econometrics 4 (1976) pp. 115-145.

ECONOMIC COMMISSION FOR EUROPE Principles for the Development of a Manual on Price and Quantity Indices in Transport.WP No 5 (Sept. 1988) 13 pp.

JACQUES, Bruno. Indices de prix du camionnage pour le compte d'autrui au Canada 1981-1986. Document de présentation, Conférence sur les statistiques en camionnage, Ottawa, 3 novembre 1988.

STATISTIQUE CANADA. Le camionnage au Canada 1986. Ottawa, Approvisionnement et services, juillet 1988. 219 pp.

STIGLER, George J. The Theory of Price, New York, MacMillam Pub. (3rd edition 1966), 355 pp.

WEI, Vivian La structure des taux dans l'industrie canadienne du camionnage pour compte d'autrui. Effets de la réglementation économique. Commission canadienne des transports, cahier de recherche no. 1983/02F.

PRICE INDICES FOR THE QUEBEC TRUCKING INDUSTRY: AN EXPLORATORY INVESTIGATION

Michel Boucher
École nationale d'administration publique
Université du Québec

I. Introduction

The new National Transportation Act of 1987[1] requires that the Department of Transport presents an annual report in which one of the main objectives is the evaluation of the regulatory reform implemented by this new law. The evolution of rates and tariffs in the trucking industry constitutes one of the important variables which must be studied in order to determine the consequences that this legislative reform will have on the conduct of the trucking industry. The best way to analyze the price behaviour in the trucking industry naturally consists in developing a price index or some price indices which reflect the monetary evolution of the main variables relevant to the transportation cost. Actually, no such price indexes exist in the trucking industry, although some attempts have been made to establish them in the liner shipping industry[2]. Thus, the primary objectives of this study are twofold: to examine the feasibility of constructing such price numbers for the Quebec trucking industry, and also, to assess how operational they can be when evaluating the regulatory reform.

The body of this paper contains five sections. Various price indices used in the study are presented in Section II. Section III describes the various elements which determine the existing structure of rates and tariffs. Our construction of the price numbers for the Quebec trucking industry follows in Section IV. Section V briefly investigates how it may be possible to expand the Statistics Canada time series by using information published by the Quebec Tariff Bureau Inc. Our conclusions are contained in Section VI.

II. General Considerations on Price Indexes

Index numbers are generally used to measure the magnitude of changes in price levels of a consumption or production pattern over time based on a group of representative goods and services consumed or produced. For instance, the Consumer Price Index (CPI)[3] measures the percentage of change through time in the cost of purchasing a constant "basket" of goods and services representing the purchases by a particular population group in a specified time period, generally a month. Changes in the costs of this basket are therefore due only to "pure" price movements and not to "real" (quality and/or quantity) movements. In comparison,

trucking rates and tariffs indices in Quebec are price numbers specifically designed to reflect the variations over time in the price of transportation services provided by Quebec trucking firms to carry goods of a given weight over a given distance.

Two price numbers are thus adopted to describe the evolution of the Quebec rates and tariffs over time, the direct Laspeyres index (L) and the Tornqvist index (T)[4]. The choice of these indices was dictated by their simplicity and their low computation cost. The direct Laspeyres index has two main characteristics, a fixed base period and fixed weights, and it can be calculated in the following manner

$$L = \frac{\sum_i P_{it}\, q_{i0}}{\sum_i P_{i0}\, q_{i0}} \qquad (1)$$

where q_{i0} are the fixed weights of the base year 0, p_{i0} and p_{it} are the respective prices of the goods in year 0 and year t. The price is always measured by the revenue per tonne-kilometre and the quantity or the output is the tonne-kilometre.

The Tornqvist index which is in the class of chain indices can be written as

$$\ln P_{t+1} - \ln P_t = \sum_{i=1} (\ln p_{it+1} - \ln p_{it}) \frac{(w_{it+1} + w_{it})}{2} \qquad (2)$$

where ln is the natural logarithm, P_{t+1} and P_t are the respective price numbers in years t+1 and t. Respective shares (w_i) in years t+1 and t are defined as the percentage of tonne-kilometres for each commodity or for each aggregate commodity relatively to the overall tonne-kilometres in a given year.

The reading of the Tornqvist index formula shows that its left-hand side gives the rate of growth of the price index over time as a function of the rate of growth of the sum of each commodity price or each aggregate commodity price weighted by the simple average of the respective shares of each of the components. One of the main characteristics of the Tornqvist index is to explicitly take the variability of the relative share of a commodity or aggregate commodities over time into account. This variability in the composition of commodities over time is generally caused by changes in the shipment size and/or the length of haul of commodities carried by trucking firms.

III. The Existing Structure of Rates and Tariffs

The demand for transportation service is a derived demand in that transportation is really a production factor needed by a firm to carry its commodities from the production plant to the market place where they will be sold. Changes in price levels observed on the trucking market directly refer to changes in prices for intermediary inputs.

The main element in the general structure of Quebec rates and tariffs is the F.A.K. (freight of all kinds) number 100. The F.A.K. No-100 rate is calcultated for 9 weight bases, starting from a LTL (less-than-truckload) shipment inferior to 500 pounds to a TL (truckload) shipment weighing 40 000 pounds and for 76 road bases or distances, beginning from a distance less than 25 kilometres to 2213 kilometres. These rates, until very recently set by the Quebec Tariff Bureau Inc., reflect the structure of the average operating costs of Quebec trucking firms which are members of this trade association. Moreover, the F.A.K. No-100 tariff, generally expressed in a matrix format, is also widely used as the "reference rate" by trucking firms when determining other rates and tariffs.

In addition to F.A.K. rates, the present system consists, of agreed charges, contract clauses and commodity rates. The first two types of rates and tariffs are generally applied to TL shipments fulfilling some strict conditions and their level may vary between 50% to 60% of the reference rate. Commodity rates apply to a specific commodity, of a determined minimum weight, generally in shipments higher than 5 000 pounds, to be carried between an origin and a destination at regular intervals. Commodity rates charged generally represent 75% to 85% of the F.A.K. No-100 rate. All of these rates and tariffs, it must be briefly mentioned, are set up by the configuration of the firm network, as determined by the Quebec Transport Commission, the regulatory board, and by also the utilization rate of the same network by the trucking firm.

Two surveys, conducted by the Quebec Tariff Bureau Inc. among a number of its trucking firms offering intraprovincial service in 1977 and 1985, indicate a strong move from F.A.K. rates to commodity rates. In other words, Quebec rates and tariffs are determined by market forces, in spite of the regulatory regime. Table 1 summarizes the distribution of rates and tariffs with respect not only to revenues but to weight as well.

Table 1
Percentage Distribution of Revenues and Weight of Goods Carried by Rates and Tariffs (1977 and 1985)

Rates and tariffs	Revenues		Weight	
	1977	1985	1977	1985
F.A.K. rates	57.8	39.6	21.8	9.9
Commodity rates	38.0	50.9	72.4	80.4
Contract Clauses and Agreed Charges	3.6	7.9	5.8	9.7
Miscellaneous	0.6	1.6	-	-

Source: Quebec Tariff Bureau Inc., Montreal 1985.

IV. Construction of the Quebec Trucking Price Indices

The Quebec data used in this paper are derived from confidential tapes compiled by Statistics Canada from the For-Hire Trucking Origin and

Destination Survey (TOD) for the years 1982, 1983, 1984 and 1985[5]. The TOD survey, as it is known, records information pertaining to shipments carried by a subsample of carriers appearing on the Motor Carriers' Freight Survey. More specifically, this data bank contains information on the origin and the destination of a shipment, the category of products carried, up to the division code (two-digit) and to the group code (three-digit)[6], the number and the weight of the shipment, and its revenues. The division code classification is selected because the group code classification produces erratic price index results which come from the low statistical degree of reliability of data sampled and the high volatility of data sampled over time. Then, those two-digit commodities are retained if and only if they are sampled for every year of the analysis. Finally, all information judged as dubious, doubtful and aberrant is rejected.

Two sets of commodities are considered for the calculation of price numbers. The first set refers to all the commodities found in the data bank which fulfill the particular condition of continuity over time, whereas the second is formed by only considering the main commodities of the sample.

The First Set: All Commodities

To begin with, the first set of commodities is disaggregated up to the main characteristics of a given shipment, its length of haul or distance and its weight or size. The computation of trucking price indices is then realized in two successive steps. In the first one, all commodities are disaggregated up to four different and exclusive lengths of haul, namely 0 to 49 kilometres, 50 to 199 kilometres, 200 to 499 kilometres and 500 kilometres and over; the Laspeyres index and the Tornqvist index are thus calculated for each class of distance. In the second step, for each of those four classes of distance, a disaggregation of commodities is realized up to three categories of shipment size, namely 1 to 2271 kilogrammes (1 to 5 000 pounds), 2272 to 4543 kilogrammes (5 000 to 10 000 pounds) and 4544 kilogrammes and over (10 000 pounds and over); once again, Laspeyres and Tornqvist indexes are computed. These different disaggregations of commodities up to these two attributes give 837 data on a theoretical possibility of 1 200 cells. In other words, 69.75% of the information contained in the data bank is thus used.

Table 2 presents the Laspeyres (L) and the Tornqvist (T) indices for the commodities disaggregated up to the four classes of distance and also a general price index for the overall commodities without any disaggregation at all. The latter is introduced as a standard to judge how important and necessary is disaggregation when calculating price indexes. In addition to these two price numbers, table 2 also gives the price per tonne-kilometre in dollars, the level of output in tonne-kilometres and the relative share of ouptut in percentage.

Table 3 presents the same price information but this time, commodities are sucessively disaggregated, for a given class of distance which is the classe of 0 to 49 kilometres, and for three categories of shipment size. The "all shipments" category is incorporated into this table to show, once again, that disaggregation of commodities up to their two main characteristics is a necessary condition in the computation of a trucking price index.

Table 2

Tornqvist (T) and Laspeyres (L) Price Indices,
General and Disaggregated up to the Lenght of Haul
1982-1985

	1982	1983	1984	1985
General				
Index (T)	100	105.48	82.35	93.46
Index (L)	100	101.61	83.72	78.39
Price	0.1321	0.1198	0.1408	0.1454
Share	-	-	-	-
Output	3,455,195,299	3,769,889,858	3,491,000,000	3,790,892,246
Distance 0-49 km				
1. All Shipments				
Index (T)	100	114.61	101.86	74.32
Index (L)	100	112.34	108.66	80.63
Price	0.9145	1.0962	0.9309	1.0026
Share	0.0280	0.0188	0.0279	0.0324
Output	96,666,768	70,915,198	97,364,174	122,897,330
Distance 50-199 km				
1. All Shipments				
Index (T)	100	97.30	97.13	96.44
Index (L)	100	96.63	93.15	88.01
Price	0.1721	0.1630	0.1628	0.1558
Share	0.2227	0.2074	0.2554	0.2850
Output	769,484,309	781,693,277	891,513,024	1,081,552,509
Distance 200-499 km				
1. All Shipments				
Index (T)	100	94.58	100.48	90.78
Index (L)	100	93.96	91.72	83.87
Price	0.1168	0.1104	0.1037	0.1048
Share	0.3751	0.3871	0.4678	0.4680
Output	1,296,348,009	1,459,475,840	1,633,327,241	1,773,886,689
Distance 500 km and over				
1. All Shipments				
Index (T)	100	114.25	69.75	95.31
Index (L)	100	108.37	74.00	71.51
Price	0.0652	0.0586	0.0955	0.0904
Share	0.3742	0.3867	0.2489	0.2145
Output	1,292,696,216	1,457,805,543	868,894,622	812,917,717

Table 3

Tornqvist (T) and Laspeyres (L) Price Indices
Disaggregated for the First Class of Distance
and for Three Categories of Shipments
1982-1985

	1982	1983	1984	1985
Distance 0-49 kms				
1. All Shipments				
Index (T)	100	114.61	101.87	74.32
Index (L)	100	112.34	108.66	80.63
Price	0.9145	1.0962	0.9309	1.0026
Share	0.0280	0.0188	0.0279	0.0324
Output	96,666,768	70,915,198	97,364,174	122,897,330
2. Shipments 1-2271 kg				
Index (T)	100	119.14	85.95	108.72
Index (L)	100	90.17	96.79	103.19
Price	11.3258	8.9905	3.1344	3.8710
Share	0.0004	0.0003	0.0007	0.0009
Output	1,357,678	1,091,007	2,591,236	3,279,154
3. Shipments 2272-4543 kg				
Index (T)	100	86.57	97.12	105.06
Index (L)	100	81.37	81.31	95.10
Price	2.0309	2.1673	1.8774	1.7488
Share	0.0003	0.0002	0.0004	0.0005
Output	912,874	780,364	1,415,640	2,018,176
4. Shipments 4544 kg and over				
Index (T)	100	114.69	101.97	74.11
Index (L)	100	112.55	108.82	80.50
Price	0.7539	0.9594	0.8774	0.9099
Share	0.0273	0.0183	0.0267	0.0310
Output	94,396,215	69,043,827	93,357,298	117,600,000

The Second set: Main Commodities

The inclusion of important commodities in this sample is realized by considering commodities which are disaggregated not only up to four lengths of haul, but also for each class of distance, commodities are then disaggregated up to three categories of shipment size. Selected commodities are those which meet the two following different thresholds: first of all, their output, measured in tonne-kilometres, must be higher than the average output in their respective group and secondly, their number of shipments must also be superior to their respective average group. As commodities do not strictly satisfy these two conditions, some of them are also included when fulfilling the first criterion, the tonne-kilometre. Table 4 presents the number of commodities kept for the entire period of analysis when the two selective criteria are applied. The number of observations decreases from 837 to 256 or 21.33% of the sample. Moreover, the latter seem to be unequally distributed among cells. For instance, the smallest class of distance seems to be under represented relative to other classes of distance, whereas the smallest category of shipment size seems, on the contrary, over represented.

Table 4
Number of Commodities Retained After
Applying Two Criteria of Selection

Distance in km / Size in kg	0-49	50-199	200-499	500 and over	Total
1-2271	22	23	25	30	100
2272-4543	10	25	21	15	71
4544 and over	16	22	25	23	86
Total	48	70	71	67	256

Rather than reproduce tables similar to those obtained when the first set of commodities was briefly analyzed, we now focus on the main conclusions drawn from these various calculations of price indices. First of all, both Laspeyres and Tornqvist price numbers, calculated for these two sets of commodities which are disaggregated in turn not only for four lengths of haul, but also for each class of distance, up to three shipment sizes, give better information on price changes than more aggregated overall indices. Technically speaking, there is always a gain of information when the analysis passes from a more aggregated to a less aggregated level. As overall price indices may be compatible with different characteristics of commodities and with different market conditions, price numbers calculated on commodities disaggegated which have thus relatively the same main characteristics give a clearer pricture of "true" price changes by reducing the level of uncertainty[7]. Secondly, a comparison of the results obtained by using Laspeyres and Tornqvist indices shows that Tornqvist index results are generally better and more reliable than those obtained by Laspeyres indices. As the Tornqvist price index is a chain index, it changes less than a fixed base period index like Laspeyres' as the commodity mix, carried by trucking firms, shifts over time.

Thirdly, there exists an optimal number of two-digit commodities to be taken in the commodity set needed to compute price numbers. The two

sets of commodities selected constitute respectively the upper and lower bound of what should be the optimal number of commodities to include. Therefore, even if the first set of commodities represents 69,75% of the commodities sampled by the TOD survey, some price indices are not highly reliable, for instance, those calculated for commodities weighing less than 2272 kilogrammes and delivered a distance inferior to 200 kilometres. The reason is the low quality of data sampled by Statistics Canada. On the other hand, the second group of commodities formed by the most important commodities carried by Quebec trucking firms, which form 21,3% of the sample, reinforces and confirms this necessary limit. For example, price indices for commodities destinated to 49 kilometres and less of the origin are not reliable, neither those price numbers calculated for the same commodities and disaggregated up to three shipment sizes.

V. Data from the Quebec Tariff Bureau Inc.

The final step in constructing trucking price indices for policy analysis considerations deals with the possibility of using information published by the Quebec Tariff Bureau Inc. and completing this up-to-date price information with interviews conducted among trucking firms. As a matter of fact, the TOD survey is published by Statistics Canada two years after the reference period, which makes the production of price numbers from that survey almost useless. An attempt to fill this publishing delay by using both sets of information failed because of two insurmountable obstacles. The first difficulty is the absence of information on the exact number of firms serving a given market and their respective number of shipments which are included in the TOD sample. As data contained in the TOD survey for a given market are an average of collected data from all the firms sampled, there is no way of weighing the individual firm's price information to obtain this average. The second obstacle is related to the complex structure of rates and tariffs used by the industry. To give a brief overview of how important this particular problem may be, we present in table 5 the various possibilities of rate bases, specific to the F.A.K. No-100 tariff, which correspond to the four classes of distance and to the three shipment sizes selected in our empirical analysis.

Table 5
Possible F.A.K. No-100 Tariffs for Each
Commodity Disaggregated up to Four Classes
of Distance and Three Categories of Shipment Size

Distance in kms / Weight in kg	0-49 (6)	50-199 (13)	200-499 (19)	500 and over (33)	Total
1-2271 (4)	24	52	76	132	284
2272-4543 (2)	12	26	38	66	142
4544 (3)	18	39	57	99	213
Total	54	117	171	297	639

For instance, the analysis retains as first class of length of haul, all distances inferior to 49 kilometres whereas the F.A.K. No-100 tariff

includes 6 rate bases for the same distance. On the other hand, the first category of shipment size covers all shipments weighing less than 2271 kilogrammes while on the contrary, the F.A.K. No-100 tariff needs four weight bases to represent it. Those numbers are in parentheses in table 5. In other words, there are 24 possible F.A.K. No-100 tariffs which can be in operation whereas our information is an average, given by a sample which is not even a random one. Moreover, we saw in table 1 that the F.A.K. tariff is the reference base in the determination of other rates and tariffs used by trucking firms when new transportation situations occur. As a matter of fact, it is likely that an average Quebec trucking firm is using a multiple, either fractional or integer, of these 639 possibilities and that its choice is exclusively determined by the extent and the utilization rate of its permit authorities such as given by the regulatory body.

Finally, it must be recalled that TOD survey is stratified from the characteristics of the Motor Carrier Freight (MCF) survey and not from the importance of shipments sent by shippers.

VI. Conclusions

This study shows that it is feasible to construct price numbers for the Quebec trucking industry if there exists a possibility of overcoming the two-year publishing delay faced by Statistics Canada. It also shows that any attempt to collect and to use information owned by trucking firms will not help to reduce the existing time gap because of insurmountable obstacles. Other avenues are thus strictly limited. One of these possibilities would thus be to realize the TOD survey on a quarterly basis, whereas a second avenue could be to survey some major shippers on a regular basis and to sample their way-bills up to some classes of distance and to some categories of shipment size. It would seem appropriate that Statistics Canada would probably want to conduct the first survey.

The timeliness of trucking price indices would therefore be appropriate to the needs of a large group of users, among them, Quebec trucking firms and shippers of whose information needs are important because they can have a direct bearing on their profits. The indices would also be of great interest to policy makers and researchers because they will have access to data which would be required to evaluate, for instance, the regulatory reform.

Notes and References

1 An Act respecting motor vehicle transport by extra-provincial undertakings, R.S.C., Chapter C-35, August 1987.

2 Wei, V., Kurasawa, H., Hennessy, B. et Fortier, S., Shipping Conference Freight Indices for Canadian Export Trade. Quarterly Time Series: 1978-1981, Canadian Transport Commission, Report 1984/01, Ottawa, 1983.

3 Consumer Prices and Price Indexes, Catalogue 62-010 Statistics Canada, Quarterly.

4 Allen, R.G.D., Index Number in Theory and Practice, London, MacMillan, 1975.

5 The For-Hire Trucking Origin and Destination Survey, Statistics Canada, Catalogue 53-224, various years.

6 Standard Classification of Goods, vol. I, Catalogue 13-580, Statistics Canada, 1975.

7 Theil, H., Linear Aggregation of Economic Relations, North-Holland Publishing Compagny, Amsterdam 1954.

Acknowledgements

Research funding for this paper was provided by Transport Canada. This paper reflects the views of the author and not necessarily those of Transport Canada.

A MODEL FOR

AN INTEGRATED MOTOR-CARRIER STATISTICAL SYSTEM

S.L. Mozes
Chief, Surface/Marine Section
Transportation Division, Statistics Canada

B. Bekooy
Transportation Division, Statistics Canada

I. Abstract

The present motor carrier statistical system, as developed and implemented by Statistics Canada, and financially supported by Transport Canada, the National Transportation Agency and the provinces has evolved over time. The main features of this system are:

1. it is centralized and national in scope;
2. it is comprehensive in terms of statistical variables collected; and
3. it is integrated among statistical variables collected within the for-hire trucking sector.

The system does have, however, the following shortcomings:

1. for-hire and private carriers are surveyed independently, using different survey concepts, methodology, and processing systems,
2. it does not provide total coverage of the industry, and
3. no information is available on the volume of traffic carried between Canada and the U.S. by American domiciled for-hire carriers and/or by private carriers, both Canadian and American.

The objective of this paper is to provide a statistical framework which would facilitate the production of complete, comparable, consistent, relevant, timely, and reliable data in the most cost-efficient manner. It is proposed that private and for-hire carriers should be surveyed in an integrated and consistent manner. Furthermore, an extension of Statistics Canada's For-Hire Trucking Survey (TOD) is proposed as the vehicle to collect international traffic flow data.

II. INTRODUCTION

Motor carriers of freight transport more than thirty nine (39) percent of the total freight carried by the Canadian transportation industry. Merchandise trade data show that 72 percent of Canadian imports from the U.S. are carried by motor carriers while the corresponding number for exports is fifty nine (59 percent.

In spite of these facts, Canadian transportation agencies, both federal and provincial, have been continually hampered in their efforts to formulate effective policies by the lack of suitable motor carrier statistics. Specifically, the lack of data describing the totality of the industry, the inadequate description of the interrelation-ships among various segments of the industry (e.g. private vs for-hire), and the complete lack of suitable transborder statistics were considered to be the most serious impediments.

III. EMERGING ISSUES

a) Policy Issues

With the recent deregulation of the industry and the implementation of the Canada-U.S. Free Trade Agreement, there is now an increased demand for complete, relevant, consistent, timely and reliable motor carrier statistics. Further, the changing relationship between different segments of the trucking industry and transborder trucking activity have emerged as issues in need of more extensive examination. It is generally agreed that transport deregulation, in conjunction with free trade, will result in:

1. significant shifts in traffic patterns, with more emphasis on international (transborder) movements as opposed to domestic ones;
2. important shifts in market shares of Canadian vs U.S. carriers;
3. changes in the composition of traffic, possibly a shift away from own-account, otherwise known as private trucking, to for-hire trucking; and
4. the entry of large numbers of small carriers (though this is only expected to be a factor during the early stages of deregulation).

b) Statistical Issues

In Statistics Canada, inconsistent industrial coverage, shrinking resources and concerns about the burden being placed upon respondents have resulted in a policy which involves setting into place a Register of Businesses in Canada. This will permit improvements in the data base, greater responsiveness to the dynamics of industrial structures, and the utilization of administrative data to give substantial relief to the burden of responding to government surveys.

The instruments of this policy are the new Business Register, the 1980 Standard Industrial Classification and the Tax Record Acquisition strategy. These instruments will be utilized in a fashion which permit the blending of survey and administrative data to yield consistent annual and subannual economic production data for each industry.

The process will cause many changes to be felt in all areas of data collection, capture, processing and dissemination. It is likely that conflicts will occur between the objectives of the new process and the objective of users whose interests lie outside the strictly defined interestss of National Accounts.

To allay such conflicts, it is appropriate at this stage to enter into an analysis of the existing survey vehicles to determine the needs of outside users and to devise ways by which such needs can be satisfied through the use of the systems and procedures planned for the Business Survey Redesign.

These emerging issues require the present concepts and methodologies used in the production of motor carrier data to be reviewed.

IV. STATISTICAL CONSIDERATIONS

There are various options that may be used to develop statistics that measure truck traffic between Canada and the U.S.; to provide consistent coverage of both private and for-hire motor carriers; and to provide measurements on the size, composition and structure of the totality of the industry. In considering the development of an appropriate survey strategy, the following should be kept in mind:

1. The implementation of the Free Trade Agreement between Canada and the U.S. may result in a reduction of information requirements for Customs Cargo Control purposes by Revenue Canada, Customs and Excise. This puts the Customs option to collect statistics in doubt as its stability over time is questionable. In addition, the collection of 'pure' transport statistics via the Customs Cargo Control System may not be feasible and/or cost effective.

2. With the advent of computerization and standardization, there will be an increasing number of transport operators providing all their traffic data to statistical agencies in machine readable form, thus improving data quality and reducing unit costs. This applies to both Canadian and American carriers.

3. Collection and processing of transborder trucking statistics, both southbound and northbound will require the close cooperation of Canadian and U.S. agencies.

4. In an effort to improve the accuracy of trade data, as well as to develop some additional transportation statistics, Canadian and U.S. Customs and Statistical Agencies have recently signed a Memorandum of Understanding (MOU) on behalf of their two countries. Due in part to the advent of the Free Trade Agreement and the inevitable changes in the collection of trade data, these offices agreed that Canadian export statistics (to the U.S. only) will be replaced by U.S. import statistics (from Canada only), and U.S. export statistics (to Canada only) will be replaced by Canadian import statistics (from U.S. only). Under this agreement, some additional transport variables will also be collected.

5. The Business Survey Redesign Project (BSRP) of Statistics Canada, will assist in identifying private motor carriers as an integral part of the motor carrier industry. Discussions have been initiated recently within the bureau which may facilitate the industry coding of private carriers; these private carriers will be identified and classified to trucking industry codes. BSRP also stipulates that under a certain annual revenue threshold, carriers will not be directly surveyed for financial data, but income tax data will be used.

6. It is expected that for the foreseeable future the present policy of "paper burden reduction" will remain in place. This implies that administrative records, such as tax data, will have to be used in a more effective and more extensive manner. The increased use of administrative data (such as tax data) will result in a reduction in the availability and reliability of transportation related data (such as tonnes transported), and will require an increased amount of data analysis, imputation, and estimation to provide basic economic/industry statistics.

V. INDUSTRY STRUCTURE CONSIDERATIONS

The motor carrier industry is characterized by a vast number of distinct operators encompassing everything from one truck owners to large commercial conglomerates. Given its size, heterogeneity and lack of clear definitions, it is recognized that from a statistical point of view, the motor carrier industry is possibly the most difficult one to describe statistically. The motor carrier industry, or trucking industry, consists of three general categories:

1. private carriers, transporting exclusively their own goods,
2. for-hire carriers, transporting goods for others, and
3. hybrid carriers, those providing both for-hire and private trucking services.

The industry can be further classified or subdivided into more homogeneous segments by using some of the following classification variables:

1. regulations (e.g. regulated vs unregulated carriers);
2. contract, that is, firms working exclusively for one or two customers vs common carriers, or carriers who work for everyone;
3. regular route, which are those carriers who travel the same route between the same city pairs vs irregular route carriers who go where needed;
4. type of commodities transported (e.g. general freight, bulk, petroleum, etc.);
5. area of operation (e.g. local, intercity, intraprovincial, extraprovincial/international); and
6. country of domicile (e.g. Canadian domiciled vs U.S. domiciled carriers).

The heterogeneity of the trucking industry can be illustrated empirically by analysing the commonalities and differences among some of the different segments of the industry, specifically:

1. for-hire and private carriers;
2. small versus large carriers (for-hire only); and
3. intercity versus local carriers (private and for-hire).

1. <u>For-hire vs. Private Truck Transport (Firms with Fleet Size of Fifteen or Over</u>

On the macro level, heterogeneity is evident upon examination of the for-hire and private segments of the trucking industry. Empirical evidence clearly illustrates these basic differences.

a. The distribution of revenues per firm for for-hire firms versus expenses per firm for private carriers indicate that for-hire trucking firms are, on average, 2.86 times as large as private firms. In 1987, for-hire carriers each earned an average $5.33 million while each private firm spent $1.87 million each.
b. For-hire carriers operate mainly road tractors, while private carriers operate mainly straight trucks.
c. With 83,972 employees, private trucking employed 14.5 percent more people in 1987 than for-hire's 73,284. On average, for-hire carriers employed 54 employees per firm, while private carriers employed 36 emplyees per firm.
d. The for-hire segment of the trucking industry spent almost four times as much, $1.58 million, as the private side, $0.32 million, for broker services in 1987.

2. For-hire Truck Transport (by Revenue Class)

a) Heterogeneity within the for-hire trucking industry is apparent upon examination and comparison of the three revenue classes which encompass these carriers. The method of classification by revenue class is the most telling indication of heterogeneity - Class 1 carriers earn $2,000,000 or over per annum, Class 2 carriers earn between $500,000 and $1,999,999 per annum, and Class 3 carriers earn between $100,000 and 499,999 per annum. In 1987, Class 1 carriers earned 6.6 billion dollars (or 70 percent of the industry total), with Class 2 and 3 carriers earning $1.6 and $1.1 billion, respectively. If the average revenues or expenses per firm are calculated, the result is an indication of the average size of the firms in a given class per period. In 1987, Class I carriers averaged over $10.11 million, while Class 2 and 3 averaged $1.11 million and $0.25 million, respectively.

b) With respect to equipment, Class 1 carriers owned or leased 79 percent of semi and full trailers operated by the for-hire trucking industry in 1987. Similarly, 63 percent of the road tractors and 41 percent of the straight trucks used by the industry were owned or leased by Class 1 carriers.

c) Class 1 carriers used broker services more extensively than Class 2 and 3 carriers. As a whole, Class 1 carriers spent over six times as much as the amount Class 2 carriers spent on brokers, and over nineteen times as much as Class 3.

3. Private and For-hire: Intercity vs. Local Comparison

a. Private: Intercity versus Local

Intercity private trucking boasts 1,453 firms, 67.78 percent higher than local trucking with 866, and spent 3.01 billion dollars in 1987, 130 percent higher than local's 1.31 billion dollars. The average revenues or expenses per firm is an indication of that firm's size. Each intercity firm spent, on average $2.07 million while each local firm spent, on average, $1.52 million.

The intercity trucking industry has owned and operated 48,291 trucks, 7,930 tractors and 21,738 trailers, a total of 77,959 pieces of owned equipment. Leased equipment numbers were less with 4,119 trucks, 2,328 tractors, and 2,523 trailers for a total of 8,970 pieces of equipment. Local trucking reported totals of 33,284 trucks, 1,677 tractors, and 3,688 trailers for a total of 38,649 owned pieces of equipment. Local carriers reported 1,824 trucks, 62 tractors, and 126 trailers leased in 1987. Private intercity trucking has owned 101.71 percent more pieces of equipment than private local. Specifically, 45 percent more trucks, 372 percent more tractors, and 489 percent more

trailers. Intercity carriers utilize road tractors more extensively than local carriers (10,258 vs 1,739). Intercity carriers operate 24,261 trailers, which is six (6) times as many as local carriers operate.

Intercity private carriers employed 46,256 full-time and 9,796 part-time persons for a total of 56,052, over 100 percent higher than local's total of 27,920. Further, intercity private carrier's employees earned 15.22 percent more in salaries and wages than did their local counterparts. Each intercity carrier employed, on average, 38.58 persons, while each local firm employed, on average, 32.24 persons.

b. For-hire: Intercity versus Local

As is the case in the private trucking industry, intercity firms are larger, grossing $8.38 billion in 1987, than local firms which reported $1.03 billion in operating revenues. On average, each for-hire intercity firm earned $1.73 million while each local firm earned $0.55 million.

In 1987, intercity carriers were semi-trailer-dependent with 60.8 percent of their fleet having been composed of this type of motor carrier equipment. Each intercity firm owned 18.8 semi-trailers, on average. Road tractors composed 22.81 percent of the equipment fleet with each firm having owned, on average, 6.97 road tractors. A clear prereference in the for-hire local trucking industry is more difficult to ascertain. Semi-trailers, straight trucks, and road tractors composed 34.57, 34.81, and 23.32 percent, respectively, of the industry's equipment. Each local firm owned, on average, 3.33 semi-trailers, 3.31 straight trucks, and 2.23 road tractors. Intercity carriers utilized over fourteen as many semi-trailers, over twice as many straight trucks, and over eight times as many road tractors as local carriers.

For-hire intercity carriers employed 87,185 persons in 1987, almost five times as many as local carriers at 15,311. On average, each intercity firm employed 17.95 persons while each local firm employed 8.15 persons.

In spite of the economic heterogeneity of the industry as described above, there is one common trait which applies to all industry subgroups - they are carriers of freight. As such, statistical data describing these industry segments should be consistent with respect to definitions, concepts, survey methodologies, strategies and data processing systems to the fullest extent. It does not, however, imply that each industry segment should be surveyed to the same degree or that the survey periodicity be the same.

VI. DATA NEEDS/USE

Complete, consistent, relevant, timely, comparable and reliable data covering the totality of the motor carrier industry are needed to formulate effective policies, to develop national macroeconomic indicators (e.g. Gross Domestic Product (GDP)) and to carry out regulatory and monitoring mandates. Main uses for data may be summarized under the following broad categories:

1. monitoring the impact of deregulation;
2. providing input into national statistical aggregates such as the GDP, input-output tables, price deflators;
3. monitoring the impact of the Canada-U.S. Free Trade Agreement; and
4. providing information for economic analysis, and for regulatory and industry marketing purposes.

Under these general headings, data are needed for the following specific reasons:

1. to monitor the level of trucking activity within the country, as well as internationally;
2. to measure structural changes which are taking place in the industry such as:
   a. the emergence of mega-carriers, resulting from mergers, and acquisitions. This, in turn, increases the economic concentration in the industry;
   b. the emergence of "hybrid" carriers, providing both for-hire and private carriage;
   c. the expected increase in the number of small carriers (new entrants);
   d. the changing nature of owner operators; and
   e. the possible shift from private carriage to for-hire, or possibly vice versa;
3. to measure the economic/financial performance of the different industry segments including measures of their productivity;
4. to measure changing traffic patterns due to:
   a. free trade, resulting in increased cross-border trading with the U.S. as opposed to between provinces; and
   b. increased competition from rail carriers as well as from intermodal transporters;
5. to measure economic/financial performance of individual carriers or groups of carriers and their market shares.

VII. TYPE OF DATA REQUIRED

As the need for industry data has clearly been established and documented, the type of data required can now be described. From a conceptual point of view, data requirements may be categorized as (1) economic production statistics, (2) traffic statistics, (3) utilization statistics and (4) infrastructure statistics. For the purpose of this paper, only the first two categories will discussed in detail.

1. Economic Production Statistics

Industry statistics, economic statistics or input-output statistics are available for the motor carrier industry. These types of statistics are essential in order to describe the relationship between and the place of the transport sector and other sectors of the economy, and to measure the services rendered to and obtained by transport industries to different sectors of the economy (input/output) data. These data, which essentially describe the input structure, of the firm or industry include revenues, expenses, balance sheet, fleet, fuel, and employment data firms and are often used to measure the financial structure, performance and economic health of the industry.

Economic production statistics should relate to the totality of the industry and must be comparable from one industry segment to another. Comparability over time is also an essential criterion, but the amount of data available for one industry segment to another may vary.

2. Traffic Statistics(1)

Traffic or output statistics, which are often used to measure and analyse transportation patterns and markets, are designed to provide data on (1) the activity at a terminal point with special emphasis on the peak problems, (2) the total volume of transport capacity or volume moving between points A and B, (3) the traffic volume originating at A and destined to B, and its composition and routing.

In order to describe the activity, capacity or traffic, the following types of traffic statistics have been developed:

a. Activity Statistics - statistics relating to the activity at a terminal point, regardless of the direction of the movement, but normally organized in such a way as to provide peak activity data;

b. Traffic Flow Statistics - statistics relating to movement of traffic and transport capacity between two points with reference to the direction of the movement; and

c. Origin and Destination Statistics - statistics relating to the origin and destination of traffic movements.

(1) Methodology of Transport Statistics, Mr. K.W. Studnicki-Gizbert, York University Transport Centre, Toronto, 1970.

Traffic statistics, otherwise called commodity origin and destination statistics, measure the output of the industry in terms of revenues, tonnes and tonne-kilometres. These data are also used to measure the changing traffic patterns, and average price levels and the types of commodities transported.

By their very nature, economic production statistics, or input statistics, and traffic flow statistics, or output statistics, describe the existing input and output relationships which exist within the industry. To be meaningful, these statistical variables must relate to the same segments of the industry.

VIII. PROPOSED SURVEY STRATEGY

1. Introduction/Background

It is the contention of the authors that consistent, integrated data (both input and output) that cover the totality of the motor carrier industry is needed in order to formulate effective, useful policies for the industry. It is also felt that the type and amount of information may differ from industry segment to industry segment. Furthermore, the authors feel that private carriers constitute an integral part of the industry and, from a statistical point of view, they should be treated as one of the many industry segments. In addition, there is sufficient empirical evidence to suggest that private and hybrid carriers maintain similar accounting and traffic records to those of for-hire carriers. Finally, given the impetus of the Free Trade Agreement and deregulation of the industry, it is a firm conviction of the authors that revised methodologies and strategies used in data collection of transborder traffic statistics by both Canadian and United States carriers will be essential for thorough statistical analysis.

2. A proposal to cover Canadian Domiciled Carriers in the Collection of Economic Production Statistics

In light of the emerging issues, data requirements, the structure of the industry as well as the relevant statistical considerations, the following survey strategy is recommended:

a. Survey Universe/Frame

One of the first essentials in the development of an integrated survey is to establish a universe of motor carriers. There are various options to establish such a universe.

- Business Register (B.R.) of Statistics Canada

  The development of a universe of for-hire carriers does not pose any difficulties as it is readily available from the B.R. of Statistics Canada. The only difficulty with this source is that owner-operators or brokers are not separately identified on this file. Though the

development of a universe of private and/or hybrid carriers using the B.R. is more problematic, it should not create any serious problems from a conceptual point of view. From a practical point of view, however, it may introduce some difficulties, as private and/or hybrid carriers would have to be identified through profiling which may take years to complete.

Other alternatives to develop the universe of private and/or hybrid carriers are:

- Provincial Motor Vehicle Registration Files
  At present, these files are used for establishing the universe of non-for-hire carriers of the Truck Use Survey conducted by Statistics Canada. These files provide names and addresses of vehicle owners.

- Canadian Agreement on Vehicle Registration (CAVR)
  CAVR, a provincially adminsitered data base, provides an indication of whether the operator is a for-hire, private or rental company.

b. Survey Coverage
As discussed earlier, the various segments of the industry will, under the proposed strategy, be surveyed to different extents. For example, large long distance general freight carriers, due to their importance, may be surveyed more extensively than small local sand and gravel carriers. The extent of statistical coverage will be a function of user needs, response burden, budget and data availability;

c. Methodology/Strategy
The next step in the development of an integrated survey is to establish the methodology and associated survey strategy. A proposed approach is presented in Table 1. The proposed strategy entails the following features:

- The universe of carriers will utilize the Business Register; however, the provincial data basis may also be used either to supplement the B.R. and/or derive the universe of small private carriers.
- Large Private carriers will be treated similarly to other segments of the industry, both from a conceptual and production point of view.
- Both census and sample surveys will be used. For large carriers, a census is proposed; for small carriers, sample surveys are recommended.
- Tax data will be used to obtain financial data from small for-hire carriers.
- The amount of detail collected will be dependent on the size and type of the carrier.

- o Survey periodicity (annual and quarterly) will vary depending on the economic importance of the industry segments covered.
- o A fully integrated data collection and processing strategy will be used achiving significant economies of scale.

TABLE 1

PROPOSED SURVEY STRATEGY TO COLLECT ECONOMIC PRODUCTION DATA FROM MOTOR CARRIERS OF FREIGHT DOMICILED IN CANADA

	For-hire Carriers (FHC)		Private/Hybrid Carriers (PC)	
	Economic Production Statistics	Traffic Data	Economic Production Statistics	Traffic Data
LARGE CARRIERS (Intercity)				
. Universe Source	. Business Register of Statistics Canada			
. Survey Type	. Census of carriers	. Sample of shipping documents	. Census of carriers	. Sample of shipping documents
. Survey Instrument	. Questionnaire (same for FHC and PC)	. Receive data on tape	. Questionnaire (same for FHC and PC)	. Receive data on tape
		. Manual transcription from shipping documents		. Manual transcription from shipping documents
. Data Processing	. Full automated and integrated system for both FHC and PC			
. Periodicity	. Annual and Quarterly	. Annual and Quarterly	. Annual and Quarterly	. Annual and Quarterly
. Principal Data Variables	. Detailed revenues, expenses, fuel, employment, fleet, balance sheet, area of operation, vehicle kilometres, etc.	. Revenues, tonnes, tonne-kilometres, commodities, distance, TL vs LTL	. Detailed expenses, fuel, employment, fleet, balance sheet, area of operation, vehicle kilometres, etc.	. Tonnes, tonne kilometres, commodities, distance, TL vs LTL

TABLE 1

PROPOSED SURVEY STRATEGY TO COLLECT DATA FROM MOTOR CARRIERS OF FREIGHT DOMICILED IN CANADA

	For-hire Carriers (FHC)		Private/Hybrid Carriers (PC)	
	Economic Production Statistics	Traffic Data	Economic Production Statistics	Traffic Data
LARGE CARRIERS (Local)				
. Universe Source	. Business Register of Statistics Canada			
. Survey Type	. Census of carriers	. N/A	. Census of carriers	. N/A
. Survey Instrument	. Questionnaire (same for FHC and PC)	. N/A	. Questionnaire (same for FHC and PC)	. N/A
. Data Processing	. Full automated and integrated system for both FHC and PC			
. Periodicity	. Annual and Quarterly	. N/A	. Annual and Quarterly	. N/A
. Principal Data Variables	. Detailed revenues, expenses, fuel, employment, fleet, balance sheet, area of operation, vehicle kilometres, etc.	. N/A	. Detailed expenses, fuel, employment, fleet, balance sheet, area of operation, vehicle kilometres, etc.	. N/A

TABLE 1

PROPOSED SURVEY STRATEGY TO COLLECT ECONOMIC PRODUCTION DATA FROM MOTOR CARRIERS OF FREIGHT DOMICILED IN CANADA

	For-hire Carriers (FHC)		Private/Hybrid Carriers (PC)	
	Economic Production Statistics	Traffic Data	Economic Production Statistics	Traffic Data
SMALL CARRIERS (Intercity and Local)				
. Universe Source	. Business Register (B.R.) of STC	. N/A	. Provincial Registration files and/or CAVR	. N/A
. Survey Type	. Use of tax data for financial information	. N/A	. Sample of carriers for both financial and operating data	. N/A
	. Sample of carriers for operating data	. N/A		
. Survey Instruments	. Transcription from tax returns for financial data	. N/A	. Questionnaire for both financial and operating data	. N/A
	. Questionnaire for operating data	. N/A		
. Data Processing	. Full automated, full integrated system for both FHC and PC			
. Periodicity	. Annual	. N/A	. Annual or less frequent	. N/A

TABLE 1
PROPOSED SURVEY STRATEGY TO COLLECT ECONOMIC PRODUCTION DATA FROM MOTOR CARRIERS OF FREIGHT DOMICILED IN CANADA

	For-hire Carriers (FHC)		Private/Hybrid Carriers (PC)	
	Economic Production Statistics	Traffic Data	Economic Production Statistics	Traffic Data
SMALL CARRIERS (Intercity and Local) (continued)				
. Principal Data Variables	. Limited amount of data on revenues, expenses, fleet, area of operation, vehicle kilometres, etc.	. N/A	. Limited amount of data on expenses, fleet, area of operation, vehicle kilometres, etc.	. N/A

3. A Proposed Strategy to Develop Transborder Motor Carrier Statistics, Flow Data:

The proposed strategy which entails the extension of the For-hire Trucking Survey of Statistics Canada, is described briefly below. In addition to this recommended approach, a second alternative, the Customs approach, is also outlined in this paper.

a) An Extension of the For-hire Trucking Survey of STC
The survey strategy as presented earlier permits, from a conceptual point of view, to cover transborder truck traffic as well. In principle, the concepts, methodology and data processing systems of the For- hire Trucking Survey (TOD) of Statistics Canada could be adapted to handle the international activities of Canadian domiciled private carriers, as well as the activities of U.S. domiciled carriers. However, the expansion of the survey to measure activities of U.S. carriers into and out of Canada introduces identification and data collection related problems.

Identification Problem (How to identify U.S. carriers operating between the two countries?) As the universe of the present TOD survey is derived from the Business Register, it does not identify U.S. domiciled carriers operating between the two countries. However, recent investigations indicated that the provincial Transport Departments are, or soon may be able, to identify those U.S. domiciled carriers which operate between Canada and the U.S.

Data Collection Related Problems (How could Statistics Canada or any other Canadian agency obtain data from U.S. domiciled carriers?) Some of the alternatives are listed below:

- o employees of Statistics Canada sample shipping documents of U.S. domiciled carriers at the premises of U.S. carriers;
- o U.S. carriers sample their own documents and send the information either to Statistics Canada or to a U.S. Agency (eg. U.S. Bureau of Census (U.S.B.C.)) for processing or forwarding to Statistics Canada;
- o employees of a U.S. Agency (eg. U.S.B.C.) would collect the data. Processing (data capture) could either be done by U.S.B.C. or STC; and
- o U.S. carriers provide the data directly to Statistics Canada in machine readable form.

b. Customs Approach In addition to using approach outlined above, there is another alternative - Canada Customs. This option entails the collection of international trucking statistics using the Customs Cargo Control Systems of Canada Customs and U.S. Customs. The Customs approach promises promises to provide complete coverage of Canada/U.S. shipments regardless of the firm's country of domicile and/or regulatory status (e.g. for-hire vs private). Briefly this approach entails the following:

- o incoming (northbound) transborder movements would be captured by the Cargo Control System of Canada Customs. This would require extensive modifications to their forms and processing systems. In addition, it would require data capture of the additional data variables needed for transport purposes; and

- o southbound traffic would be captured by the Cargo Control System or its equivalent of U.S. Customs. Their system would also have to be modified and expanded to meet transport requirements.

In evaluating the Customs option, the following considerations should be taken into account:

- o because of the Canada-U.S. trade data exchange, the collection of data on the southward movements would have to be provided for within the U.S. import data collection system;

- o collection of transportation data via the Cargo Control Systems would require significant changes in the existing cargo control documents and to the associated processing systems; and

- o the implementation of the Canada/U.S. Free Trade Agreement may result in a reduction of information requirements for Cargo Control purposes. For transport purposes, a significant extension of the present system would be required, which may be difficult at this time.

4. Advantages of the Proposed Survey Strategies

Conceptually, the proposed survey strategy, as outlined earlier, could ensure that consistent, integrated, complete and reliable data, could be obtained for the totality of the trucking industry. It ensures that all carriers small or large, private or for-hire, will be surveyed using similar methodology, concepts, survey instruments and data processing systems. Furthermore, it conforms with the framework of the Business Survey Redesign Project of STC, its definitions, survey frame and generalized methodology and processing systems. It is envisaged that implementation of the proposal would yield the following advantageous results:

a. there will be fully comparable/integrated data available for large carriers, and to a lesser extent for small carriers as well. Data covering the totality of the motor carrier industry will be produced;
b. response burden will be minimized as:
   o income tax data will be utilized,
   o sampling methodology will be used for small carriers,
   o traffic data will be received in machine readable form, and
   o administrative records such as tax data and shipping documents will be utilized,
c. economies of scale will be accomplished due to the fully integrated concepts and processing systems, and
d. the proposed model is capable of yielding transborder traffic data carried by both Canadian and U.S. carriers, both private and for-hire.

IX. CONCLUSION

From both a conceptual and processing point of view, the proposed methodology is superior to the present one. Furthermore, if implemented it would yield economies of scale. However, its feasibility both technical and financial would have to be addressed with regard to the following areas:

1. A workable definition of small versus large carriers will have to be developed. It is recognized that under the framework of the Business Survey Redesign Project of Statistics Canada, these thresholds will be given and will vary from province to province. The implication of these thresholds on survey coverage will have to be investigated.
2. The ability of the Business Register to provide a universe of private motor carriers will have to be explored. If the B.R. is not capable of providing such a universe, alternate solutions may have to be considered.
3. Further study is required regarding the feasibility of:
   o obtaining data from U.S. domiciled carriers, and
   o obtaining concetually similar data from private and for-hire carriers.
4. Budgetary resource considerations

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contribution of E. Drover, Director, Transportation Division, Statistics Canada, B. Nemes, Assistant Director, Transportation Division of Statistics Canada and all participants of the Special Meeting on trucking statistics, November 1988, in the conceptualization of the model. Nevertheless, the views and opinions expressed in this paper are those of the authors and do not necessarily reflect those of Statistics Canada.

REFERENCES

(1) Transport Data Plan, Phase I, Transport Canada, Strategic Planning Group, 1977.
(2) Methodology of Transport Statistics, Mr. K.W. Studnicki-Gizbert, York University of Transport Centre, Toronto, 1970.
(3) Royal Commission on Transportation, Review of Transportation Statistics by Mr. D. Eldon, Ottawa, 1961.
(4) A Framework for Transport Statistics; an Introductory Paper for Discussion, Australian Bureau of Statistics, 1978.
(5) National Income and Expenditure Accounts Volume 3, Statistics Canada, 1975.
(6) Study Design for Monitoring of Regulatory Change on Motor Carriers, by Transmode Consultants, 1989.
(7) A conceptual Framework for Monitoring Transborder Trucking by A. Cubukgil, S. Flott, F. Nix, 1984.
(8) A Report on the Feasibility of Developing Trucking Statistics in New Zealand, S. Mozes, 1988.
(9) Business Survey Redesign Project, Objectives, Policies and Strategy.

RECOVERING THE COSTS OF TRANSPORT INFRASTRUCTURE: CANADA'S PROPOSED NEW POLICY

BY J.A.A. LOVINK[1]

Because the proposed policy had not yet been approved for public discussion by the CTRF's deadline for the submission of papers, it was impossible to submit a paper as planned.

Instead, there will be an oral briefing on the proposed approach, backed up by a hard copy of the slides to be presented.

Following is a synopsis of the planned presentation.

Transport Canada provides comprehensive infrastructure facilities and services for air and marine transport in Canada, at an annual cost in 1987/88 of about $1,800 million.[2] In that year, Departmental revenues from external users equalled about $900 million.

As part of a major commitment to reduce its costs and increase its revenues, the Department has developed a proposed new cost recovery policy that would make significant changes in the existing fee structure for air services and would introduce new charges for marine services provided free today.

The policy's underlying guidelines and principles have already been the subject of extensive consultations with users of the Department's facilities and services, domestic and international. Further public consultations are planned for the first half of 1989.

The presentation will describe the policy development process, explaining:

- The general approach;
- The definition and allocation of costs;
- The evaluation of alternative types of user charges;

- The leading cost recovery proposals and their impact; and
- The expected payoffs from the policy for the effectiveness and efficiency of the transportation system in Canada.

Notes

[1] Director-General, Economic Evaluation and Cost Recovery, Transport Canada, Ottawa.

[2] Cash expenditures, excluding grants and contributions and departmental overhead.

THE ROLE OF BENEFIT-COST ANALYSIS IN PUBLIC INVESTMENT DECISIONS: TRANSPORT CANADA'S EXPERIENCE

BY E.K. CULLEY[1]

Transport Canada incurs annual capital expenditures of some $700 million (Cdn.), mostly on the infrastructure for air and marine facilities and equipment (airports, ports, air and marine navigational aids, ships, aircraft and other assets). A substantial part of these expenditures is made up of major investment programs that require careful economic and financial evaluation. The balance of the expenditures need varying types and levels of justification, depending on the type and amount of investment involved.

The presentation will deal with the principal components of Transport Canada's capital program, the role of benefit-cost analysis in an organizational context, and the types of projects requiring evaluation. The presentation will discuss the major difficulties in conducting benefit-cost analysis on a large scale and will outline the approach adopted to deal with problems and the results to date.

The presentation will elaborate the general theme by reference to recently completed work on a proposal for microwave landing systems. The focus will be on the identification and measurement of benefits and the development of base case assumptions and transition strategies. A presentation of the results of the benefit-cost analysis will also be included.

Note

[1] Director, Economic Evaluation
Transport Canada, Ottawa.

Computer-Aided Algorithmic Design in the Vehicle Routing Domain

Jean-Yves Potvin
Guy Lapalme
Jean-Marc Rousseau

Centre de Recherche sur les Transports
Université de Montréal
Montréal, Québec
Canada

Abstract. This paper advocates computer-aided algorithmic design as a means to enhance the development of expertise in the vehicle routing domain. We present a computer system, called ALTO, that supports the development of routing algorithms for transportation vehicles. ALTO provides a general framework modelling generic problem-solving procedures for vehicle routing problems. Within this general framework, specific procedures can be created via an instantiation process controlled by the user. In this way, many different heuristic strategies can be quickly designed and tested on complex problems for which no efficient algorithms are currently known.

Section 1. Introduction

In this paper, we describe ALTO, a computer system providing support to expert algorithm designers working in the vehicle routing domain (ALTO stands for ALgorithmes de TOurnées, i.e. Routing Algorithms). The system runs on the 1108 Xerox Lisp Machine and uses advanced graphic and interactive features of the INTERLISP-D environment [Teitelman&Masinter81]

Our work was motivated by the fact that many problems in Operations Research (OR) are NP-hard and therefore cannot be solved optimally in polynomial time. Heuristic resolution strategies are thus widely used to solve such problems in a reasonable amount of time [Bodin&al83]. However, availability, efficiency and range of application of heuristic resolution strategies drop quickly as problem complexity increases. Relatively few heuristics have been developed for constrained routing and scheduling problems (involving, for example, capacity

constraints, maximal travel time constraints, time windows, etc..) and their efficiency is in general quite sensitive to specific characteristics of those problems. The range of application of such heuristics is thus severely limited.

The major difficulty here stems from an inability to deduce the kind of strategy that will perform well given the characteristics of the problems at hand. We thus claim that computer-aided algorithmic design can provide strong leverage with respect to this difficult problem. With the support of computerized tools for algorithmic design, it becomes possible to quickly configure new heuristic strategies and evaluate them on different instances of a given generic problem. Alternative resolution approaches can be explored quickly, and this exploration in turn enhances the development of expertise in the field. Expert users are thus directly involved in the problem-solving process, as opposed to the traditional "black-box" approach, where a specialized algorithm is delivered without any access to its internal resolution mechanisms (see also [Cullen&al81, Krolak&al71, Krolak&al72]).

Such flexibility is achieved within ALTO via the "general heuristic", a set of templates modelling generic problem-solving procedures widely used in the field of vehicle routing. Specific procedures are then generated from the generic ones through an instantiation process requiring provision of user-defined formulas. In this way, designers of algorithms can use their own intuition and judgement while they are searching for a suitable algorithm.

A sophisticated graphic and interactive interface facilitates interaction with the system during the problem-solving process. Figure 1 shows a typical ALTO screen: a transportation network with routes for a fleet of vehicles is displayed in the large window on the right hand side of the screen, while informations relating to the current routes are displayed in the window on the left-hand side (total length, total travel time, etc...). The small window under the transportation network is called an "inspection window" and is used to examine various objects involved in the problem definition. In this example, it shows various informations about node 1 (identifier, coordinates, etc...).

In the remainder of the paper, we will describe in detail the main features of ALTO. Section 2 first presents the class of routing problems that ALTO can address. Sections 3,4,5 and 6 then presents each template of the general heuristic in turn. Section 7 then explains how "classical" algorithms can be easily reproduced within the ALTO

framework. Finally, in section 8, a real-world example illustrating the flexibility of ALTO is described.

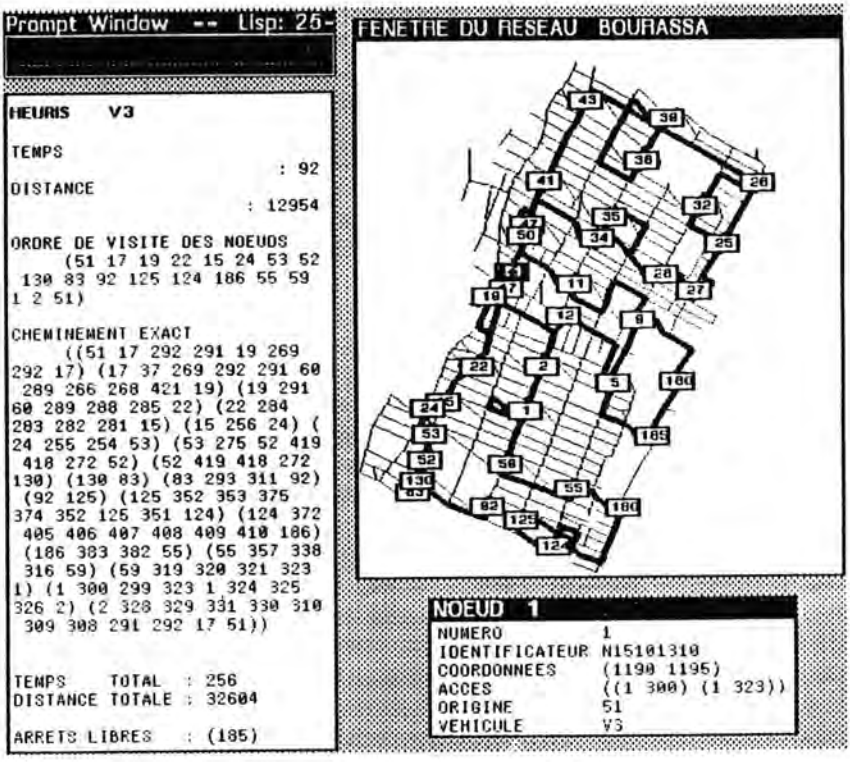


Fig. 1 ALTO screen

Section 2. The target class of routing problems

ALTO solves a class of transportation problems known as "node routing problems" [Bodin&al83]. In these problems, a "demand", that is, a request for collecting some quantity of a product, is located on specific nodes of a transportation network (such nodes are typically called "stops" or "clients"). A fleet of vehicles must then service those stops at minimal cost, while satisfying various physical and/or operational constraints. Since many different kinds of node routing problems are described in the OR literature, we restricted ourselves to the following characteristics which are found in many "real-world" applications:

a) A fleet of vehicles is housed at a central origin (depot).

b) The demand at each stop is deterministic and must be entirely collected by the vehicle servicing the stop.

c) A single route is generated for each vehicle, starting and ending at the origin.

d) The following constraints can be introduced:

   i) maximal capacity for each vehicle

   ii) maximal travel time (or distance) for each vehicle

   iii) time window at each stop

e) The operational costs are minimized (e.g. the total distance traveled by the fleet of vehicles)

With this class of problems in mind, we devised a general framework fit to embody user-defined formulas. This general heuristic is in fact divided into four generic procedures (basic operators), acting upon sets of objects in some abstract way. The behavior of each basic operator, however, can be refined and adapted to the problems at hand, by specifying appropriate instantiation formulas. Each basic operator is modeled so as to take into account "active constraints", as specified by the user from the three constraint types introduced above. Elasticity of such constraints can be adjusted via relaxation parameters that allow constraints to be violated to some extent (e.g. by allowing a stop to be serviced a little bit before or after its current time window).

The following sections will now describe in more detail each basic operator.

Section 3. Operator INIT

INIT is an operator allowing creation and initialization of new routes. For each new route, one or more seeds are selected in the set of "free" stops (i.e. stops not serviced by a vehicle). Figure 2 shows the basic principle: among the free stops (white squares), n_2 and n_4 are used to initialize route R_x, while n_5 and n_6 initializes R_y and n_7 initializes R_z.

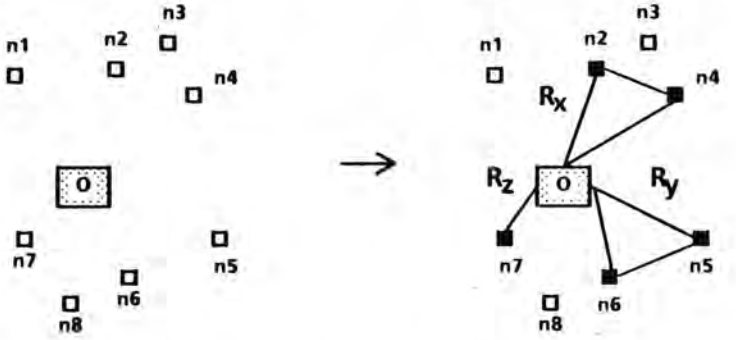


Fig. 2 Initialization of routes Rx, Ry and Rz

The template for INIT is depicted in the following figure:

INIT

N ← **number of routes;**
SE_k ← **subset of free stops;**
While N > 0 and vehicles are still available do
    SEEDS ← **selection of seeds;**
    v ← **selection of the vehicle;**
    create a route to service the SEEDS;
    SE_k ← SE_k - SEEDS;
    N ← N - 1;

Fig. 3 Operator INIT

The bold portions of the template are decision points involving user-defined formulas. It is thus possible to specify the number of

new routes, the subset of free stops upon which the selection of seeds will take place and finally the selection formulas for the seeds and the vehicle.

A "manual" mode is also available for initialization. The manual mode allows the user to interactively associate individual free stops to vehicles by pointing at specific stops with a mouse device. The manual approach looks attractive here, because expert users can often initialize routes in a judicious way, just by looking at the distribution of the stops over the network.

Section 4. Operator ADD

ADD is an iterative procedure allowing insertion of free stops into existing routes. At each iteration, two fundamental decisions must be made: a free stop has first to be selected and then inserted at a proper location in a route. The basic principle is depicted in figure 4: here, the free stop n_3 is selected and inserted between n_2 and n_4 in route R_x. The procedure is then repeated for each remaining free stop.

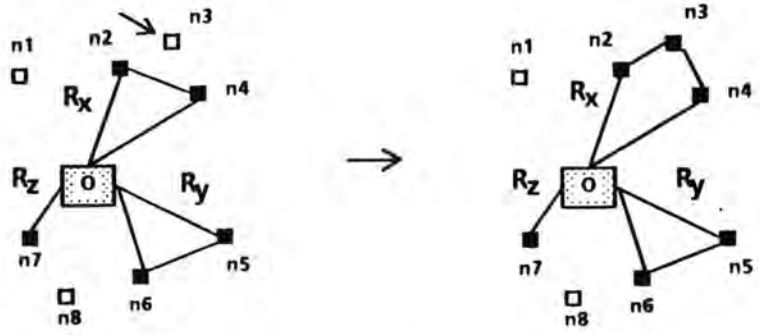


Fig. 4 Selection and insertion of stop n3

The template for operator ADD is depicted in the following figure:

```
ADD
SEk ← subset of free stops;
While SEk ≠ Ø do
        k  ← selection of the free stop ;
        i  ← selection of the stop in a route ;
        if stopping criterion verified then teerminate ;
        if the insertion of k satisfies the constraints then
                insert k before / after i
        remove k from SEk ;
```

Fig. 5 Operator ADD

As for INIT, bold portions of the template are user-defined decision points. As we can see, a selection and insertion procedure is iteratively applied to the set of free stops SE_k. The procedure is repeated until SE_k is empty or a user-defined stopping criterion is satisfied.

If desired, the step-by-step execution of this iterative procedure can be visualized by the user. To this end, each selected free stop blinks on the screen before it is inserted and the routes are then updated and displayed accordingly. Such graphic facilities provide a means to analyze the operator's behavior and detect flaws in the instantiation formulas.

Section 5. Operator MERGE

MERGE is an iterative procedure allowing creation of larger routes from smaller ones. The basic principle is depicted in figure 6: here, routes R_x and R_y are selected and merged to create route R_{xy}. The procedure is then repeated with the new set of routes .

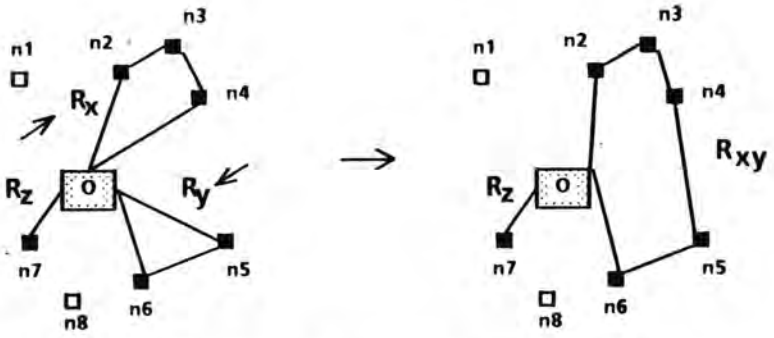


Fig. 6 Creation of route Rxy from Rx and Ry

Actually, the merging process simply links the routes from their both ends, thus producing four larger routes from which the one with minimal length is chosen. Eventually, a more sophisticated way to handle this process will be devised so as to allow integration of user defined formulas.

The template for operator MERGE is the following:

```
MERGE
SEr ← subset of routes ;
While |SEr| > 1 do
    r1 ← selection of route 1 ;
    remove r1 from SEr ;
    r2 ← selection of route 2 ;
    remove r2 from SEr ;
    if stopping criterion verified then terminate ;
    if merging r1 and r2 satisfies the constraints then
        v ← selection of the vehicle ;
        create a new route r serviced by vehicle v
                        by merging r1 and r2 ;
        add r to SEr
```

Fig. 7 Operator MERGE

Here, the merging procedure is iteratively applied to the set of routes SE_r. This procedure ends when the cardinality of SE_r drops under two or when a user-defined stopping criterion is satisfied.

Section 6. Operator EXCHANGE

Operator EXCHANGE modifies the sequence of stops into existing routes, allowing intra-routes as well as inter-routes exchanges. In this way, the initial assignment of stops to vehicles can be modified in a global optimization perspective. We use the fact that any Multiple Traveling Salesmen Problem can be converted into an equivalent Traveling Salesman Problem, by creating M copies of the origin and M copies of its incident links [Svestka&Huckfeldt73].

Using this transformation, the set of all existing routes can be coalesced into a single "super-route" which is then suitable for a 2-opt exchange procedure (figure 8).

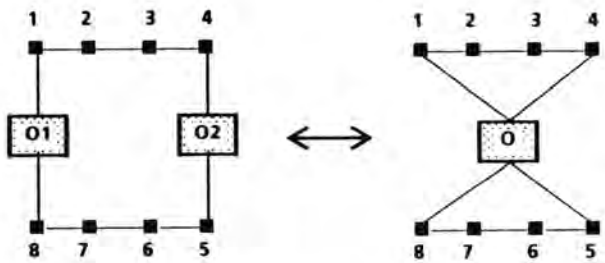


Fig. 8 TSP - 2TSP Equivalence

The template for operator EXCHANGE is depicted in the following figure:

```
EXCHANGE
QUALITYmax ← 0;
SOLUTION   ← initial solution;
While exchanges have not been tried for SOLUTION do
      NEW SOLUTION ← solution after exchange;
      if NEW SOLUTION satisfies the constraints then
         QUALITY ← evaluation of the quality formula
                                for NEW SOLUTION;
         if QUALITY > QUALITYmax then
            QUALITYmax ← QUALITY;
            SOLUTION   ← NEW SOLUTION;
```

Fig. 9 Operator EXCHANGE

Here, the user specifies a "quality formula" for the current solution. To this end, six different criteria are available:

c1) length of the routes
c2) compacity of the routes (as defined in [Ferland&al85])
c3) % of use of vehicle's capacity
c4) % of use of vehicle's maximal distance
c5) % of use of vehicle's maximal travel time
c6) service time at the stops

Creation of the quality formula is based on multicriteria decision analysis techniques. Basically, these techniques create a quality formula by aggregating many different criteria into a single global utility function. To this end, a partial utility function is created by the user for each selected criterion and a weight is associated to it. The global utility function then corresponds to the weighted sum of the partial utility functions (for more details about multicriteria decision analysis, the reader is referred to [Jacquet-Lagreze83, Potvin87]).

Having described in turn each basic operator, we will now conclude this section by emphasizing the fact that the four basic operators are independent and can be applied by the user in any desired sequence. The only restriction is obvious: the first operator of a given sequence must be an instance of operator INIT.

Section 7. An example .

In figure 10, instantiated operators for initialization (INIT1) and insertion (ADD1) are shown. Such specific instances are generated from the generic templates providing the basic structure for operators INIT and ADD.

```
INIT1
N  ← "1";
SEk ← "all free stops"
While N > 0 do
    SEEDS ← "select the farthest stop from the origin";
    v     ← "select a vehicle at random";
    create a route to service the SEEDS ;
    SEk   ← SEk - SEEDS;
    N     ← N - 1;
```

```
ADD1
SEk ← "all free stops";
While SEk ≠ Ø do
    k ← "select the stop in SEk which is the farthest
            from the route" ;
    i ← "select stop i in the route which introduces
            minimal extra-mileage between i, k
            and the successor of i in the route";
    if "false" verified then terminate ;
    if the insertion of k satisfies the constraints then
        insert k "after" i
    remove k from SEk ;
```

Fig. 10 Instantiated operators INIT1 and ADD1

In the figure, text betwen double quotation marks represents user-provided formulas which are used to "fill the slots" of the generic structures. For the sake of simplicity, instantiation formulas in figure 10 are

shown using a descriptive notation, but they are in fact created by the user via a specification language built on top of INTERLISP-D. Within this specification language, instantiation formulas can be easily created and modified. This language provides, for example, basic control stuctures (if..then..else, for, etc.) and facilities for integrating user-defined Lisp function [Potvin87].

Going back to the example of figure 10, execution of operators INIT1 and ADD1 would generate a route according to the well-known farthest insertion algorithm [Rosenkrantz&al77]. In fact, within the ALTO framework, it is possible to create and combine instantiated operators so as to reproduce the behavior of many routing algorithms already documented in the literature (see [Lapalme&al88]).

Section 8. A real application

The following "real-world" example is introduced for illustrative purpose and shows how the flexibility of ALTO provides new opportunities when facing complex problems, like this mail pick-up problem. The network is the BOURASSA postal zone, which is displayed in figure 1 (cf. introduction). Each stop is a post office that must be serviced within a fixed time span. For this application, violation of the lower bound of the time window is tolerated and implies an additional waiting time for the vehicle (up to the lower bound, when the mail is available). For each vehicle, the speed is set at 35 kilometers per hour and the maximal travel time, which must not be exceeded, is set at 120 minutes. Finally, there is no a priori restriction with respect to the number of vehicles to be used.

With templates such as those provided by the general heuristic, this problem can be solved in many different ways, using new or already known resolution strategies. We first experimented with strategies allowing relaxation of the time windows during the route generation phase, and we used afterward the exchange operator to attain feasibility. The results were not as good as expected and we thus tried strategies insuring feasibility of the solution during the route generation phase. To this end, many different instantiated operators were tried and the approach now presented is the one that produced the minimal length solution. This approach is in fact an adaptation of the clustering technique of Ferland and Rousseau [Ferland&al85] which was modified to take care of the temporal restrictions.

Here, a cluster is initialized with the farthest free stop from the origin. The distance between this seed and the remaining free stops is

then evaluated, using the formula of Ferland and Rousseau. Each free stop is considered in turn for inclusion within the route. At each step of this iterative process, the closest free stop is selected and inserted at the minimal extra-mileage location that satisfies the time constraints. If there is no such location, the selected stop is discarded and remains free. The route generation procedure is then repeated until all stops are serviced.

Our approach modifies the clustering technique of Ferland and Rousseau by considering the temporal restrictions during route generation (as opposed to "real" clusters where stops are inserted at random). This approach, coupled with a 2-opt exchange procedure [Lin65], has reduced the length of the routes by a factor of 10% as compared with a solution produced by a specialized algorithm called POST9 (see Table II). This last algorithm, developed at CRT (Centre de Recherche sur les Transports, Université de Montréal), was already better than expert route designers.

It must be noticed that ALTO, once correctly instantiated, took 6 minutes to solve the problem, as compared to 90 seconds for POST9. However, ALTO is implemented on a LISP machine (which is not a "number crunching" machine) and relies on a general approach which is inherently slower. Hence, a trade-off has to be made between generality and efficiency, and we think that this additional computation time is tolerable, given the wide spectrum of resolution strategies that is now available to us.

Due to the heuristic nature of the algorithm presented above, more tests need to be done in order to evaluate its robustness along several dimensions (number of stops, distribution of the time windows along the time line, width of the time windows, etc...). However, the purpose of this example is to show how the inherent flexibility of the general heuristic allows experts to try new ideas and explore fruitful alternatives when facing any given problem. As a matter of fact, ALTO is currently used at CRT as a tool for identifying "good" candidate resolution strategies for different kinds of randomly generated mail pick-up problems (large/small time windows, various distribution of time windows, etc...).

POST9	SEQUENCE OF STOPS	LENGTH (kms)	TRAVEL TIME (min)
ROUTE1	(53 59 56 125 124 92 83 52 15 1 55 186 130)	17.3	78
ROUTE2	(180 25 28 34 35 39 26 32 9 185 2)	14.5	69
ROUTE3	(11 12 19 47 41 43 50 22 24 17)	11.2	61
ROUTE4	(38 27 5)	6.8	53
TOTAL		49.8	261

ALTO	SEQUENCE OF STOPS	LENGTH (kms)	TRAVEL TIME (min)
ROUTE1	(53 56 59 92 124 125 55 83 52 15 17)	12.0	68
ROUTE2	(180 25 34 50 43 39 32 9 185 2)	14.5	65
ROUTE3	(12 38 26 27 28 35 41 47)	7.4	70
ROUTE4	(19 11 5 186 1 24 130 22)	10.4	50
TOTAL		44.3	253

Table II ALTO vs POST9

Conclusion

In conclusion, ALTO is a sophisticated tool for designing and testing new routing algorithms. Its flexibility is very useful to "probe the unknow" and explore alternative resolution strategies when facing any particular problem. Interesting developments can now be foreseen in the area of expert systems and machine learning, so as to allow ALTO to learn from previous experimentations and improve by itself its problem solving behavior.

References

[Bodin&al83] Bodin L., Golden B., Assad A. & Ball M., "Routing and Scheduling of Vehicles and Crews: The State of the Art", Computers & Operations Research, vol. 10, no. 2 (1983).

[Clarke&Wright64] Clarke G. & Wright J.W., "Scheduling of Vehicles from a Central Depot to a number of Delivery Points", Operations Research 12, pp. 568-581 (1964).

[Cullen&al81] Cullen F., Jarvis J. & Ratliff D., "Set Partitioning Based Heuristics for Interactive Routing", Networks 11, pp. 125-143 (1981).

[Ferland&al85] Ferland J. A., Rousseau J.M. & Chapleau L., "Clustering for routing in densely populated areas", European Journal of Operational Research 20, pp. 48-57 (1985).

[Gillett&Miller74] Gillett B. & Miller L., "A Heuristic Algorithm for the Vehicle Dispatch Problem", Operations Research 22, pp. 340-349 (1974).

[Golden77] Golden B., "Evaluating a Sequential Vehicle Routing Algorithm", AIIE Trans. 9, pp. 204-209 (1977).

[Jacquet-Lagreze83] Jacquet-Lagreze E., "PREFCALC: Evaluation et Décision Multicritères", Manuel de l'usager, EURO-DECISION eds. (1983).

[Krolak&al71] Krolak P., Felts W. & Marble G., "A Man-Machine Approach toward solving the Traveling Salesman Problem", Comm. ACM 14, pp. 327-334 (1971).

[Krolak&al72] Krolak P., Felts W. & Nelson J., "A Man-Machine Approach toward solving the Generalized Truck Dispatching Problem", Trans. Sc. 6, pp.149-170 (1972).

[Lapalme&al88] Lapalme G., Potvin J.Y. & Rousseau J.M., "A General Heuristic for Node Routing Problems", in *Advances in Control and Optimization*, G. Pederzoli and H.E. Eiselt (eds), Springer-Verlag, pp. 124-143 (1988).

[Lin65] Lin S. , "Computer Solutions of the Traveling Salesman Problem", Bell System Tech. J. 44, pp. 2245-2269 (1965).

[Potvin87] Potvin J.Y., "Un Système Informatique pour le Développement et l'Expérimentation d'Algorithmes de Génération de Tournées", Thèse de Doctorat, Université de Montréal (1987).

[Rosenkrantz&al77] Rosenkrantz D., Sterns R. & Lewis P., "An Analysis of several Heuristics for the Traveling Salesman Problem", SIAM J. Comp. 6, pp.563-581 (1977).

[Svestka&Huckfeldt73] Svestka J. & Huckfeldt V., "Computational Experience with an M-Salesmen Traveling Salesman Algorithm", Management Science, vol. 19, no. 7, pp. 790-799 (1973).

[Teitelman&Masinter81] Teitelman W. & Masinter L., "The Interlisp Programming Environment", Computer, April 1981, pp. 25-32 (1981).

SLOT VALUES AND MARKET ENTRY IN A SINGLE HUB AIRPORT SYSTEM

JOHN R.G.BRANDER, B.A.COOK AND JOHN E.ROWCROFT
DEPARTMENT OF ECONOMICS, UNIVERSITY OF NEW BRUNSWICK

Increasing airport congestion may be seen as an inevitable consequence of air transport deregulation. In a series of earlier papers the authors have argued that the long term solution to this problem is a system of peak load pricing, implemented through a periodic auction of the available capacity. One such paper, [Brander, et al., 1987], presented a simulation model of passenger traffic along individual links into a congested hub airport. From the solution algorithm it was possible to deduce the auction prices for runway slots at the hub at peak and off-peak periods. The present paper is an examination of this model when the number of firms competing for passengers is allowed to vary. In particular, the effect of the number of carriers on auction prices, airport revenues and passenger welfare are considered. Some variation in the level of demand is also examined.

It has been suggested that slot auctions may be used by existing firms as a barrier to entry, or as a way of excluding competitors from a particular market. This contention is examined in the context of the single hub model.

In Section 1 the underlying structure of the single hub model is described. Demand is characterised as either business or recreational and passengers who are unable to obtain flights in the peak periods constitute the residual demands in the off-peak period. The solution method consists of an initial continuous approximation followed by a simulated auction procedure which provides an integer solution and the appropriate slot auction prices.

Measures of performance for the system are discussed in Section 2. In particular the assumptions underlying the measurement of airport revenue from the slot auctions are examined. This leads directly to a discussion of the conditions under which firms might be barred from entry to the market in Section 3.

The data for the simulations are described in Section 4 and in Section 5 the results are reported. Their implications are discussed under the three headings of increasing the number of firms, changing the pattern of demand, and barriers to entry. Section 6 provides some concluding observations.

1. THE MODEL

(a) Demand: Passenger demand for air travel is uneven in the sense that it varies with the time of day. Specifically, it is more intense during the breakfast period and in the late afternoon. This tends to make central airports congested at these times and relatively less utilised during the rest of the day.

Much of the morning and evening demand is from business travellers flying at short notice and prepared to pay a substantial

premium to do so. By contrast, what may be termed recreational demand is much less sensitive to the times of arrival and departure. Such passengers will often plan well-ahead to obtain reduced fares. Thus there is a considerable incentive for air carriers to schedule increased flights during the morning and afternoon peak periods.

A working day is divided into two intervals, a shorter peak period and the balance of the day which is designated 'off-peak'. As already noted, the peak period may be expected to consist of two separate intervals, one in the morning and one in the late afternoon. However, there appears to be little loss of generality in treating these two periods as a single entity for which a certain amount of airport capacity is available. Since a congestion problem exists, it may be assumed that passengers prefer to travel during the peak period. Thus, in the first instance, demand from both markets is applied to this peak interval. The residual of unsatisfied demand in each market becomes the demand in the longer off-peak period.

The traffic pattern under consideration consists of a central hub airport serving n routes. A route is uni-directional in the sense that an outbound flight to a particular destination and an inbound flight from the same place are considered to be separate routes. Each of the n routes has two distinct markets, business and recreational, so that there are 2n passenger demand curves. Adopting a linear form for analytic convenience:

$$\text{demand for seats in market } j\text{: } q_j = a_j - b_j p_j \qquad j = 1,\ldots,2n \qquad (1)$$

Thus, for $j = 1$ to n, q_j is the business demand on route j and for $j = n+1$ to $2n$, q_j is the recreational demand on route $j-n$. Initially these demands are applied to the peak period. Then the residual demands are applied to the off-peak period.

(b) Cost: Service on each route is provided by some or all of m carriers or firms. The cost to firm i of operating a single flight on route j is given by:

$$\text{cost of flight by firm } i \text{ on route } j = c_{ij} + d_j(f_{ij} + h_{ij} g_{ij}) \qquad (2)$$

where d_j is the length of route j. Aircraft size is g_{ij} passengers and c, f and h are parameters of choice. Specifically, h is a cost per passenger per mile (or kilometre), f a cost per flight per mile, and c is a fixed cost per flight, including any fee for runway use.

There appears to be considerable support for the use of a function of d and g to represent cost. For example, in British Air Transport in the Seventies [1969] it is noted that "size of aircraft and stage length are highly significant factors" influencing cost levels, whereas "stage density appears to be of minor importance in affecting unit cost" [Sarndal and Statton, 1975]. Moreover, as noted below, equation (2) provides a good fit to published cost data for several contemporary aircraft types.

(c) Contribution: For each period, peak or off-peak, a carrier faces a number of routes and two separate demands for travel on each of these links. Well-established techniques, such

as advanced booking, exist to enable firms to discriminate within each pair of markets. Thus there are four ticket prices for each route, corresponding to the business and recreational fares in peak and off-peak periods. This is a greater degree of discrimination than is generally practiced in North America. However optimal discrimination may be anticipated as competition increases, particularly if an airport congestion toll is introduced. Alternatively, if peak traffic is limited by airport size, and off-peak is not, then the optimal differential between peak and off-peak fares is an indication of an individual passenger's valuation of increased airport capacity.

Hence a carrier maximises its profit over all markets on all routes subject to the behaviour of the other carriers, the size of the aircraft in use, and the capacity of the central airport in the relevant period.

Combining demand and cost, the net contribution of market j to the profit of firm i is:

$$\pi_{ij} = p_j \theta_{ij} g_{ij} Q_{ij} - c_{ij} Q_{ij} - d_j (f_{ij} + h_{ij} g_{ij}) Q_{ij} \quad j=1,\ldots,2n \qquad (3)$$

where θ_{ij} is the (average) loading factor for firm i on route j. Thus the typical number of passengers carried by each of this firm's flights on route j is $\theta_{ij} g_{ij}$. Q_{ij} is the number of flights by firm i on route j. The total number of passengers carried on flights serving market j is thus:

$$q_j = \Sigma_i \theta_{ij} g_{ij} Q_{ij} \qquad (4)$$

Hence the fare for market j is given by equation (1) as:

$$p_j = (a_j - \Sigma_i \theta_{ij} g_{ij} Q_{ij})/b_j \qquad (5)$$

Substituting equation (5) in the contribution function (3) and summing over all 2n markets yields the total contribution for firm i:

$$\pi_i = \Sigma_j (a_j \theta_{ij} g_{ij} b_j^{-1} - c_{ij} - d_j f_{ij} - d_j h_{ij} g_{ij}) Q_{ij} - \Sigma_j (\theta_{ij} g_{ij} Q_{ij} b_j^{-1} \Sigma_k \theta_{kj} g_{kj} Q_{kj}) \qquad (6)$$

where the cost parameters for market j+n are the same as those for market j.

(d) Conjectural Variation: Each firm seeks to maximise its total contribution given in equation (6) subject to the capacity of the airport in the relevant period and the anticipated behaviour of the other firms. There seems to be little basis for expecting a significant amount of collusion between carriers using the same airport and, therefore, the model is solved under a 'Cournot assumption'. Specifically, each firm maximises its own contribution on the assumption that its rivals' schedules remain unchanged. Thus the Lagrangian function for the i^{th} firm's profit maximisation problem is:

$$V_i = \Sigma_j (a_j \theta_{ij} g_{ij} b_j^{-1} - c_{ij} - d_j f_{ij} - d_j h_{ij} g_{ij}) Q_{ij} - \Sigma_j (\theta_{ij} g_{ij} Q_{ij} b_j^{-1} \Sigma_k \theta_{kj} g_{kj} Q_{kj}) + \tau (N - \Sigma_k \Sigma_j Q_{kj}) \qquad (7)$$

Here N is the airport slot capacity, and τ is the shadow price of an extra runway slot at this airport during this period. The maximisation of V_{ij} is carried out under the assumption that Q_{ik} is constant for all k not equal to i.

(e) Initial Solution: Under the assumptions in Section (d) the Kuhn-Tucker conditions for a solution may be shown to be:

$$V_{ij} = a_j\theta_{ij}g_{ij}b_j^{-1} - c_{ij} - d_jf_{ij} - d_jh_{ij}g_{ij} - \theta_{ij}g_{ij}b_j^{-1}\Sigma_k\theta_{kj}g_{kj}Q_{kj} + (\theta_{ij}g_{ij})^2b_j^{-1} - \tau \leq 0 \; ; \quad Q_{ij}V_{ij} = 0 \tag{8}$$

$$L = N - \Sigma_i\Sigma_jQ_{ij} \geq 0 \; ; \quad \tau L = 0 \tag{9}$$

All Q_{ij} and τ are, of course, non-negative.

It may be anticipated that the capacity constraint will be tight in the peak period, whence $\tau > 0$ in condition (9). However, in the remainder of the day some airport capacity may be unused causing $\tau = 0$ in (8) and (9). A priori it is also unclear which Q_{ij} will be zero, if any. Hence an iterative technique is required.

Initially the system is solved assuming that all flight volumes Q_{ij} are positive, and that the capacity constraint is slack. If the total number of flights exceeds the space available a solution is recomputed using a positive τ and $L = 0$.

Next each flight volume is checked to ensure that it is non-negative. Any negative values are constrained to be zero and the system is re-calculated. Optimality is confirmed by checking the values of the V_{ij} in conditions (8).

Thus what is termed the initial solution provides a set of flights by each carrier on each route for each of the two markets which maximises the contribution of each firm and is within the capacity of the airport. A positive shadow price τ indicates the value of an extra runway slot in the sense that it is the extra contribution which would be earned by a carrier which could operate one more flight. Equivalently it is the maximum amount which a firm would be prepared to pay for one more runway slot in the relevant period.

(f) The Auction Method: In general the initial solution will not assign whole numbers of flights to each route and to each carrier. This is to be expected since the solution is derived directly from a set of differential equations and conditions, (8) and (9).

Fractional flights are not only difficult to envisage in practice, they also make the model respond inappropriately to different sizes of aircraft (g_{ij}). To ensure a solution in terms of whole numbers of flights a new iterative scheme is required. Slots are distributed one at a time to the firm and route which can earn the most extra contribution from one more flight. In a sense the process may be regarded as an auction of each successive slot to the highest bidder, although no fee is necessarily collected.

Let each firm currently operate a whole number of flights, Q^*_{ij} on each of the n routes and within the capacity of the airport, N. Thus:

$$Q_{ij} + Q_{ij+n} = Q^*_{ij} \quad ; \quad \Sigma_i \Sigma_j Q_{ij} \leq N \qquad (10)$$

We note that only the Q^*_{ij} need be integers since Q_{ij} and Q_{ij+n} represent the portions of the Q^*_{ij} flights which are drawn from the business and recreational markets respectively. Temporarily treating Q^*_{ij} as the maximum number of flights available, each of the equations in (10) becomes a "less-than-or-equal-to" constraint. A new optimising solution will generate a set of shadow prices, μ_{ij}, one for each firm on each of the n routes.

The Kuhn-Tucker conditions for this problem are:

$$\begin{aligned} W_{ij} &= V_{ij} - \mu_{ij} \leq 0: \quad Q_{ij} W_{ij} = 0 \\ M &= \Sigma_i \Sigma_j (Q^*_{ij} - Q_{ij} - Q_{ij+n}) \geq 0: \quad \mu_{ij} M = 0 \\ \mu_{ij+n} &\equiv \mu_{ij} \qquad i = 1,\ldots,m \; ; \; j = 1,\ldots,2n \end{aligned} \qquad (11)$$

For most cases solution is by a similar iterative procedure to the initial solution algorithm. However, if some, but not all, firms supply a market on a particular route, the μ_{ij} equation itself must be solved iteratively. A modified Newton-Raphson method was adopted and found to converge rapidly for the values considered.

The μ_{ij} represent the value to each of the firms of an extra flight on the corresponding route. If additional runway capacity is available then the next slot is "awarded" to the firm-route combination with the highest positive μ. If no capacity remains, or all shadow prices are zero, the solution is final. The last value for the maximum μ_{ij} provides a second measure of the value of an extra unit of airport capacity.

In principle the iteration procedure can start with all the Q^*_{ij} equal to zero. Every slot would be allocated individually. However, for a problem of any size, the computational time required is considerable. Each new μ solution requires a lengthy iterative procedure of its own which is repeated for each additional slot. A more computationally efficient approach is to use the initial continuous solution as a starting point. Each non-integer volume Q^*_{ij} is rounded down, freeing up a small number of slots ($\leq 2nm$) which are allocated by means of the 'μ auction solution'. Starting from zero remains as an available method if the initial solution technique fails, or to mimic a particular auction procedure.

2. MEASURES OF PERFORMANCE

The behaviour of the airport system may be evaluated differently by the airport, the carriers, the passengers and by society in general. Hence a number of different performance measures are appropriate. Following directly from the solution process, various estimates of the slot auction prices are available.

(a) Slot Prices: In a competitive bidding situation the final bid does not represent the maximum price which any carrier will pay, but the highest price which would be paid by an unsuccessful bidder. This result follows from the recognition that the successful firm will not bid against itself. It remains true for a variety of auction types including English, Dutch, sealed bid first price and sealed bid second price [McAfee and McMillan,

1987]. Since all the μ_{ij} are calculated the price which would be paid at actual auction can be extracted automatically during the solution process.

Various different auction methods can be simulated by making small modifications to the algorithm. Thus, if the initial values of the Q^*_{ij} are set equal to zero, prices are generated which correspond to a slot-by-slot auction. If slots are auctioned in batches, then the solution method is readily modified to generate the corresponding prices and allocation.

(b) Airport Revenue: As noted elsewhere [Brander et al., 1988], airport revenue depends upon the form of the slot auction, particularly the size of the lots in which slots are sold. To preserve generality in the present analysis all slots are deemed to be sold at the auction price for the final slot. Since the demand curves are downward sloping the highest price which would be paid by an unsuccessful bidder for the last slot provides a lower bound on the auction price of airport runway capacity. Thus airport revenue is the product of capacity and the appropriate μ.

(c) Revenue and Profit: The total contribution to firms' profit may be calculated by summing the individual firm's contribution from each route and each period and subtracting the total revenue received by the airport. Since airport revenue is a lower bound, total contribution represents the maximum retained by the carriers.

(d) Social Welfare: Within the model, and the auction, the slot prices are determined by the profit maximisation of the individual carriers. However, the performance of an air transport system is normally considered in the broader context of how it serves society as a whole, or, at least, that part of society which is involved directly with air travel.

In this context an appropriate and widely used measure of social welfare is the sum of consumers' and producers' economic surplus. The relevant calculations for the present model are as follows. For a single linear demand curve, $q = a - bp$, consumer surplus at quantity q is given by $q^2/2b$. The number of passengers using carrier i on route j is $g_{ij}Q_{ij}$ where g is the capacity of the relevant aircraft. Hence the total number of passengers on this route in this period is ΣgQ, and total consumer surplus for the system is given by:

$$CS = \Sigma_j(\Sigma_i g_{ij}Q_{ij})^2/2b_{ij} \qquad (12)$$

summed over peak and off-peak periods.

For each aircraft size and route, cost per passenger is constant. Therefore producer surplus for each firm is simply the contribution to fixed cost, π_{ij} and total producer surplus including payment to the airport is given by:

$$PS = \Sigma_{ij}\pi_{ij} \qquad \text{again summed over both periods.} \qquad (13)$$

Combining the two, total surplus, CS + PS, provides a useful means of gauging the impact on social welfare of market expansion.

(e) Passenger Revenue: A more direct measures of the level of operations is provided by the total passenger revenue generated

by flights to and from the hub. Revenue here is a reflection of total passenger revenue miles and the fares for the different routes, both of which may be expected to respond to changes in the number of carriers.

3. BARRIERS TO ENTRY

In principle the slot auction may be used to influence competition in two ways. Existing firms may attempt to discourage potential entrants, or to drive one of their own number from the market. Since the periods are separate, if the slots are auctioned separately, exclusion or expulsion may be attempted in peak, off-peak or both periods.

It is assumed that all firms operate with full and accurate knowledge of the effects of entry and exit. Thus an entry preventing slot price is one which would reduce the potential entrant's contribution to zero. Specifically, if the market is served currently by m firms, the entry preventing price is found by re-solving the system for m+1 firms and dividing the last firm's contribution by the number of flights which it operates in the relevant period. Entry prevention is worthwhile if the profits of the m firms, net of entry preventing slot fees, exceed those which they would earn in the market with m+1 firms and normal auction payments.

The slot fee necessary to exclude the m^{th} firm is calculated in a similar way by dividing its contribution by the number of slots used. Exclusion will be worthwhile if reducing the system to m-1 firms enables the remaining firms to increase their own profits by sufficient to pay the increased slot fees.

Raising slot fees above the marginal price calculated in the model would lead normally to a reduction in the number of slots actually used by the firms to maximise their contributions to profit. However exclusion and expulsion require that all slots be purchased at the appropriate price. This raise the question of how the purchase costs are apportioned between the firms concerned. In the present analysis firms are assumed to optimise their operations neglecting the larger fee and then to pay for the slots used at the higher exclusion or expulsion price. In this way, the exclusion or expulsion 'premium' is treated as a form of sunk cost. Since collectively they must buy all the slots, the firms will continue to use them all if they would have done so without the extra fee.

4. THE DATA

To examine the behaviour of the model data was selected to reflect, in a general way, part of a network in the North American context. No identification with a specific location is intended at this stage.

(a) Carriers, routes and markets: Computation focussed on four or more firms operating on some or all of eight 'spokes' to the hub airport. Each of the routes differed in length from a short haul of 250 miles, increasing in increments of 250 miles to a substantial flight of 2000 miles.

As noted above, demand for service on each route came from two markets, a relatively high-priced business market and the larger lower-priced recreational demand. To avoid generating results from

peculiarities of demand, a "white noise" approach was adopted to the two types of market. Thus basic demand for seats on route j was given by:

$$\text{business demand:} \quad q_j = 6400 - (5000/d_j)p_j$$

$$\text{recreational demand:} \quad q_{j+n} = 20000 - (160000/d_j)p_{j+n} \qquad j = 1,..,n \quad (14)$$

d_j is the length of route j as before. In a sense demand price is simply 'scaled up' as d_j increases.

(b) Aircraft Size: Throughout the analysis g was assumed to represent both the capacity of an aircraft and the number of fare-paying passengers actually aboard. This is for convenience only, and altering the loading factor to a constant less than 100% would simply shift the profit functions downward.

In general, each firm might be expected to operate a mixed fleet of aircraft using different sizes on different routes. Aircraft capacity might also be varied between peak and off-peak services. However a distinction has yet to be drawn between each firm. To avoid too many interacting effects each carrier was identified with a particular size of aircraft. Firms were deemed to have a sufficient number of aircraft of the designated capacity to operate as many flights as they wished. Fleet size does not appear as a constraint.

For investigatory purposes four sizes of aircraft broadly appropriate to the route distances were selected. Thus the initial configuration consisted of four firms operating single type fleets of 50, 100, 150 and 200 passenger aircraft.

(c) Operating Cost: The linear cost function (2) permits considerable flexibility in terms of cost variation between routes and firms. However, for the present analysis, the following simplified version was used:

$$\text{cost of flight by firm i on route j} = c_j + d\,(f + hg_{ij}) \qquad (15)$$

To obtain 'reasonable' values for f and h two steps were involved. Canadian Transport Commission data [1983] provided operating costs per mile for eleven medium and large aircraft types. Representative passenger capacities for each of these types were obtained from Aviation Week and Space Technology [1985]. Linear regression provided values for f and h as follows:

$$\text{cost of flight by firm i on route j} = d_j(2.2031 + 0.0247g_{ij}) \quad (16)$$

Support for this straight line form is good with an R^2 of 0.97. However costs for small aircraft may be understated since none were included in the original estimation.

Parameter c was set equal to zero in the basic cost equation in (15) and remained available to introduce a landing/take-off fee as required.

(d) Airport Size: Following Borins [1982] a single runway fully utilised and with a full complement of airport services is deemed to be able to support 40 aircraft movements per hour. Each peak period in the model is considered to be of two hours duration and thus a single runway represents a peak capacity of 80 slots if

it is fully supported. Consolidating the two peak periods produces a total peak capacity of 160 slots. If the hours between midnight and 7 a.m. are unavailable for take-offs and landings this leaves 13 hours for off-peak traffic, a total of 520 slots.

5. RESULTS

As noted in the previous section, the basic configuration consisted of four firms each operating aircraft of a different size. With the demand specified these firms were found to use all the available capacity in the off-peak as well as the peak period. However, the auction price for an off-peak slot was about 5% of the peak price.

(a) Increasing the Number of Firms: The number of firms was increased from 4 to 8 by adding successive firms with aircraft of a particular size. The effects of the expansion on the various measures of performance mentioned in Section 2 are summarised in Table 1. The first line of data in the table shows the basic four firm configuration where the entry in the second column indicates that the fourth firm uses 200-seat aircraft. A sample of the corresponding fares is shown in Table 2, where a dash signifies that no passengers of the relevant type are carried on a particular route in the period in question.

Firms operating small (50-seat) aircraft have no impact on peak traffic since it is only profitable for them to use th airport during the off-peak period. Slot prices are higher for the intermediate sized aircraft since peak fares do not fall as rapidly as with the largest entrants. As might be expected, total airport revenue reflects the pattern of the auction prices since airport capacity is fixed. Total contribution falls as competition increases with the effect most pronounced for the entry of the firms with the largest aircraft.

The growth in total consumer surplus as the number of firms increases is also influenced noticeably by the size of the entrant carriers. Reference to Table 1, shows that the increase in consumer surplus is outweighed by the decline in the airlines' net revenue and thus total surplus decreases as more firms compete for the same airport capacity. This result arises even in the absence of explicit congestion costs.

Declining profits as the number of firms increases reflect the reduction in total passenger revenues. Comparison with total passenger revenue miles (TPRM) suggests that the reduction in revenues is the result of declining TPRM for the introduction of more small aircraft, but is derived from the changes in the fare schedule for the entrants with larger aircraft.

Further experimentation using successive firms with aircraft of different sizes produced similar results to those already described. For example, for an expansion of 100, 150, 100, 150, the results were within the bounds set by those for 100 and 150.

(b) Barriers to Entry - Excluding a Potential Entrant: In Section 3 it was argued that it may be possible and profitable for the existing four firms to exclude a potential entrant by bidding up the price of slots to the point where an entrant could make no contribution to profit. This involved solving the model for five firms and computing the appropriate slot prices for the peak and

off-peak periods. These prices were then used to calculate the reduced net contribution for the four firms. This contribution was compared with the net contribution which would be earned by each of the same firms if entry ocurred and the slots were auctioned between the five firms.

Thus for a potential entrant with 50-seat aircraft, the 5 firm solution yields:

Entrant:		Peak	Off-peak
Number of Slots	(1)	0	36
Total Contribution	(2)	0	180764
Exclusion price per slot (3)=(1)/(2)		0	5021

There is no potential entry by a firm of this size in the peak period. Off-Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	48	101	176	195
Slot Cost (5)=(3)x(4)	241019	507143	883735	979138
Total Net Contrib.	14216	264459	693323	1209181
With Entry: T. N. C.	79933	421386	1020798	1604553

In every column net contribution with entry exceeds the net contribution with the entry-preventing slot price and therefore exclusion is not profitable for any of the firms.

A firm with 100-seat aircraft has a potential for entry in both periods. Thus:

Entrant:		Peak	Off-peak
Number of Slots	(1)	24	72
Total Contribution	(2)	1716144	559058
Exclusion price per slot (3)=(1)/(2)		71506	7765

Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	0	37	57	66
Slot Cost (5)=(3)x(4):	0	2645722	4075842	4719396
Total Net Contrib.	0	(56534)	1440426	3183399
With Entry: T.N.C.	0	413582	2147699	4097148

Off-Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	48	101	176	195
Slot Cost (5)=(3)x(4):	372705	784234	1366586	1514115
Total Net Contrib.	(117470)	(12632)	210472	674204
With Entry: T.N.C.	52205	343844	899745	1467699

Exclusion is not profitable in either period for any of the firms in the short run. However in the long run preventing entry of another firm with aircraft of capacity 100 causes the existing firms with aircraft of capacity 50 and 100 to exit. Thus the market would be reduced to a duopoly of the 150 and 200-seat firms. At this stage the slot price must be sufficient to deter the entry of a 100-seat firm into the duopoly.

Entrant:		Peak	Off-peak
Number of Slots	(1)	37	127
Total Contribution	(2)	2589187	958191
Exclusion price per slot (3)=(1)/(2)		69978	7545

Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	-	-	79	81
Slot Cost (5)=(3)x(4)	-	-	5528264	5668220
Total Net Contrib.	-	-	2085159	3512960
With Entry: T.N.C.	-	838092	2818636	4779220

Off-Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	-	-	282	238
Slot Cost (5)=(3)x(4)	-	-	2127637	1795665
Total Net Contrib.			216873	916776
With Entry: T.N.C.	-	696962	1316202	1831083

Exclusion is not profitable in either period for either firm. Thus exclusion of a 100-seat entrant is unprofitable both in the short and the long runs.

Similar results hold for potential entry by a firm operating

150-seat aircraft. However the case for a 200-seat entrant is less clear:

Entrant:		Peak	Off-peak
Number of Slots	(1)	50	152
Total Contribution	(2)	5294302	1306371
Exclusion price per slot (3)=(1)/(2)		105886	8595

Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	0	37	57	66
Slot Cost (5)=(3)x(4)	0	3917784	6035504	6988479
Total Net Contrib.	0	(1328596)	(519236)	914316
With Entry: T.N.C.	0	265113	1456098	2887591

Off-Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	48	101	176	195
Slot Cost (5)=(3)x(4)	412538	868049	1512640	1675937
Total Net Contrib.	(157303)	(96447)	64418	512382
With Entry: T.N.C.	35058	229323	596299	992378

Exclusion is not profitable in either period for any of the firms in the short run. In the long run, preventing entry of another firm with aircraft of capacity 200 causes the existing firms with aircraft of capacity 50 and 100 to exit and the 150-seat firm remains in the off-peak period only. Thus the market would be reduced to a monopoly in the peak period and a duopoly of the 150 and 200-seat firms, off-peak. At this stage the slot price must be sufficient to deter the entry of a 200-seat firm into these markets.

Entrant:		Peak	Off-peak
Number of Slots	(1)	79	169
Total Contribution	(2)	8439549	1443487
Exclusion price per slot (3)=(1)/(2)		106830	8541

Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	-	-	-	160
Slot Cost				
(5)=(3)x(4)	-	-	-	7092757
Total Net Contrib.	-	-	-	11394531
With Entry: T.N.C.	-	-	-	6193701

Off-Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	-	-	282	238
Slot Cost				
(5)=(3)x(4)	-	-	2408659	2032840
Total Net Contrib.	-	-	(64159)	679601
With Entry: T.N.C.	-	-	1372484	1358632

It is profitable for the 200-seat firm to maintain its monopoly in the peak period, although the maintenance of the duopoly in the off-peak period is unattractive to either firm. Attempting to exclude a second 200-seat firm from the off-peak period causes the 150-seat firm to exit leaving a monopoly in both periods.

Considering the off-peak period with a potential 200-seat entrant:

Entrant:		Off-peak
Number of Slots	(1)	222
Total Contribution	(2)	2343576
Exclusion price per slot (3)=(1)/(2)		10557

Off-Peak:

A/c Capacity	50	100	150	200
Without Entry:				
# of Slots (4)	-	-	-	334
Slot Cost				
(5)=(3)x520	-	-	-	5489457
Total Net Contrib.	-	-	-	1657367
With Entry: T.N.C.	-	-	-	2359994

Combining Peak and Off-Peak:

Without Entry: Total Net Contrib.	-	-	- 13051898
With Entry: T.N.C.	-	-	- 8537278

Exclusion is profitable in the peak period. It is not profitable for the 200-seat firm to attempt to exclude other firms from the off-peak market in the long run unless it is necessary to do so in order to maintain the monopoly in the peak period.

6. CONCLUSION

The model discussed in this paper has a number of severe limitations. In particular, it treats a single hub airport as an isolated system which is unconstrained by any other part of the transportation network. Moreover, each type of demand is characterised by a simple linear form with price directly related to distance. Each firm operates a single size of aircraft and there are no explicit congestion costs at the hub other than the rigid limitation on the number of available slots. However, within this framework, the results permit a few tentative conclusions.

During the peak period, when slots are at a premium, most of them will be used by larger aircraft. This would appear to be indicated by efficiency considerations as well as the profit motivation of the model. However smaller aircraft remain viable in the off-peak period. Increasing the number of firms using a hub appears to benefit the consumers of air travel and to increase the airport's share of net revenue via the slot auction. Moreover there appears to be little incentive for existing firms to use the slot auction to restrict entry into the market, except in an extreme case. If barriers to entry are used they may be expected to take other, less costly forms.

REFERENCES

Aviation Weekly and Space Technology, August 19, 1985 and September 9, 1985.

Borins, S. F., "The Effects of Non-Optimal Pricing and Investment Policies for Transportation Facilities", Transportation Research-B, vol. 16B, 1982 pp 17-29.

Brander, J.R., B.A. Cook and J.E. Rowcroft, "Airport Congestion and Peakload Pricing: Simulating the Problem", Presented to the Meeting of the Canadian Transport Research Forum, Saint John's, Nfld., 1987.

Brander, J.R., B.A. Cook and J.E. Rowcroft, "Auctioning Runway Slots: Long Run Implications", Journal of the Transportation Research Forum, forthcoming.

Canadian Transport Commission, Research Branch, Analysis of Elements of Direct Operating Costs of Canadian Air Carrier Jet Aircraft, April 28, 1983.

Committee of Inquiry into Civil Air Transport (Sir Ronald Edwards, Chairman), British Air Transport in the Seventies. London: HMSO 1969.

McAfee, R.H. and J. McMillan, "Auctions and Bidding", Journal of Economic Literature XXV no. 2 June 1987, pp 699-738.

Sarndal, C. and W.B. Statton, "Factors Influencing Operating Cost in the Airline Industry", Journal of Transport Economics and Policy, January 1975 pp 67-88.

TABLE 1

Firms	Slot	Price	TAR	TFP	ratio TAR /	$CS	$TS	$TPR	TPRM
# cty	peak	off-p	x$10,000		TAR+TFP		x 10,000		
4 200	47327	2587	892	2789	0.2423	1787	5468	2572	12499
5 50	47327	2887	907	2765	0.2471	1788	5460	2559	12321
6 50	47327	3108	919	2747	0.2506	1789	5455	2551	12216
7 50	47327	3334	931	2729	0.2543	1792	5452	2545	12174
8 50	47327	3479	938	2720	0.2565	1791	5449	2541	12102
5 100	54822	3067	1037	2599	0.2851	1811	5446	2545	12426
6 100	58654	3250	1107	2480	0.3087	1841	5428	2516	12413
7 100	59159	3477	1127	2402	0.3194	1872	5402	2481	12327
8 100	60490	3548	1152	2374	0.3268	1881	5407	2475	12337
5 150	53072	2854	998	2566	0.2799	1894	5458	2507	12992
6 150	58428	3104	1096	2338	0.3192	1988	5423	2437	13289
7 150	60796	3387	1149	2209	0.3421	2045	5403	2393	13469
8 150	64592	3661	1224	2070	0.3715	2085	5379	2356	13496
5 200	48214	2125	882	2554	0.2567	2026	5462	2433	13747
6 200	52214	2004	940	2261	0.2936	2209	5410	2306	14529
7 200	51643	1739	917	2136	0.3003	2324	5376	2224	15020
8 200	52428	1904	938	2044	0.3145	2379	5361	2185	15301

TAR: Total Airport Revenue CS: Consumer Surplus
TFP: Firms' Total Contrib'n to Profit TS: Total Surplus
TPRM: Total Passenger Revenue Miles TPR: Total Pax Revenue

TABLE 2

Firms		PEAK BUSINESS			OFF-PK BUSINESS			OFF-PK RECREATION		
#	cty	250	1000	2000	250	1000	2000	250	1000	2000
4	200	280	600	924	87	178	280	26	90	136
5	50	280	600	924	85	170	267	27	92	138
6	50	280	600	924	87	167	257	28	93	138
7	50	280	600	924	89	165	247	28	94	139
8	50	280	600	924	88	160	243	28	95	139
5	100	300	600	885	85	164	250	27	92	135
6	100	310	620	880	81	156	232	28	93	134
7	100	310	650	820	76	151	214	28	95	135
8	100	310	680	840	72	147	208	29	95	135
5	150	290	570	860	80	155	240	27	86	130
6	150	310	550	780	76	139	210	27	84	125
7	150	310	560	740	70	133	192	28	83	122
8	150	-	560	740	67	124	182	29	83	121
5	200	270	520	799	70	140	220	23	81	122
6	200	280	480	712	62	117	189	21	75	115
7	200	270	430	648	55	103	167	20	71	110
8	200	270	420	624	51	94	152	20	70	105

- : No flights by any carrier

Microeconomics of Freight Car Supply and Demand

Douglass Wm. List [1]
Catherine S. Cook [2]
George F. List [3]

Abstract

To deal effectively with freight car investment decisions, knowledge of relevant demand and supply conditions is indispensable. Critics of microeconomics argue that although important variables that influence demand and supply can be isolated by economic theory, they can never be measured accurately empirically. This paper offers a methodology for defining and quantifying a railroad's demand and supply for freight cars in classic microeconomic terms, and shows how that knowledge can be used in the capacity investment decision process.

The first part of the paper describes how to construct a supply curve for freight car capacity. The relative economics of all sources for freight car capacity are explored, including existing serviceable equipment, potential repair program candidates, foreign equipment, leased equipment, and new cars.

The second part of the paper describes how a comparable process is used to estimate a demand curve from traffic records common on most freight railroads. Methods for handling such issues as the definition of demand and demand segmentation are reviewed. The section concludes with examples of actual demand curves constructed using the outlined methodology.

The third section of the paper demonstrates how the demand and supply curves interact, how the curves can be adjusted to reflect broader market realities, and how they can be used to guide management decision-making. Drawing on specific examples, the authors show how this approach to investment can lead to fundamental insights different from those often reached by other evaluation processes.

The paper is illustrated throughout with data drawn from actual railroad situations.

---

1 Management Consultant, Baltimore, Maryland. Formerly Vice-President, Marketing and Strategic Planning, CSX Equipment.
2 President, Planning Associates, Cincinnati, Ohio. Formerly Director, Strategic Development, CSX Equipment.
3 Assistant Professor, Civil Engineering, Rensselaer Polytechnic Institute, Troy, New York.

Introduction

Decisions regarding the addition or deletion of freight car capacity are fundamental to a railroad company. Often involving millions of dollars, these decisions are usually made at the highest levels of the organization after extensive involvement of many managers and analysts.

Despite the importance of these decisions, many managers remain frustrated that they are often made in the context of inadequate information - information that fails to portray the key aspects of such a major capacity decision with adequate richness as to its merits, dimensions, and potential ramifications.

In the paper which follows, we will show how the classic economic concepts of supply curves and demand curves can be used to evaluate and communicate key aspects of car capacity situations. This approach to evaluating car capacity issues was initially developed as part of the equipment planning process of CSX Equipment. A primary objective was to make more explicit the relationships between marginal costs and marginal revenues as they relate to equipment investment. Its conceptual origins lie in a broad base of published and unpublished thinking on microeconomics and financial analysis in general, as well as the application of these concepts to the specifics of capacity investment, transportation, and railroad freight cars. Several of the more significant references in these areas are noted at the conclusion of the paper.

So as to preserve an orderly presentation of the concepts, we begin by considering a single railroad as a "closed" system. Freight cars do not flow in and out of the system, and we can create stand-alone, internal demand and supply curves for this system without concern for broader markets. We subsequently explore how the framework can be adjusted to reflect market realities better, and how the concepts can be applied in the capacity investment decision-making process.

Definition of Car Type

Quantity demanded and supplied depend on a number of factors, not the least of which is the shippers' ability to substitute another car type for the one in question when market prices change. Some car types, such as jumbo covered hoppers, have close substitutes, such as medium cube covered hoppers and even open top hoppers fitted with lids. A change in the price of jumbo covered hoppers, the prices of the substitutes remaining constant, can be expected to cause a certain amount of substitution. A fall in the price leads shippers to use more jumbos, and a rise in the price leads shippers to desire more of the substitutes.

To a great extent, the responsiveness of quantity demanded and quantity supplied to price depends on how widely or narrowly the car type is being defined. There are very few close substitutes for "box cars", for example, but several alternatives to 50 foot, 100 ton box cars with cushion underframes.

In our analysis, we assume for simplicity that there is no substitution among car types. That is, the railroad cannot divert the demand for one car type to another.

Constructing a Supply Curve for Freight Car Capacity

We begin our discussion by looking at the supply curve for freight car capacity. We start with the supply curve because it is the easier to conceive, and influences the structure of the demand curve.

Structural guidelines

The supply curve is the relation between the amount of capacity supplied and the price. For any given price we need to ask what amount of capacity the railroad will choose to supply. First, we define the appropriate capacity unit, such as "car-days", "car-months", or "car-years" along the x-axis, and "$/car-day" or other cost per unit of capacity along the y-axis.

Second, we identify the time period relevant to the investment decision. The pertinent time period will vary depending on the certainty of forecasted demand and the flexibility of the railroad's repair, purchase, lease and build capabilities. We are primarily concerned with capacity that can be brought on-line within that time frame, keeping in

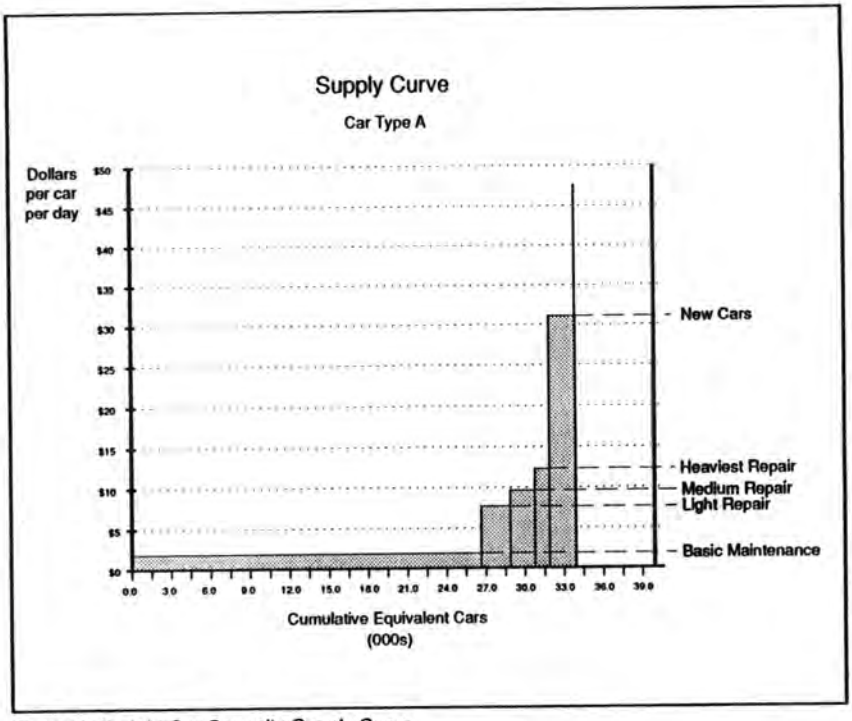


Figure A Freight Car Capacity Supply Curve

mind that we are as interested in potential capacity as we are in existing capacity. Hence, a one-year analysis should consider only how many new cars could reasonably be purchased and installed within that time frame, not the infinite number of new cars which could be purchased in the longer term.

Determining how much capacity is represented by a given set of cars requires some thought. Ultimately, we need to ensure that the measure of capacity used in the supply curve is consistent with that used in the demand curve. We favor the use of a measure like "available car days" as a unit of capacity since it is easier to manipulate consistently with data from the demand side. To measure the "available" car days from a set of cars, total car days (number of cars times total time period) must be reduced for unavoidable out-of-service time required for normal maintenance and other unavoidable time between loads not captured by the demand analysis.

To create the supply curve, blocks of capacity are arrayed from left to right in order of ascending cost, as shown in Figure A. The process for estimating the cost of each block of capacity is explored in more detail below.

Existing serviceable fleet

This is the least costly segment of the fleet to use. Its cost can be modelled as the basic maintenance costs to keep these cars in service: brake shoe replacement, wheel replacement, and the like. Such costs typically run on the order of $25-50 per car per month.

Existing unserviceable cars

Railroads usually possess an inventory of cars which require substantial repairs to return to service. These cars are typically listed as "(heavy) bad-

order" equipment. In general, repair to these cars is a more economical way to add capacity to the serviceable fleet than the acquisition of new cars.

For purposes of the supply curve, we price this latent capacity as an annuity. First, meaningful repair categories may need to be defined, based on extent and cost. For each group of cars with similar repair needs, we estimate: the cash cost of the repair, the expected serviceable life of the car following repair, the periodic cost of keeping the car in service, and the residual value of the car when it falls out of service. Standard discounted cash flow techniques can be used to convert this stream of cash flows into an equivalent periodic payment. This periodic payment is the cost assigned to this source of capacity in the supply curve.

	Full Life Cycle Basis	Service Life Cycle Basis
Discount Rate:	15.0%	15.0%
New Car Cost:	$35,000	$35,000
Anticipated Life (years):	30	8
Repair Schedule:		
Year 8	8,650	0
Year 15	10,100	0
Year 23	10,100	0
Basic Maintenance (per year):	854	854
Salvage Value:	2,000	4,500
Net Present Value (before taxes):	$(45,052)	$(37,082)
Equivalent Annual Cost:	$(6,862)	$(8,264)

Figure B Estimating the Cost of New Car Capacity

In effect, the "annuity" approach is an estimate of the lease rate we would have to pay to get the specified capacity from an external investor. Minimum free market lease rates for equipment are set in precisely this manner. Investors contemplating rebuilding cars to place them on the market look at these very same cash flows to determine whether current market rates will support the financing costs of the anticipated rebuilding. Market rates themselves appear to function just as we would expect from microeconomic theory, with prices on available cars hovering just below the level that would make it attractive to invest in additional capacity.

New cars

New car construction is usually at the far right side of the supply curve. There are two distinctly different methods for valuing new car construction, with profound implications for capacity investment decisions.

On some railroads, it is typical to look at the cost of new car capacity on a full life-cycle basis. A complete economic life cycle of cash flows is estimated that includes not only new car acquisition costs and normal operating costs, but also a provision for major repairs several times over the life of the car (say in years 8, 15 and 23 for a car that is to last 30 years). This entire stream of cash flows is then reduced to a single periodic payment.

An alternative approach is to treat the new car in precisely the same manner as an unserviceable car being repaired. We do not assume that the car will automatically be repaired at the end of its initial service cycle. Instead, we simply assign a residual value to the "hulk" which will remain at the end of the first service cycle. These two alternative approaches to estimating the equivalent periodic cost of new car capacity are shown in Figure B.

Working through these two different approaches with numbers, one discovers that the first approach yields a dramatically lower estimate of periodic cost for new equipment than the second approach. In effect, the automatic repair assumption creates "cheap" future capacity that subsidizes the cost of the first service cycle through the discounted cash flow analysis.

Which approach is correct? That depends largely on investor behavior. Some freight car owners are

so intent on maximizing asset productivity that they can be expected to meet downstream repair needs almost automatically. These owners can "take the long view" and effectively plan for an ongoing cross-subsidy from older cars to newer ones. Most railroads, however, behave differently. Cars which fall out of service are accumulated until there is a clear need to repair them. The decision to expend funds on major repairs is subject to extensive internal review. In such situations, any assumption of automatic downstream repairs when acquiring new cars results in a gross underestimation of the true cost of the additional capacity. The single cycle approach is also somewhat more realistic if one believes there are reasonable risks of premature technological obsolescence.

From a purely economic perspective, one would argue that new cars should be viewed as having a single service cycle with a probability distribution of residual values. The "worst case" scenario is that the car will only go one service cycle because lack of demand or technological obsolescence precludes repair for a second cycle. Immediate repair and return to service is in fact the "best case" scenario in most instances.

Observations about the supply curve

Following the principles outlined above, we can construct a supply curve for freight car capacity as shown previously in Figure A. If the analysis has been done correctly, the total number of cars owned should be accounted for. Discrepancies may be due to ambiguous car type definition and /or inaccuracies in record keeping.

The general shape of this curve is significant. We have a large region over which capacity is almost free. Capacity then moves up steeply in price, ending in a region where no additional capacity can be obtained at any price for the period in question. This shape to the car capacity supply curve helps us understand the behavior of the freight car capacity market. Relatively small swings in demand can create dramatic changes in market prices for equipment.

The supply curve we have constructed represents a fixed period in time. Of greater interest to the manager and planner is how this supply curve changes over time.

In the very short run, the railroad can expand capacity only through basic maintenance. The supply curve resembles a backwards "L". At the limit, the amount of supply is perfectly fixed at the existing serviceable fleet level, regardless of the prevailing market price.

In the long run, the railroad can respond to higher prices by performing major repairs and new car construction. Therefore, the longer the relevant time period, the greater the effect of a given change in price on the amount of capacity supplied. Over the very long run, when the railroad has complete flexibility in the amount it will supply, the supply curve for freight car capacity will resemble the classic upward sloping supply curve. Our medium-run step function supply curve lies between these two extremes.

Absent investment activity, the supply curve "shifts left" over time as serviceable cars become unserviceable and cars of all types are scrapped and destroyed. While this "natural attrition" of supply puts a constant upward pressure on prices, we have seen in recent years that demand for a particular car type can contract far faster than the natural contraction rate for supply. The more dynamic the transportation marketplace becomes in terms of its equipment needs, the more likely we are to see major discontinuities caused by market shifts away from existing capacity.

Constructing a Demand Curve for Freight Car Capacity

Determining the railroad's demand curve is a more difficult task both conceptually and practically. However, most railroads today have sufficient data available to permit a reasonable attempt at defining their internal demand curve for equipment, and the results of the effort can be enlightening.

On the x-axis we measure the quantity of capacity required to support a given piece of business. On the y-axis, we estimate the net contribution that will be earned by supplying the required capacity. Both of these dimensions are explored in greater detail below, but first we need to spend time deciding how we will actually define "demand".

What demand is out there?

Clearly, the demand curve of interest in investment decisions should be forward-looking, and some thinking should be devoted to how intelligence gleaned from historical records should be adjusted for previously unserved demand and future adjustments in shipper requirements.

That said, the remainder of this discussion focuses on the manipulation of historical traffic data to develop the demand curve. We should reiterate that we are looking at the railroad's internal demand for cars, not shipper demand for transportation per se. We take as a given that the revenue received by the railroad for a particular movement is set through some combination of market and regulatory forces which are beyond the scope of this analysis. We further assume that the maximum price the railroad will pay for equipment is the full contribution before car costs derived from this revenue.

The analysis presented here requires a data base that can identify shipper, origin, contribution, any specific car cost charges against contribution, and car days required (loaded and empty) to handle the traffic for individual traffic movements. We further make the heroic assumption that the assignment of empty days and empty transportation costs to individual data records is a reasonable representation of the true incremental empty costs generated by those movements. (How empty costs should be assigned to loaded moves is a major topic in itself.)

Aggregating data around shipper/origin points

One simple approach to creating a demand curve would be to take all of the railroad's traffic records and sort them in descending order of contribution before car cost per day. While often used, this approach is rarely effective. The least profitable traffic identified by such an approach tends to be thoroughly polluted with bad data, extraordinary operational foul-ups, and specific origin/destination pairs that are loss leaders necessary to hold other profitable business. This type of analysis stimulates extensive discussion of data quality problems and finger pointing over operational mistakes and pricing levels, but rarely decisive action over capacity investment.

We leap over many of these problems by shifting the focus from the profitability of individual carloads to the profitability of specific origin/shipper points. The rationale for this shift is as follows:

- The shipper/origin point is the true logical unit of demand for a capacity investment decision. The railroad clearly has the ability to furnish or not furnish a car to a specific shipper/origin point. It has virtually no operational control over how that car is subsequently used by the shipper.

- Operational foul-ups are largely probability-driven phenomena. Their occurrences usually have little or nothing to do with the specific traffic movements with which they appear. Aggregating the data into larger units distributes these costs back into the overall traffic base as they should be.

- Data errors exhibit similar characteristics to operational foul-ups. Costs and/or revenues have become detached from their appropriate home. Aggregating data according to some criteria of "likeness" improves the chances that the right costs and revenues will fall together in the analysis.

Contribution per day before car costs

Most railroads have automated costing systems for assigning to individual carloads an estimate of the variable costs associated with that movement. These costs include train labor, fuel, roadway maintenance, locomotive costs, and equipment costs.

The appropriate price for the analysis is contribution before car costs, the gross margin left after subtracting all variable costs except those associated with freight car ownership and maintenance from net revenue. This is the amount of incremental contribution which the company will earn if a freight car is provided. This contribution will be compared to the incremental cost of obtaining a freight car, as indicated by the supply curve.

Estimating capacity requirements

Consistency with the supply analysis requires that contribution before car costs be translated into a contribution per unit time, usually per month or per day. This conversion process is not as simple as it sounds. In the denominator, we must be sure to include the incremental days needed for supporting empty movements as well as the loaded movement itself. Wherever possible, car day requirements which are movement driven (e.g. shipper detention) should be captured on the demand curve in conjunction with the appropriate traffic involved.

Constructing the curve

Construction of the demand curve begins at the left with the most profitable traffic and continues right in descending order of contribution per unit of capacity.

While we can plot each shipper-origin point individually on this curve, for most purposes such detail is unnecessary. A simpler approach is to divide the traffic into larger blocks, say 10% increments, and plot the total capacity and average contribution of each increment. This simplification protects the mathematical integrity of the curve (for example, total contribution is the area under the curve under either the detailed or simplified approach) while making it easier to prepare and analyze.

Observations

Four examples of demand curves are shown in Figures C through F. These examples vividly illustrate how little an average contribution figure communicates about the profitability of the underlying traffic. Average contribution figures can mask the fact that 60% or more of the underlying traffic will not support the marginal cost of capacity.

Demand and Supply Interaction

The interaction of demand and supply determines the railroad's optimal car supply in a competitive market. Using historical data alone, there is a high risk that the first attempt to overlay supply and demand will be both surprising and disappointing. The two curves cross at or below the size of the existing fleet! (See Figure G.)

In retrospect, this is not a surprising result at all. If the only demand reflected in the analysis is what was actually carried historically, and the supply curve reflects the current fleet size, the only feasible points of intersection are to the left of the current fleet size.

Meaningful results are achieved only if we project future demand and supply. Demand must be adjusted up or down for anticipated changes in price and volume. Supply must be adjusted, almost always down, for anticipated losses in capacity over time, absent additions to the fleet. With these adjustments, the analysis begins to help sharpen our understanding. (See Figure H.)

What is the anticipated capacity shortfall? What is the contribution of the traffic at the margin? Is investment in capacity warranted, or should the marginal traffic be turned away? What is in the marginal traffic category? Working from the demand and supply curves and their underlying data, we can intelligently review the options for bringing future capacity into line with future demand, and the probable economic consequences of each option.

Dealing with the Un-simplifying Aspects of the Real-World Case

The supply and demand curves created above ignore many of the more difficult issues associated with railroad interactions with one another and the broader markets for car supply and transportation services. We identify below some of the major complications that arise in adjusting these curves to address real-world issues.

External sources of car supply capacity

Today there are a dazzling array of options for obtaining cars on the secondary market, including short-term leases, medium-term leases, shared-use agreements, and car-hire leases. The general approach we have taken with these options is to attempt to define each one in sufficient detail to reasonably estimate the level of available capacity and effective cost of that capacity. Straight term

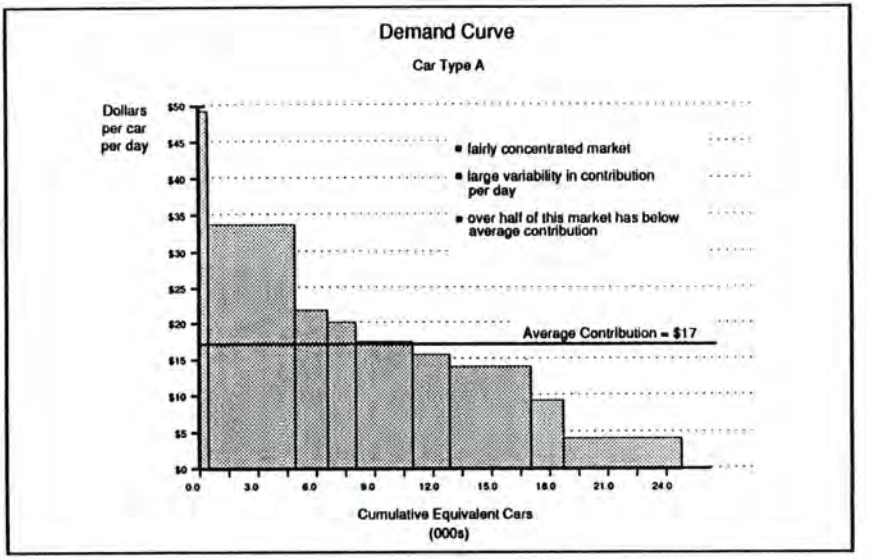


Figure C

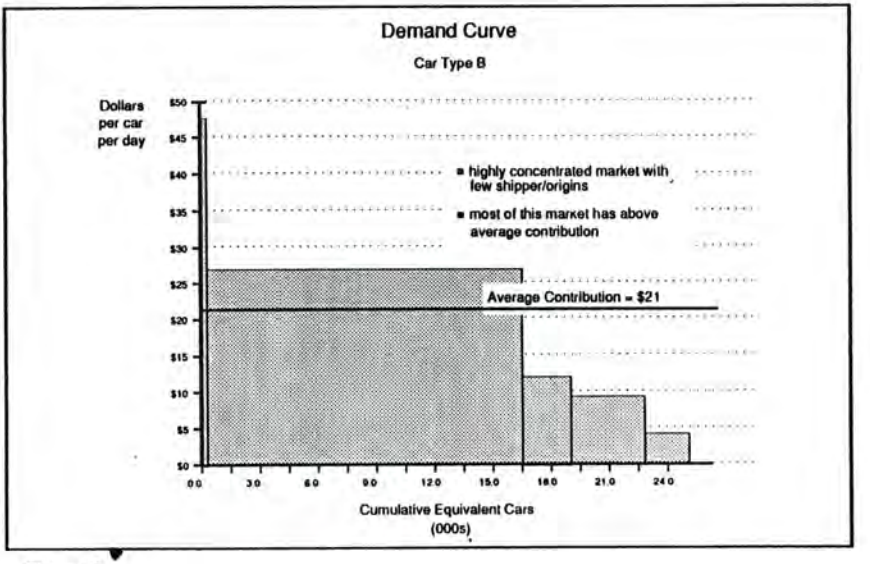


Figure D

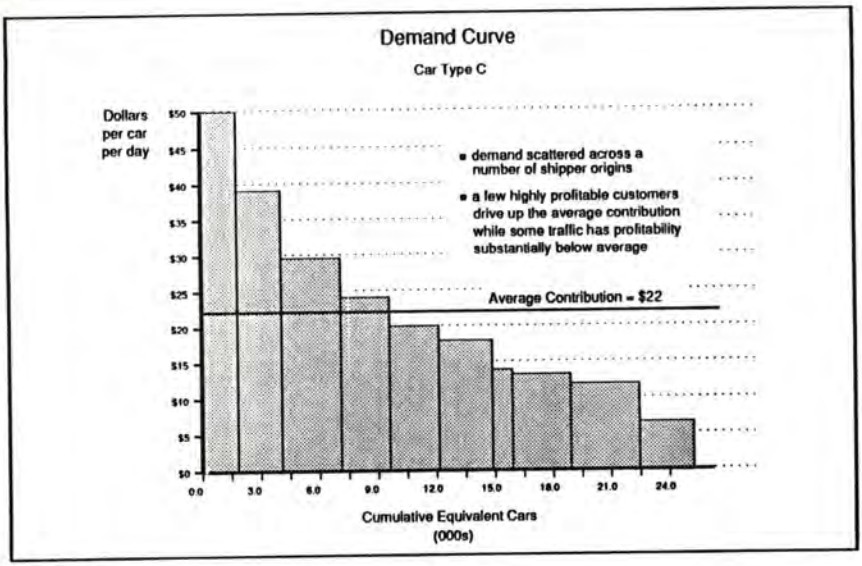


Figure E

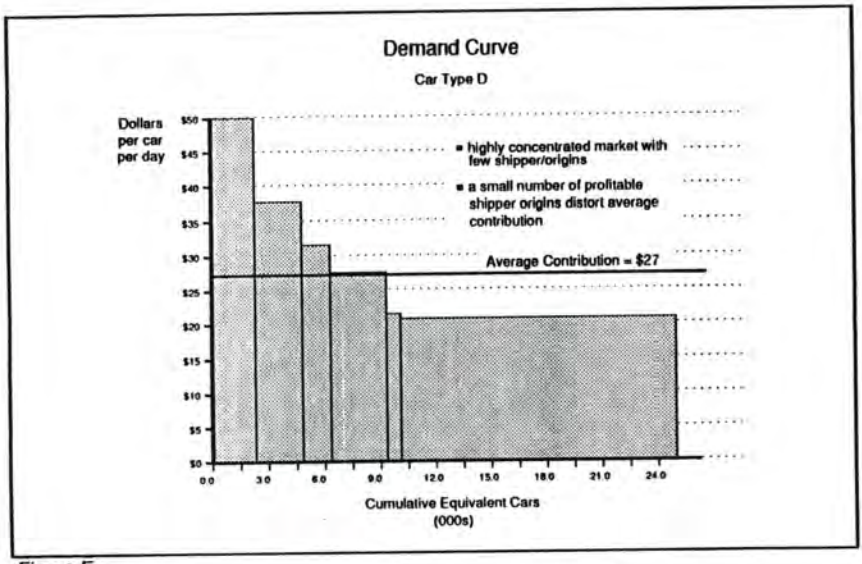


Figure F

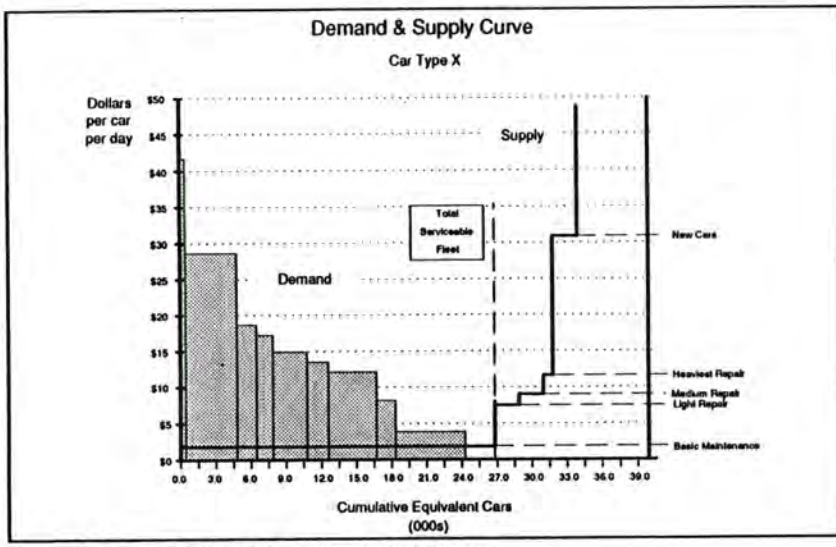


Figure G Demand & Supply Based on Historical Data

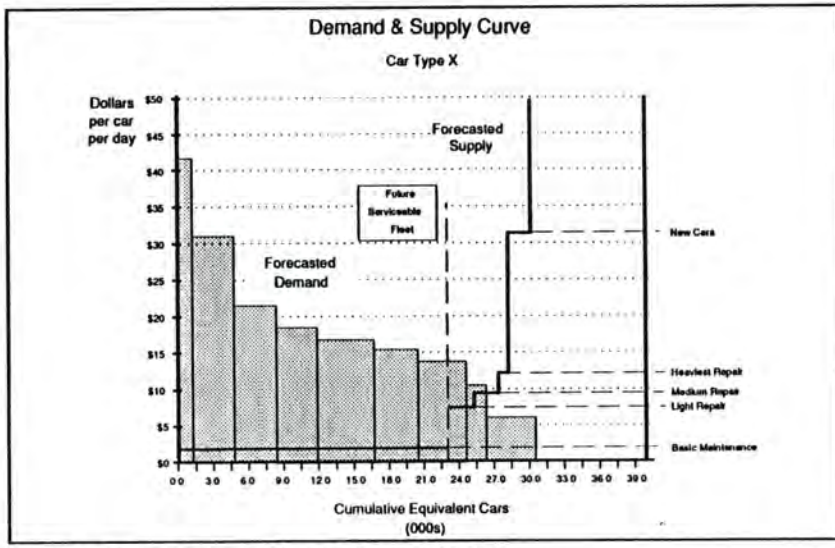


Figure H Demand & Supply Based on Forecasted Data

leases under which cars function as if they were owned by the lessee railroad are relatively easy to incorporate. Reloading foreign equipment is probably the most difficult, and is discussed in detail below.

The general objective is to insert these capacity options on the supply curve at the appropriate point given by their cost. Hence, one source of leased equipment may fall between two categories of repair options. In this case and in the absence of other factors, the leased cars are a more attractive capacity option than the second set of cars to be repaired.

Non-system equipment

A major source of equipment on most railroads is foreign equipment that can be reloaded before it is returned to the owner. As a practical matter, this is a difficult type of capacity to incorporate into the model.

In estimating the volume of available foreign capacity we need to look at how much effective, system-car equivalent capacity can be produced, a number considerably different from the actual number of car days on-line. Adjustments must be made to reflect discretionary car days used to meet on-line needs and involuntary time created by inbound loads. Part of the involuntary time is the unavoidable days required to dispose of the car if it is not used for discretionary purposes. This source of capacity may also be more or less efficient in terms of general levels of utilization and empty transportation costs. Simply put, it is not safe to assume that a foreign car with a nominal cost of $15 per day has the same cost per unit output as a system car that prices out to $15 per day.

Off-line time

Most railroads see their equipment go off-line in support of forwarded movements. The investment required to support this movement needs to be incorporated in our analysis.

Ideally, off-line time associated with individual movements should be tied back to those movements in the traffic data base. Hence, the demand for capacity created by a specific movement and the contribution produced includes the off-line portion of that movement.

As a practical matter, many railroad data systems fail to make this linkage. Absent significant data enhancement, it is necessary to treat off-line time as a stand alone demand for capacity. If nothing else, this treatment does allow the analyst to see how off-line earnings compare with the marginal cost of the capacity generating those earnings.

Strategies for Improving Management Decision Making

Despite these limitations, the demand and supply curves can provide valuable insight to the asset manager.

Using the supply curve

By definition, the supply curve indicates the amount of capacity that the railroad should be willing to supply at any given price. As such, the data also reflect the relative cost of different options for expanding or contracting the fleet. Several fundamental questions may then be addressed.

For example, has the asset manager chosen the most economical alternative for changing the fleet size? In some instances, management may choose other than the least cost option for intangible or "strategic" reasons. The supply curve will then indicate how much management is paying for these "strategic" benefits.

Second, how does the current market rate for freight car capacity (in the form of short and long term lease rates) compare to the marginal cost of the existing fleet size? In Figure I, the prevailing market rate (M) is higher than the railroad's marginal cost of capacity (C). Therefore, assuming that *external* demand exists that will support rate M, the railroad should repair cars up to point B and lease all capacity not needed internally to the external market.

A third area of constructive inquiry is how fast the railroad can respond to any significant increase in demand. When the supply of potential light repairs and short term lease options is high, management can take a "wait and see" approach to projected demand. However, if short lead time options are limited, the railroad may need to start placing orders

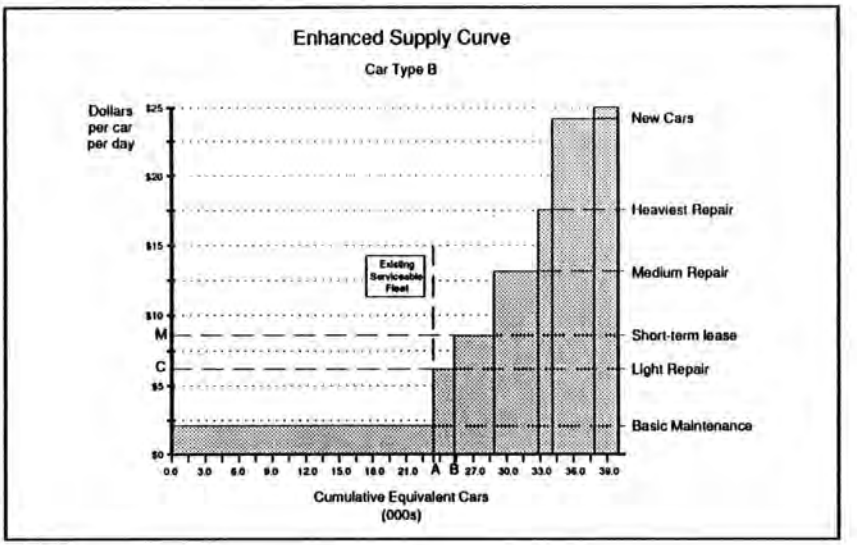


Figure I

and/or performing heavy repairs before they are actually needed.

Using the demand curve

With a few enhancements, the demand curve is a powerful tool for stimulating management discussion. First, add a vertical line (C-D) for the forecasted level of total capacity for the relevant time period. Barring additions to the fleet, the railroad must forego part of its projected traffic base. Second, superimpose horizontal lines representing the cost of various supply options. We now have a powerful one-page summary of the economics surrounding a capacity investment decision. Replacing the supply curve with the horizontal lines masks some of the details around the supply side issues, but makes the chart far more readable and comprehendible to the layman.

The downward sloping demand curve presumes that the least profitable traffic will be the first to be turned away. (Again, management may have "strategic" reasons for sacrificing other than the least profitable markets.) Basic economics tells us that it will be profitable for management to expand capacity whenever marginal revenue is greater than marginal cost. The railroad in Figure I should therefore expand capacity to point E using light repairs and short-term leases, where the contribution of the marginal traffic is greater than or equal to the cost of the additional capacity.

We can also see the relative importance of "car ownership" and "track ownership" to the railroad's economics. We will assume that the short term lease rate line represents the current market rate for equipment. For most analyses, this line represents the economic cost of the equipment used by the railroad. The contribution below this line less the operating costs of car ownership is the net contribution created by car ownership. The contribution above this line is created by other factors, primarily by the ownership of the railroad's track network. We assert that a major problem in the financial analysis of railroad capacity investments is the failure to separate, and not double count, these two pools of contribution.

Economic analysis suggests that car ownership is not required to capture the contribution above the line, nor is railroad ownership required to capture the contribution below the line. A freight car investment analysis that includes contribution above

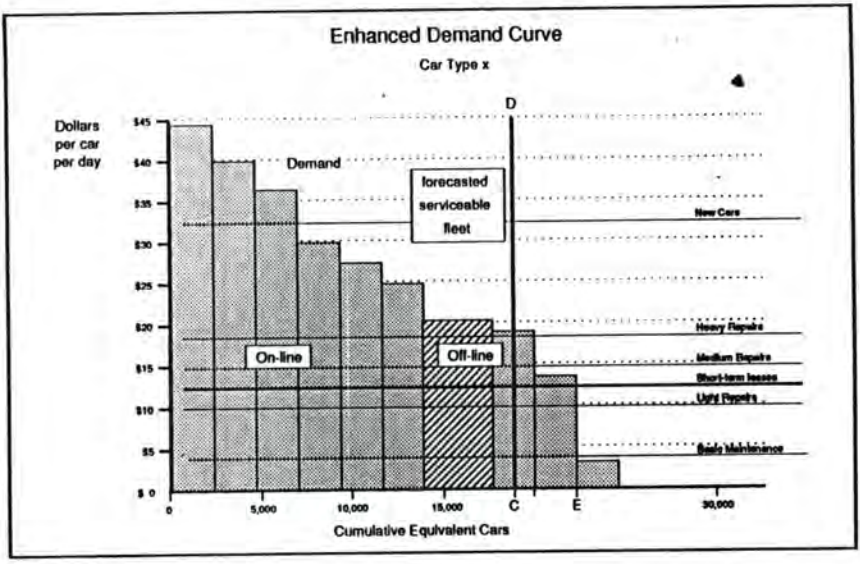


Figure J

the line as a return on that investment grossly overestimates the true economic return to the railroad from car ownership (as contrasted with the options of short term leasing or shipper supplied equipment). Similarly, an analysis of network economics that fails to deduct the full market value of equipment from contribution figures can substantially overstate the economic earnings of the network.

Conclusion

Despite the complexities of the freight car market, the basic microeconomic concepts of demand and supply can be applied effectively to railroad freight car capacity investment decisions. The results of such an analysis are invariably informative, often surprising, and should be considered essential to making informed investment decisions.

References

Allen, W. Bruce."The Demand for Freight Transportation: A Micro Approach". *Transportation Research.* Volume 11, pp. 9-14, 1977.

Borts, G. "Production Relations in the Railway Industry". *Econometrica*, Volume 20, pp. 71-79, 1952.

Braeutigam, R.R., Daughety, A.F., and Turnquist, M.A. "The Estimation of a Hybrid Cost Function for a Railroad Firm". *Review of Economics and Statistics*, Volume 64, pp. 394-404, 1982.

Daughety, A.F. and Inaba, F.S. "Estimation of Service Differentiated Transport Demand Functions". *Transportation Research Record*, Volume 688, pp. 23-30, 1978.

Daughety, A.F. "Freight Transport Demand Revisited: A Microeconomic View of Multimodal, Multicharacteristic Service Uncertainty and the Demand for Freight Transportation".

Transportation Research, Volume 13B, pp. 281-288, 1979.

Daughety, A.F., Turnquist, M.A. and Griesbach, S.L. "Estimating Origin-Destination Specific Railroad Marginal Operating Cost Functions". *Transportation Research*, Volume 17A, No. 6, pp. 451-462, 1983.

Daughety, A.F. "Transportation Research on Pricing and Regulation: Overview and Suggestions for Future Research". *Transportation Research*, Volume 19A, No. 5/6, pp. 471-487, 1985.

Felton, John Richard. *The Economics of Freight Car Supply*. University of Nebraska Press, Lincoln, Nebraska, 1978.

Harker, Patrick T. "Research Directions in Transportation Regulation and Pricing". *Transportation Research*, Volume 19A, No. 5/6, pp. 489-491, 1985.

Keeler, T.E. "Railroad Costs, Returns to Scale, and Excess Capacity". *Review of Economics and Statistics*, Volume 56, pp. 201-208, 1974.

Martland, Carl D. "Overcoming Fundamental Problems in the Car Hire/Car Service System". *Proceedings - Twenty-third Annual Meeting*, Transportation Research Forum, Volume 23, No. 1, pp. 549-560, Oxford, Indiana, 1982.

Wilson, George W. *Economic Analysis of Intercity Freight Transportation*. Indiana University Press, Bloomington, Indiana, 1980.

Winston, C. "The Demand for Freight Transportation: Models with Applications". *Transportation Research*, Volume 17A, pp.419-427, 1983.

Winston, C. "Conceptual Developments in the Economics of Transportation: An Interpretive Survey". *Journal of Economic Literature*, Volume 23(1), pp. 57-94, 1985.

Acknowledgements

The authors would also like to acknowledge the following individuals whose own work contributed directly or indirectly to the concepts included in this paper: Joel Szabat, Ralph Tang, F. William Barnett, Lee Broesch, R.M. Hebbeler, David Levy, and R.A. Sewell.

ROAD-USER COSTS: REPORT ON EXPLORATORY RESEARCH (1)

Fred P. Nix
University of Toronto/York University Joint Program in Transportation

1. INTRODUCTION

RTAC estimates there is a $1.8 billion gap between the amount spent on roads and the amount required to maintain them. (2) This concern over funding raises an issue: who should pay for the roads, or, what is the relationship between road-user costs and road-user taxes?

Those who suggest users should pay for all, or a large portion of road costs often argue that the "price" should be based on each user's costs. Others argue that roads are built and paid for out of general government revenues; there are no road prices per se, nor should there be. This is countered by the argument that, while no tax is directly tied to road expenditures in Canada, there is a well established understanding that there is a link between such things as fuel and vehicle-registration taxes and the use of the road. Still others argue that we should go further, possible as far as the Americans, and make a direct link between certain taxes and dedicated road funds.

Whatever the resolution of the debate about how much road-users as a class should pay, others argue about the structure of existing taxes. Automobile associations and the railways claim that trucks do not "pay their share." For the railways, this is a serious matter as the (possible) existence of an indirect subsidy for trucks affects the railway's ability to compete. Without considering the inter-modal implications, others point out that the current structure of road-user taxes favours some vehicles (the heavier ones) over others: they suggest that weight-distance taxes such as those used in some American states ought to be considered by the provinces.

These concerns over road financing and road-user taxes precipitated the research reported here. The purpose is to explore the feasibility of conducting a cost-allocation study using new RTAC road-cost data, current estimates of fleet characteristics, and a methodology similar to that employed by Haritos in 1973—the last major attempt to calculate costs on a national basis. (3) This is an exploratory effort; the intent is to see how far it is possible to go with new data and to discover what problems and/or issues might arise in the conduct of a full-scale cost-allocation study.

2. RTAC DATA

RTAC has recently developed data on road lengths (by province, by jurisdiction, by road type) and costs (life-cycle costs for various activities, for different road types). The data is developed on the

basis of the expenditures required to maintain a network of almost 900 thousand kilometres of roads. Requirements are the estimated annual maintenance costs per kilometre of road (paved urban, intercity freeway, etc), plus capital expenditures per kilometre by road type. These latter amounts are estimated as the unit construction costs (eg, cost per kilometre to resurface a paved rural highway) divided by the frequency of occurrence (resurfacing may only be done every ten years for some roads). Similar data is developed for bridges.

While it is unlikely that such estimates are free error, this is still the most accurate information on road costs ever assembled in Canada. With some (minor) adjustments to RTAC's data, total 1986 expenditure needs are shown in Table 1.

3. ROAD-USER COSTS

The costs of a vehicle trip may be thought of in four components:

i) Private user costs (fuel, maintenance and other vehicle expenses, and the driver's time). These are not dealt with here.

ii) Public-sector costs of building and maintaining roads. These represent 93 to 94% of the costs estimated by Haritos and are essentially similar to the needs estimated by RTAC (Table 1).

iii) Public-sector costs of other agencies associated with roads. These include things such as "licencing and control" costs: everything from those expenditures not directly related to the building and maintenance of roads—for example, enforcement, weigh scales, licensing vehicles and drivers—to the costs of various other agencies such as the police or justice systems. They may also include "health care" or "accident/safety" costs, which were not estimated by Haritos but which have been included in other studies. None of the costs in this category are dealt with here; some should be in a full cost-allocation study. (4)

A) Roads	Maintenance	Resurfacing	Reconstruction	Total
Paved Urban	558.7	254.7	821.6	1,635.0
Rural				
- freeway	162.6	82.3	140.8	385.7
- paved	1,240.7	653.6	1,080.6	2,974.8
- surfaced	272.4	76.6	221.4	570.5
- gravel	1,687.9	0.0	541.1	2,229.0
- earth	55.0	0.0	26.6	81.6
	3,977.3	1,067.3	2,832.2	7,876.8
B) Bridges				443.6
C) Total Road Expenditure Needs				8,320.3

TABLE 1 RTAC ROAD EXPENDITURE NEEDS (millions of 1986 dollars)

iv) Social costs ("externalities"). These are the difference between total social marginal costs associated with a trip and the private marginal costs of the vehicle operator. Assuming the pricing structure accounts for the marginal costs of the above-noted items (vehicle, operator, roads, and licensing and control) there remains some costs not accounted for. Traditionally these have been identified as congestion (the cost one user imposes on another) and pollution (the costs associated with vehicle emissions). They may also include other items such as accident costs (eg, accident investigation or costs not included in an efficient health-care price), some other user costs (for example, those associated with pavement wear which imposes a cost—slower travel time, higher maintenance—on other users). This subject cannot be dealt with here as there is little readily-available data to measure these items. Again, a full cost-allocation study would have to deal with this subject.

With these limitations, then, road-user costs were estimated on the basis of costs described only in category (ii) above. The implicit assumption in the analysis is that certain taxes are prices for the use of the road whether or not the funds generated are directly linked to road expenditures, and that these prices should be linked to each user's costs. More precisely, it is assumed that taxes should be set at a level that comes as close to the economist's notion of a marginal cost as current measurement techniques, and/or data sources, and/or understanding of engineering relationships permit. The arguments in support of these views have been well covered elsewhere: efficiency is increased when services (at least those with certain characteristics) are sold at prices reflecting marginal costs.

4. COST ALLOCATION

Given that efficient prices are based on marginal costs, there are still a number of choices to be made before costs can be allocated. The most vexing of these is deciding what exactly constitutes a "marginal" cost. Haritos argues that the definition depends on the time frame understood in the question "what costs can be avoided?" In the very short run—say after a decision has been made to send a vehicle on a trip—there are few escapable costs—perhaps only a small amount of fuel which varies as a function load. But in the long run—say every twenty years when a decision has to be made to rebuild a road—all costs are escapable. Presumably because of the high administrative costs of alternative pricing schemes, Haritos adopts a simple two-part price structure: costs avoided within one year are considered "escapable" and thereby constitute the marginal cost upon which the efficient per-mile price is based (the fuel tax); costs not avoided within a year are considered "inescapable" and constitute the marginal long run cost upon which the annual fee (vehicle registration tax) of each vehicle is based. (5)

Another vexing (and related) question is this: do capital costs vary as a function of vehicle usage? Haritos' manner of dealing with this is to test two alternative assumptions (explained below). Most recent engineering sources seem to suggest that capital costs do vary with usage, and this is the basis of the development of pavement costs per

ESAL (equivalent-single-axle-load, or any of a number of other measures of the effect of an axle load on pavements). Of equal importance is the issue of maintenance costs. Here too there is no consensus on what aspects of maintenance vary with vehicle usage: Haritos suggests a large portion do, but other recent studies include no maintenance costs in the computation of marginal costs.

A full description of the steps taken to combine the RTAC data with the Haritos methodology is lengthy. The following is an overview.

Adjust RTAC data: The analysis starts with the $8.3 billion shown in Table 1. These exclude some items in Haritos' analysis: licensing drivers and vehicles, police, justice, enforcement (about 6% - 7% of the total). Following Haritos' example, deductions are made to account for non-vehicle use of the roadways (utilities, sidewalks) and parking (parking-meter fees are assumed efficient). Finally, costs are organized into slightly different categories than those shown in Table 1. With these adjustments, 1986 costs are as shown in Table 2.

Assumptions about capital costs: Haritos allocates costs under two scenarios: "A" where all capital costs are inescapable, that is, are assumed not to vary with vehicle usage and, hence, constitute a portion of the annual registration fee; and "B" where one-third of capital costs are assumed to be escapable and, hence, constitute a portion of the per-mile price.

Vehicle characteristics: Critical to the analysis is information on vehicle characteristics. Available Statistics Canada (and other) data is shown in Table 3; weight groups used are the same as in Haritos.

Allocation of capital costs: Pavement costs are allocated on the basis of a cost developed for each axle weight category; earthwork and drainage costs are allocated to each vehicle, with larger vehicles assigned a somewhat higher share of costs; bridge costs are allocated on the basis of a cost developed for vehicles in different weight groups. The allocating factors--that is, the percent of total capital costs allocated to a particular weight class--are based on the 1961 U.S. cost allocation study using the "incremental" method.

Allocation of maintenance costs: To allocate maintenance costs, Haritos analyzes costs that vary with vehicle usage (eg, most of the surface and shoulder maintenance) and costs that do not (eg, about 60% of snow plowing, sanding, and salting operations). The results of another analysis suggest which of these annual and trip costs ("inescapable" and "escapable") should be allocated to all axles and axle-weight groups versus all vehicles and vehicle-weight groups. Having made the division, by urban versus rural roads, into the four above categories—annual vehicle; annual axle; trip vehicle; trip axle--costs are then assigned to weight classes on the basis of the figures developed in the 1961 U.S. cost-allocation study.

The end result of this series of allocations, assignments, and assumptions is the costs shown on Table 4.

	Urban Roads	Rural Roads	Bridges	Total
Capital Costs			325.0	325.0
- pavement	563.9	1,882.2		2,446.1
- earthwork, etc	281.9	941.0		1,222.9
Maintenance	414.1	3,145.1	118.6	3,677.8
				7,671.8

TABLE 2 ROAD COSTS (millions of 1986 dollars)

A) Fleet, By Weight Group

	Total	Weight Groups ('000 lbs) 0 - 10	10 - 20	20 - 30	30 - 40	40 +
Auto	11,118,071	11,118,071				
Buses	53,285	3,054	34,081	15,916	220	14
Other	64,103	3,674	41,001	19,147	265	17
Trucks	3,095,243	2,819,063	16,176	79,566	20,072	160,366
TOTAL	14,330,702	13,943,861	91,258	114,629	20,558	160,396

B) Axles, By Weight Group

	Total	Weight Groups ('000 lbs) 0 - 3	3 - 7	7 - 12	12 - 16	16 +
Auto	22,236,142	22,236,142				
Buses	119,891	3,598	16,296	71,353	28,438	206
Other	144,232	4,329	19,604	85,839	34,212	247
Trailers - small	4,135,192	4,135,192				
Trucks - small	5,638,126	4,792,407	563,813	281,906		
- large	1,249,455		47,505	276,180	462,885	462,885
TOTAL	33,523,038	31,171,669	647,218	715,278	525,535	463,338

C) Distance Travelled

	average annual km	total km (billions)	
Auto	20,000	222.4	
Buses	70,000	3.7	) fleet average
Other	40,000	2.6	) =
Truck - small	30,000	84.6	) 23,784 km
- large	100,000	27.6	)
TOTAL		340.9	

TABLE 3 1985 VEHICLE CHARACTERISTICS

5 OBSERVATIONS ON THE METHODOLOGY

The incremental method: The "incremental" methodolgy of the 1961 U.S. study has been criticised, particularly in respect of the way in which it allocates pavement costs: it results in axles in one weight group being assessed a different thickness requirement per standard axle load (ESAL) than axles in another weight group.

It is not clear how seriously this method distorts the allocation of pavement costs. On the one hand, it can be shown that it does not charge "enough" costs to heavy axles in comparison to light axles: the slope of the allocation curve is far shallower for this method in comparison, for example, to the slope of a line based on a function with an exponent of four (as in the computation of ESALs). But in the present case, the allocation of total pavement costs (whether as an annual or a trip charge) has to be seen in the context of recent work suggesting that the environment is the most important factor accounting for pavement deterioration. This work even suggests that on lightly-travelled roads under some conditions axle loads have little to do with pavement deterioration. In these cases, the incremental method allocates too high a proportion of costs to heavy axles.

These problems with the underlying engineering relationships cannot be resolved here. At best it can be observed that the incremental method has been criticised but that it is not clear how much distortion is introduced, nor in which direction the distortion occurs. (6)

Annual Vehicle Costs

Vehicle Weight tons	Assumption "A"	Assumption "B"
0 - 5	208.63	175.87
5 - 10	431.77	324.71
10 - 15	497.74	368.71
15 - 20	587.54	428.61
20 +	688.85	496.18

Annual Axle-Load Costs

Axle Weight '000 lbs	Assumption "A"	Assumption "B"
0 - 3	53.62	38.72
3 - 7	186.66	134.81
7 - 12	509.54	367.67
12 - 16	703.80	508.38
16 +	869.31	627.02

Variable Costs (per unit of distance)

Vehicle Weight tons	$ Per Kilometre Assumption "A"	Assumption "B"
0 - 5	0.0023	0.0036
5 - 10	0.0023	0.0068
10 - 15	0.0023	0.0077
15 - 20	0.0023	0.0089
20 +	0.0023	0.0104

Axle Weight '000 lbs	$ Per Kilometre Assumption "A"	Assumption "B"
0 - 3	0.0007	0.0013
3 - 7	0.0022	0.0044
7 - 12	0.0062	0.0121
12 - 16	0.0086	0.0168
16 +	0.0105	0.0207

TABLE 4 ROAD-USER COSTS, 1986 (RTAC data, Haritos methodology)

Axle loads and pavement wear: Closely related to the above discussion is another issue concerning axle loads and pavement wear. Where pavement costs are related to axle loads, there is a clear distortion in the Haritos methodology in the sense that each axle is treated separately for costing purposes. Two single axles weighing 8 tonnes each are given the same costs as one tandem axle weighing 16 tonnes. The various methods of calculating equivalency factors for truck axles are all in agreement on this point: the 16-tonne tandem causes less pavement damage than the two 8-tonne single axles.

Capital costs and vehicle trips: Without resolving the issue of whether capital costs vary with usage, certain consequences of adopting either assumption should be made clear. In general, assumption "B" results in a higher allocation of costs than does assumption "A" for vehicles with heavy axles (trucks) travelling long distances.

Sensitivity: The values shown in Table 4 are quite sensitive to changes in the estimates of total RTAC road costs and changes in the estimate of vehicle characteristics (number of vehicles, distribution of vehicles by weight group, number of axles, distribution of axles by weight group, average annual fleet distance). Since some of the assumptions used in preparing these estimates are weak the numbers in Table 4 are rough approximations only: "true" road costs may easily be +/- 20% of the values shown on Table 4.

6. ANALYSIS

To explore the costs developed, the following vehicles are considered:

i) Standard automobile: The same automobile used by Haritos is used here for comparative purposes.

ii) Three-axle truck: This 18.1-tonne unit is a "typical" farm truck or, possibly, urban cartage vehicle. Weight distribution is 4.5 tonnes (steering), and 13.6 tonnes (tandems).

iii) Five-axle tractor-semitrailer: The 3-S2 is the most common truck combination in Canada. It is shown with a registered weight of 72,000 lbs (32.7 t) in order to compare it with one of Haritos' trucks. The axle-weight distribution is 4.5 t (steering), 14.1 t (drive tandems), and 14.1 t (trailer tandems).

iv) Six-axle tractor-semitrailer: The 3-S3 is commonly used to haul gravel and other heavy, bulk materials in Eastern Canada. This will also become common in the West with somewhat different axle arrangements as new regulations are introduced. It consists of a steering axle (5.4 t), drive tandems (17.0 t), a single belly axle (10.0 t), and trailer tandems (17.0 t). However, because of the weight breaks used, it makes no difference if this is considered one of the new RTAC configurations with a tridem on the semitrailer. Total weight would be 46.5 tonnes (instead of 49.4), and the three semitrailer axles would be slightly lighter than the figures above, but the road costs would be identical.

v) Eight-axle B-train: This double-trailer unit, under the new RTAC regulations, will become the most common configuration for hauling big shipments of dense commodities (lumber, petroleum products, acids, fertilizers). Total weight is 62.5 tonnes distributed as follows: 5.5 t (steering), 17 t (tandem drives axles), 23 t (tridem), and 17 t (tandem on second semitrailer). One of the distortions introduced in the methodology becomes most pronounced here: the three axles in the tridem are treated as if they were three separate axles in the "16 + ton" class.

vi) Empty, eight-axle B-train: Many trucks haul empty on their return trips. The last vehicle is the same B-train as above with no load. Total weight is 18.1 tonnes distributed as follows: 2.7 t (steering), 4.5 t (tandem), 6.3 t (tridem), and 4.5 t (tandem).

Costs for these vehicles are shown in Table 5; Table 6 contains the same costs (assumption "B" only) at various annual distances; and, all costs are shown as a ratio of automobile costs in Table 7. As can be seen: (i) Assumption "A" results in higher annual costs but lower trip costs than assumption "B" (capital costs are assumed not to vary with trips); (ii) total costs per unit of distance approach trip costs (obviously) for high rates of utilization; (iii) there is a very large difference between the cost of a truck fully loaded versus an empty truck (making the problem of developing road prices tricky); and (iv) large trucks have road costs anywhere from 12 to 27 times as high as automobiles and this difference becomes greater the heavier the truck and the greater the annual distance driven.

Rate of Increase in Road Costs: Comparing costs in 1968 and 1986 for the automobile and the 5-axle tractor semitrailer, which are identical to vehicles used in Haritos' analysis, suggests that road costs have about doubled in the 18-year period. In almost the same period (1970 -1985), the construction cost index increased by over 300% and the price index for asphalt increased by 375% (7) The faster rise in the cost of road construction (and maintenance) in comparison to the rise in road-user costs is an indication of the increased intensity of road use over the last twenty years: vehicles, drivers, and kilometers driven per kilometre of road are all much higher today than in 1968.

Comparison with Other Computations of Road Costs: There is an enormous range of costs for the six vehicles listed above using information from other studies. (8) Admittedly, some of this results from using costs from different countries for different years under different road conditions. Correcting (roughly) for different currencies and years, costs for the 62.5-tonne B-train varied from $5.00 to $0.028 per kilometre. The high figure is based on the FHWA's cost of $0.50 (1986 CDN) per ESAL-km for urban, local roads in the U.S. and a calculation of load-equivalency factors based on the University of Waterloo's recent interpretation of RTAC data. (9) The low figure is based on the estimated cost per standard axle load of $0.006/km for busy Ontario highways (costs are lower for roads designed for heavy traffic than for low-volume roads) times load-equivalency factors for the 8-axle B-train calculated using the traditional ASSHTO ESALs. Using just the most recent University of Waterloo calculations, here is how the costs for trucks shown on Table 4 compare: (10)

Assumption:	Annual Costs "A"	Annual Costs "B"	Trip Costs:cents/km "A"	Trip Costs:cents/km "B"
automobile	$ 315.86	$ 253.30	0.36	0.62
3-axle truck (18.1 t)	2,605.98	1,880.61	2.55	5.60
3-S2 (32.7 t)	4,013.57	2,897.37	4.26	8.96
3-S3 (46 - 49 t)	5,077.14	3,665.11	6.32	13.04
8-axle B-train (62.5 t)	7,477.83	5,393.69	8.41	17.18
B-train, empty (18.1 t)	2,182.15	1,574.65	2.01	4.57

TABLE 5 ROAD COSTS, EXAMPLE VEHICLES

'000 Km:	Costs (annual & trip) at: 10	50	90	130	170
automobile	315	563	811	1,058	1,306
3-axle truck (18.1 t)	2,441	4,682	6,922	9,163	11,404
3-S2 (32.7 t)	3,793	7,375	10,957	14,539	18,122
3-S3 (46 - 49 t)	4,970	10,187	15,405	20,623	25,841
8-axle B-train (62.5 t)	7,111	13,982	20,853	27,724	34,595
B-train, empty (18.1 t)	2,031	3,858	5,685	7,512	9,339
'000 Km:	Costs (annual & trip) Cents Per-Km at: 10	50	90	130	170
automobile	3.2	1.1	0.9	0.8	0.8
3-axle truck (18.1 t)	24.4	9.4	7.7	7.0	6.7
3-S2 (32.7 t)	37.9	14.8	12.2	11.2	10.7
3-S3 (46 - 49 t)	49.7	20.4	17.1	15.9	15.2
8-axle B-train (62.5 t)	71.1	28.0	23.2	21.3	20.3
B-train, empty (18.1 t)	20.3	7.7	6.3	5.8	5.5

TABLE 6 ROAD COSTS AS FUNCTION OF UTILIZATION (Assumption "B" only)

Assumption: "000 km:	Annual Costs "A"	Annual Costs "B"	Trip Costs "A"	Trip Costs "B"	Total (annual + trip) "B" 10	"B" 90	"B" 170
automobile	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3-axle truck	8.3	7.4	7.1	9.0	7.7	8.5	8.7
3-S2	12.7	11.4	11.8	14.5	12.0	13.5	13.9
3-S3	16.1	14.5	17.6	21.0	15.8	19.0	19.8
B-train	23.7	21.3	23.4	27.7	22.6	25.7	26.5
B-train, empty	6.9	6.2	5.6	7.4	6.4	7.0	7.2

TABLE 7 INTRA-VEHICLE COMPARISON OF ROAD COSTS
(costs as a ratio of automobile costs)

i)	3-axle truck	Waterloo	from 0.5 to 6.9 cents/km
		Table 4 - total	from 6.7 to 9.4 cents/km
		Table 4 - trip	from 2.6 to 5.6 cents/km
		Table 4 - pavement	2.2 cents/km
ii)	3-S2	Waterloo	from 1.0 to 10.3 cents/km
		Table 4 - total	from 10.7 to 14.8 cents/km
		Table 4 - trip	from 4.3 to 9.0 cents/km
		Table 4 - pavement	3.9 cents/km
iii)	3-S3	Waterloo	from 3.5 to 21.4 cents/km
		Table 4 - total	from 15.2 to 20.4 cents/km
		Table 4 - trip	from 6.3 to 13.4 cents/km
		Table 4 - pavement	5.9 cents/km
iv)	3-S3-S2	Waterloo	from 2.8 to 22.0 cents/km
		Table 4 - total	from 20.3 to 28.0 cents/km
		Table 4 - trip	from 8.4 to 17.2 cents/km
		Table 4 - pavement	8.0 cents/km
v)	Empty, 3-S3-S2	Waterloo	from 0.02 to 1.8 cents/km
		Table 4 - total	from 5.5 to 7.7 cents/km
		Table 4 - trip	from 2.0 to 4.6 cents/km
		Table 4 - pavement	1.7 cents/km

It is not obvious that the incremental methodology performs poorly in comparison to Waterloo's estimate of pavement costs. In every single case, pavement costs (Table 4) fall with the range of the highest and lowest Waterloo number shown. In all but one case, "trip" costs also fall within this range (the exception being the empty B-train).

Comparison with Road-User Taxes: The final step is to compare costs with road-user taxes. This can only be done at a general level as: (i) Costs shown on Table 4 are system average for all Canadian roads. Most road-user taxes are provincial. (ii) There is no agreement on what constitutes a road-user tax in Canada. As a result, the following comparisons of registration taxes and provincial-federal fuel taxes have to be seen as one possible comparison between road costs and revenues. There are other taxes that might be considered road-user taxes, and there are some who would not agree that the taxes compared here do in fact constitute road-user taxes.

Registration taxes vary considerably from one jurisdiction to another. Further, there are a range of special cases--eg, farm trucks in some provinces pay almost no taxes--that make it difficult to draw up a list of "typical" registration taxes. However, these problems aside, from research conducted in 1986, Table 8 shows the range of "typical" registration taxes for most vehicles. Fuel taxes (summer 1988), in cents per litre, were in the following range: unleaded gasoline - 13.93 to 23.33 cents/litre; diesel - 11.64 to 19.14 cents/litre. On Table 8, these have been converted to a tax per kilometre. (11) The costs shown are based on the "A" and "B" assumption described earlier.

Annual Taxes versus Annual Costs

	Taxes	Costs
automobile	$86	$253 - $316
3-axle truck (18.1 t)	$250 - $675	$1,881 - $2,606
3-S2 (32.7 t)	$450 - $1,600	$2,897 - $4,014
3-S3 (46 - 49 t)	$600 - $2,700	$3,665 - $5,077
8-axle B-train (62.5 t)	$1,450 - $4,000	$5,394 - $7,478
B-train, empty (18.1 t)	$1,450 - $4,000	$1,575 - $2,182

Trip Taxes (fuel) versus Trip Costs, per kilometre (cents/km)

	Taxes	Costs
automobile	1.2 - 2.0	0.4 - 0.6
3-axle truck (18.1 t)	5.1 - 8.4	2.6 - 5.6
3-S2 (32.7 t)	6.9 - 9.7	4.3 - 9.0
3-S3 (46 - 49 t)	7.1 - 11.7	6.3 - 13.0
8-axle B-train (62.5 t)	8.6 - 14.1	8.4 - 17.2
B-train, empty (18.1 t)	5.1 - 8.4	2.0 - 4.6

TABLE 8 Comparison of Road-User Taxes and Costs

The comparisons shown in Table 8 are not sound enough to use for policy conclusions: a fuller study would analyze these relationships on a provincial basis; there would have to be some resolution as to what constituted a road-user tax; the costing methodology could be improved in certain important areas; and some of the data and/or assumptions used to develop the costs shown here are weak.

7. CONCLUSIONS

The agencies responsible for building and maintaining roads in Canada have concluded we are not spending enough to maintain the current road network, let alone add needed capacity. Pricing the use of these roads is one possible solution: a policy could be adopted to make road-users pay for their use of the road. This is the policy in the United States with respect to federal-aid highways. Some will argue, though, that because of different institutional arrangements in Canada—in particular, because the collection of what are traditionally regarded as road-user taxes is not tied to road expenditures--road pricing solutions have no place on this side of the border. This argument, however, overlooks efficiency considerations. Whether or not funds generated from taxes imposed on road users are tied to road agencies, it is generally accepted that efficiency increases when services are priced at the marginal cost of providing those services. This does not deny that there are instances of where other policies could result in roads with prices set at less than marginal costs (defense objectives, regional re-distribution policies, full-employment policies, and so on). But, for the most part, the use of the Canadian road network should be based on the payment of a price that approaches the marginal cost of providing roads.

There have only been a few attempts made at computing efficient road prices in Canada; there should now be a large-scale effort. Three key ingredients exist--road cost data, costing methodologies from any number of sources, and data on vehicle characteristics. All three of these ingredients, however, require either improvement, further research, and/or consensus before it will be possible to develop a cost-allocation exercise on which everyone can agree.

The areas where improvements, further research, and/or consensus are required are:

Framework: Efficient prices dictate the use of marginal costs as opposed to other methods variously referred to as "equitable", "ability-to-pay", "benefits received", etc. Accepting this, it is still clear there are choices to be made as to how marginal costs are to be defined and measured.

Costs: Even if a marginal cost framework is adopted, there exist significant differences of opinion as to what costs are, in fact, marginal. Some recent studies include only pavement costs (in a mature road system it can be argued that these are the major ones to consider), but this still leaves room for significant disagreements. Do "pavement costs" include surface maintenance, pavement resurfacing or overlays, pavement reconstruction, the original construction of pavements? Every recent study on this issue adopts a slightly different answer to this question. Should bridge costs be included in marginal costs? Many of these issues have to be resolved by the engineering community (see "engineering relationships" below).

Externalities: Most agree that the cost of externalities, such as noise or pollution, should be included in road prices. Actually doing so, however, seems to depend on the availability of data or the willingness of the analyst to make heroic assumptions.

Allocation Method: Even after the framework has been chosen there are different ways to allocate costs. Haritos, and much of the earlier American work, use a method that assigns a portion of pavement costs to all axles, another portion that only applies to axles over a certain weight, and so on. Most involved with this subject would probably agree that the "old" incremental methodology should give way to some of the more modern concepts (eg, costs per ESAL-km), but these still leaves the problem of knowing how to allocate costs that do not vary with short-term or trip usage (assuming--as some do not--that these costs belong in a marginal cost analysis).

Road-User Taxes: Before proceeding too far with a cost-allocation study, there will have to be some consensus on what constitutes a road-user tax and whether or not the revenues raised from these taxes should be tied to road-building.

Administrative Costs of Taxation Schemes: Administrative costs of different tax schemes vary enormously. Road prices based on strict marginal costs would have to devise a scheme whereby each user could be charged for the use of particular roads (freeways, urban arterial, country roads) at particular times (winter rush-hour on a major

freeway in Toronto, versus summer night-time driving on a secondary road in Saskatchewan) according to particular vehicle characteristics (width, height, axle loads, axle spacing, speed, tire size, etc). The costs of administering such a scheme are prohibitive.

Engineering Relationships: Associated with the above discussion, there is a problem in knowing what engineering data to use: i) Which load-equivalency factors properly represent the relationship between pavement costs and axle loads, and do any of these recognize non-load related variables: pavement type, temperature, axle spread, vehicle speed, tire size, and so on? ii) What is the relationship between pavement costs associated with environmental degradation and marginal costs (if, indeed, there is one)? iii) Do bridges "wear out" because of repeated loadings? iv) Are climbing lanes built for (caused by) heavy trucks, are they built so that cars can maintain speed, or are they built to increase capacity needed because of the peaking characteristics of automobiles? v) How do engineers design roads for capacity (ie, what peak hour traffic volumes are used), how accurate are the measures they use to convert traffic to a homogeneous variable (ie, the passenger-car-equivalents), and how should these capacity considerations be incorporated into a cost allocation study?

Road User Costs Attributed to Non-Users: Although the days when debates raged about the portion of road costs attributable to property owners for "access" seem to have passed, there remains other cloudy issues about some portion of costs being the responsibility of non-vehicle uses (utilities in urban areas being one of the cloudiest).

The research shows that it is possible to compute road costs but that these vary considerably depending on aspects of the methodology chosen and (to a lesser extent) on aspects of the data or assumptions about data. Because of this, the numbers developed here are not robust enough for policy. It is interesting, though, that the preliminary evidence seems to indicate road-user costs have not increased over the past two decades as fast as road-building costs. This is, apparently, a result of increased intensity of use (economies of scale). It is also interesting that the computed road-user costs show how difficult it is be to develop prices for "average" vehicles travelling under "average" circumstances on "average" roads. Appropriate road-prices should reflect many conditions: traffic, temporal, road-type, particular vehicle characteristics, etc. This will make the task of developing road prices difficult. The (very) preliminary evidence suggests that annual registration fees for cars and trucks are too low—although there may be some exceptions to this where empty truck travel is considered. This same evidence suggests that (perhaps) fuel taxes are too high for automobiles and too low for trucks under some circumstances. Surprisingly, though, the fuel tax is not quite as bad a "price" as a function of vehicle weight as might have been expected: a fully-loaded B-train pays a tax of 8.6 to 14.1 cents/km versus trip road costs of 8.4 to 17.2 cents/km.

There remain many controversial issues. It will take a major effort to resolve these before a cost-allocation study could be undertaken for policy guidelines.

ENDNOTES

1. The paper is based on a March 1989 report entitled "Road User Costs," funded by Transport Canada. Opinions and/or errors are, of course, the sole responsibility of the author.

2. Roadway Infrastructure Study, Update Report, Ottawa, 1988.

3. RTAC data from RTAC, op cit. Data on vehicle characteristics is from StatsCan's cat #50-002 & #53-219, with some information from the 1988 RTAC report Canada's Highways: A Profile, and Perera, M.H., Corupe, E.G., 1984, Ontario Commercial Vehicle Survey - 1983, Ontario MTC, TDF-84-05, Toronto. The methodology for the cost allocation follows that used in Haritos, Z., 1973, Rational Road Pricing Policies in Canada, CTC, Ottawa.

4. Licensing & control costs are minor in Haritos' analysis: $2.72 per vehicle and $8.34 per drivers' licence (1968 dollars). Health costs are a more contentious item. Bunting (Highway Costs and Revenues Attributable to Intercity Trucking, CIGGT, Report No. 82-9 and 82-10, Queen's University, Kingston) argues that these should be included and, in his computations, they form a significant part of the total. However, this issue is closely tied up with the efficiency of health-care prices.

5. Haritos' concept of marginal cost is quite different than others. For example, K. A. Small and C. Winston ("Optimal Highway Durability", The American Economic Review, June 1988, 78,3, pp 560 - 569) use marginal repaving costs only: there is no inclusion of items that do not vary with usage. The appendix to the 1982 U.S. highway-cost allocation study includes few of the items in Haritos' analysis (U.S. FHWA, 1982, Final Report on the Federal Highway Cost Allocation Study).

6. Pavements and axle loads: (i) Rilett, L.R., 1988, "Development, Analysis and Application of Load Equivalency Factors from Canroad Test Data", MSc thesis, Civil Engineering, University of Waterloo; (ii) Rilett, L.R., Hutchinson, B.G., 1988, "LEF Functions From Canroad Pavement Load-Deflection Data", TRB, Washington; (iii) Rilett, L.R., Hutchinson, B.G., Haas, R.C.G., 1989, "Cost Allocation Implications of Flexible Pavement Deterioration Models," TRB, Washington. The second paper contains a Canadian method for calculating load-equivalency factors (LEFs); the other two papers use these, along with the more traditional ESALs, and a model of pavement deterioration to show that environmental factors account for anywhere from 55% to 88%--depending on traffic load and initial design life of the pavement--of pavement costs are attributable to environmental degradation.

   To compare equivalency factors with the cost allocation obtained through the incremental method, consider the annual axle costs shown in Table 4 under Assumption "A." The following shows the relationship of costs to either ASSTHO's ESALs or the Waterloo's LEFs. The ESALs shown are just a close approximation to actual ESALs, which would depend on (for flexible pavements) a terminal

serviceability and a structural number: for here, the numbers are simply the load divided by 18,000 lbs, all raised to the power of 4.1. LEFs are based on: LEF = 0.0153598 X (load)$^{2.159}$

axle load ('000 lbs)	costs (Table 4)	ESALs	LEFs
1.5	1.00	1.00	1.00
5.0	3.48	139.25	13.46
9.5	9.50	1935.05	53.79
14.0	13.13	9487.48	124.25
18.0	16.21	26585.39	213.77

7. RTAC, Canada's Highways: A Profile, 1988, p 18.

8. Other studies were: Appendix "E" to the 1982 U.S. highway-cost allocation study (FHWA, op cit); recent estimates of U.S. road costs per ESAL-mile by Small and Winston (op cit); figures used by the Quebec Department of Transport (Morin, C., Vaillancourt, G., Couture, J., 1988, Le Transport Routier des Marchandises et L'Importance de La Reglementation Des Charges, Ministere des Transport du Quebec, Rapport # RTQ-88-22, Quebec); and costs per ESAL-km (or LEF-km) produced at the University of Waterloo (op cit Rilett, Hutchinson, and Haas).

9. The Waterloo analysis (Rilett & Hutchinson, op cit) suggests that an axle with a given weight does more damage to pavements than either the factors developed by RTAC or the traditional ESALs.

10. For the purpose of the comparison, total costs from Table 4 are only shown at annual distances above 50,000 km. The Waterloo figures are based only on those costs that vary with axle loads.

11. The 1986 research was: Nix, F.P., 1986, "Structure of Road-User Taxes for Large Commercial Trucks in Canada", Proceedings, CTRF, Vancouver, pp. 506 - 518. The figure shown for an automobile is from RTAC (Canada's Highways: A Profile, 1988 p 10). For the B-train, many provinces do not have registration fees for 62.5 tonnes (the agreement to allow the 62.5-tonne B-train was made in Feb., 1988 with an implementation date of July 1989). It is speculated that in high-tax jurisdictions, the tax may exceed $4,000. Fuel taxes in 1988 (from B. Bisson, University of New Brunswick) were as follows:

	provincial	federal	total
unleaded gasoline	5.0 - 14.4	8.93	13.93 - 23.33
diesel	5.0 - 12.5	6.64	11.64 - 19.14

The comparisons shown in Table 8 are based on fuel consumption rates of 8.6 L/100 km for automobiles (RTAC, Canada's Highways: A Profile, 1988, p 12), and the following for trucks (Clayton, A.M., 1984, Heavy Vehicle Fuel Performance in Canada, Transportation Group, Department of Civil Engineering, University of Manitoba, Winnipeg): km/L = 2.65 - 0.0207 (RGVW).

Modal Competitive Balance In Canadian Surface Transportation

by
Paul Kerry
CP Rail

The National Transportation Act, 1987 (NTA, 1987) declares in the statement of national transportation policy that "a safe, economic, efficient and adequate network of viable and effective transportation services making the best use of all available modes of transportation at the lowest total cost is essential to serve the transportation needs of shippers and travellers and to maintain the economic well-being and growth of Canada and its regions...". The policy statement further states that this objective is most likely to be achieved when "each carrier or mode of transportation, so far as practicable, bears a fair proportion of the real costs of the resources, facilities, and services provided to that carrier or mode of transportation at public expense, ...". (1)

These policy directions reflect a fundamental principle that the lowest overall cost of transportation to society is achieved when each mode is responsible for the total cost of the services provided. It recognizes that a hidden subsidy to a transportation mode will result in a deviation from the optimal mode or mix of modes that minimizes the overall total cost of resources consumed.

The extent and nature of total cost recovery in the rail and truck modes of surface transportation are heavily influenced by government policy. While these modes of transportation are substitutive for a large amount of freight traffic in Canada, the two modes are subject to the policies of different levels of government in regard to total cost recovery. The rail mode is subject to federal policies, while the truck mode is subject to provincial policies. Differences in the cost recovery policies used by the two levels of government in regard to their respective modes means that transportation resources are not being used in the most efficient manner.

Since 1955, more than 150,000 kms. of paved road have been constructed in Canada. The length of highways with four or more lanes has been steadily increasing. This expanding and improving paved highway network is used by the trucking industry to compete in the freight transportation business against the rail sector which provides and maintains its own infrastructure.

Notwithstanding the expansion of the paved highway network, its physical condition is deteriorating. Recent estimates indicate an accumulated deficit in highway spending of $10 billion between what has been spent by all levels of government and what should have been spent to maintain the existing highway infrastructure in a good state of repair. Construction and maintenance of new infrastructure to alleviate congestion problems caused by increasing demands on the system is not included in this estimated deficit.

The state of Canada's roads centres attention on a fundamental and as of yet unresolved issue relating to the financing of the highway network. This issue is whether different classes of highway users pay charges for the use of the highway network that are equal to their share of the full cost of constructing and maintaining the network.

Commercial vehicle operators are in business to make a profit from the transportation of goods. They provide this service in competition with other modes, and particularly the railways. To the extent that commercial vehicle operators do not contribute an amount equal to their share of the full cost of providing and maintaining the highway network, they are receiving a public subsidy and benefitting from an artificial competitive advantage. They are in a position to charge lower rates than the railways for the movement of traffic, yet still sustain commercial viability. This is because they are not required to set rates at a level that would generate the revenues necessary to repay that portion of the highway expenditures incurred for their benefit. If this is the case in Canada, a major policy thrust of the NTA, 1987 is being undermined by imperfect competition between the rail and truck modes.

Many studies have indicated that heavier truck axle loadings significantly increase the damage to roads. As a result, costs related to truck activity are incurred to design infrastructure that incorporate features to mitigate the damage aspects of the higher axle loadings compared to automobiles.

In addition, highways are designed to handle an expected traffic volume. Higher expected volumes lead to the requirement, for example, of divided highways, multiple lanes, and passing lanes. Some estimates have indicated that the highway capacity requirement of one tractor-semi trailer is equal to five passenger cars. Therefore, the volume of truck traffic is a key component in the provision of highway capacity.

To address cost issues such as these, many parties in North America advocate highway cost allocation studies to determine the total cost responsibility of different classes of highway users.

If such studies were to be conducted in the Canadian context, they would need to address the highway costs associated with heavier axle loadings and highway capacity requirements for trucks. The full range of highway capital costs, renewals and rehabilitation, and routine maintenance would also have to be considered. Different vehicle types (axle loading and configuration, vehicle weight and size) would warrant analysis to ascertain specific cost-causality functions. Not all roads need be studied, but the focus should be on at least the National Highway System.

Moreover, the study should address those costs that are largely unrelated to changes in the volume of traffic or the composition of that traffic, but which are incurred to provide a highway network. These costs, which can be called the highway "fixed" costs, would include items such as road damage from weather, safety devices, signing, snow clearance, lighting, administration, etc. The studies, to be complete, should identify these fixed costs and distribute them among users. It is wrong to argue that freight transportation on the highway system is a low-level incremental activity. Such users obtain benefits from the highway system and they should not be supported by default by other users or by the general taxpaying public.

Whether different classes of highway users are paying their full share of highway costs is obviously dependent on the amount of costs allocated to the users. However, an equally important aspect of the equation are the revenues that the classes of users pay to government to defray their share of the costs.

In Canada, there are essentially two types of highway-related sources of revenue: vehicle registration fees and fuel taxes.

Vehicle registration fees are annual amounts paid by the trucking industry based on the weight of the vehicle. Weight, in itself, is not a good indicator of highway cost responsibility since it does not take into account utilization of the vehicle. A vehicle that travels 150,000 kms. per year would obviously incur more highway costs than a vehicle that travels 100,000 kms. per year, all other factors being equal.

The other major source of highway-related revenues are taxes levied on fuel by both the federal and provincial governments. The amount of these taxes collected is a function of the amount of fuel consumed. However, there is minimal relationship between the fuel consumption of a vehicle and the cost incurred by that vehicle in highway construction and repairs. For example, declining vehicle fuel consumption rates through improved engine technology will reduce the amount of revenues that governments receive from taxes on fuel, but there will not have been a corresponding reduction in highway cost responsibility by these vehicle as a result of this improved technology. Another example is that fuel consumption is not directly proportional to the weight of a vehicle. A truck with

a gross vehicle weight (GVW) of 50,000 kg. may consume, say, 50 litres per 100 kms. A truck with a GVW of 5,000 kg. may have a fuel consumption rate of 20 litres per 100 kms. However, the highway cost responsibility for the truck of 50,000 kg. GVW will be greater than the factor of 2.5 times that of the smaller truck as implied by the respective fuel consumption rates.

It has been suggested that the taxes levied on fuel paid at both federal and provincial levels should be considered as highway user charges. However, these suggestions fail to appreciate two significant points. First, railways and other transportation modes also pay taxes on fuel. In the case of the railway mode, neither the federal nor provincial governments provide the right-of-way. The costs of the railway right-of-way are paid for by the railways from revenues received for the carriage of goods. Therefore, only the incremental revenues above the taxes on fuel paid by the railways can be described as a contribution by the trucking industry to defray highway costs.

The difference in total taxes on fuel paid to both the federal and provincial governments by the truck mode and the rail mode operating in each province is set out in the table below. One significant feature of the table is that the total taxes on fuel paid by the railways in Manitoba and Saskatchewan are higher than the truck mode, while, in Alberta, the taxes are the same.

FEDERAL AND PROVINCIAL TAXES LEVIED ON DIESEL FUEL

January 1 to March 31, 1989
Cents Per Litre

Province	Truck (a)	Rail (b)	Net (c)=(a-b)	% of Total (c)/(a)
N.S.	15.04	6.54	8.50	57%
N.B.	17.74	10.14	7.60	43%
Que.	18.99	8.64	10.35	55%
Ont.	16.44	9.64	6.80	41%
Man.	16.44	20.14	(3.70)	(23%)
Sask.	13.54	21.54	(8.00)	(59%)
Alta.	11.54	11.54	-	-
B.C.	14.77	8.96	5.81	39%

The second point is that fuel taxes have been viewed as sources of general tax revenue and therefore are not earmarked for highway construction and repairs. For example, the federal government levies an excise tax on transportation fuel. The tax was set at two cents per litre in the budget of May 1985. It was raised to

three cents per litre on January 1, 1987 on the express undertaking that the proceeds from the increase were to fund the continued full indexation of federal old age pensions. The rate has subsequently been raised to four cents per litre. The fact that this tax is equally applicable to all modes of transport and that a portion of the revenues is explicitly committed to expenditures unrelated to transportation, clearly indicates that it is not a "user charge" but a source of general revenues.

These cost responsibility issues have not escaped the attention of various jurisdictions who have adopted a supplementary or substitutive form of highway taxation. This form is the weight-distance tax. The attractiveness of the weight-distance tax lies in its direct link to the causal factors in the consumption of highway resources.

The benefits of the weight-distance tax have been summarized by R.H. Baldock, Highway Engineer, State of Oregon, in the following terms:

> "The weight-mile tax offers a solution to the tax problem with respect to heavy motor transport. It is not a theory any more than the gasoline tax or the license fee are theories. It is a sound and tested method of applying a highway use tax to operations for which the fuel tax is in-adequate and unsuitable. It is more than a method of allocating highway costs; it is an effective method of distributing those costs in the form of an equitable tax."

The American Association of State Highway and Transportation Officials (AASHTO) claims that the weight-distance tax offers equity among taxpayers, a minimum of evasion, and is cost-effective to administer.

A study by Battelle (2) indicated that in the ten states studied that have a weight-distance tax or variant thereof, the compliance rate ranged from 80-95 percent, and the administration cost ranged from 0.8 percent to seven percent of revenues collected.

In the present circumstances, the ability of the truck mode to compete for freight traffic is governed to a large degree by the decisions of the provincial governments through the latter's responsibility for the highway network and the structure of cost recovery for that network. The major rail carriers, on the other hand, are subject to the policies of the federal government. This split responsibility means that decisions may be made that place the railways at a competitive disadvantage to the truck mode. To the extent that truck operators do not pay for their full share of

the cost of highway construction and maintenance, this would lead to the situation where transportation resources are not directed to the lowest-cost alternative.

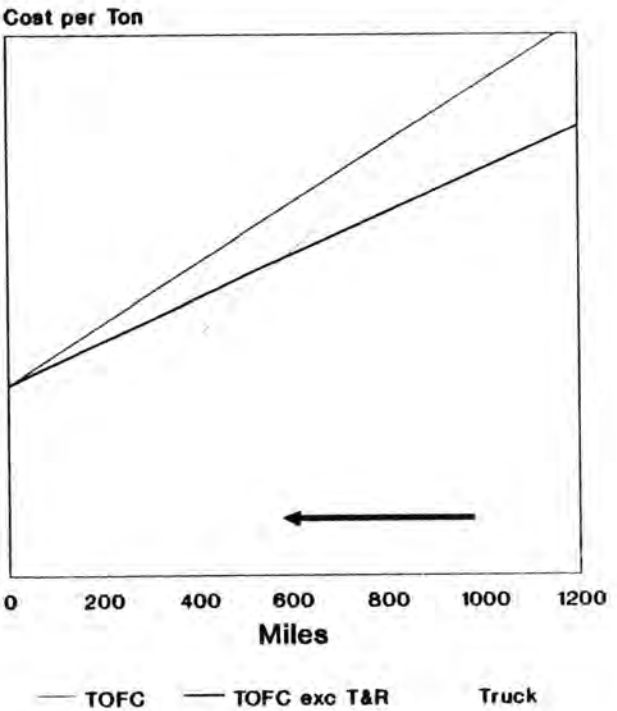
Since the end of the Second World War, the truck mode has been increasing its share of the transportation market. In that time, the rail network has been shrinking. The reduction in the rail network has, in part, been the result of past policies that have assisted the growth of the trucking industry. Congested roads and needed repairs are quite visible, and government budgets are strained to meet current highway expenditure requirements. Also lurking in the background are the environmental impacts of unconstrained highway expansion and the attendant increase in damaging vehicle emissions into the air. But largely invisible is the fragile status of the railways' ability to continue its business in those areas where trucks can logistically handle the traffic. At particular risk is the intermodal sector — the sector that would seem to offer a reasonable alternative to highway construction.

To illustrate, the graph shows the sensitivity of the competitive balance between the rail and truck modes. The line on the graph labelled "TOFC" represents the cost per ton for a trailer-on-flat-car railway intermodal movement for increasing distance. The line labelled "TOFC EXC T&R" represents the cost per ton for the same movement, but excluding the track and roadway cost component. The graph shows that if the track and roadway cost component is excluded from the rail cost, the competitive cross-over mileage with a representative intercity truck movement (the line labelled "Truck") declines from 1,000 miles to 600 miles. These cross-over mileages are understated since they do not take into account the railways' need to recover from all traffic collectively sufficient revenues to recover their constant cost.

The competitive cross-over point would similarly decrease to the extent that costs for the truck mode are increased to reflect its full share of highway cost responsibility.

It is evident that governments on all levels should pause and jointly ponder how policy affecting the competitive balance between the truck and rail mode should be co-ordinated. Investment decisions to accommodate traffic in the rail mode are made in response to both current and anticipated market conditions. Investments are undertaken on the basis that future returns will justify the expenditure. If it is perceived that the subject traffic will decline or that revenues will be artificially constrained, these investments will not be made. However, once investment decisions that meet current strategic aims have been made, it is difficult and time-consuming for the railways to reverse direction. Thus, if governments on all levels come to the conclusion that the rail mode has an important role to play in certain sectors of the freight transportation market in Canada, it

is necessary for them to co-ordinate and put into effect the appropriate policies. This should be done with dispatch. Otherwise, choices will be made according to current conditions and, as history has shown, the rail mode will diminish even further. And the decision to do so will have been made by default.



References

(1) National Transportation Act, 1987.

(2) Battelle, Columbus Division, The U.S. Experience with Third Structure Highway Taxes, June 1987.

Road Cost Recovery Issues in Australia

George Docwra
University of Queensland, Australia

and

Garland Chow
University of British Columbia, Canada

1. INTRODUCTION

Road cost recovery has recently become an important and politically sensitive issue on the Australian land transport policy agenda. The increasing costs of road works, the growth in the number of heavy vehicles using the road system, the demand for increases in size and weight limits, and the Federal government's concern to bring about micro-economic reform in the supply and pricing of infrastructure are some of the factors which have focused attention on road cost recovery. Some important dimensions of the cost recovery debate are: the appropriate methodology for determining an efficient and equitable structure of road user charges, the level of taxation imposed by the Federal government on road users, the level of cost recovery for rail services, the level and structure of charges imposed by State governments, the road expenditure decisions of the Federal government and State road authorities, and constraints imposed by the High Court. It is the purpose of this paper to provide an overview of the Australian road cost recovery debate and consider the policy decisions that need to be made if significant reform is to be achieved.

The paper provides in section 2, a short discussion of the theoretical requirements for cost recovery and the problems which arise when these conditions are not met. Section 3 reviews the background to road expenditure and cost recovery in the Australian Federal system. The interrelationships between State and Federal policies are also discussed. In section 4 attention is focussed on the road cost recovery approach adopted by the Inter-State Commission in its recent investigations of cost recovery arrangements for interstate land transport. The policy options which confront government are examined in section 5. Section 6 is a short summary and conclusion.

2. ROAD COST RECOVERY: PRINCIPLES AND ISSUES

The concept of cost recovery has a clearly defined basis in economic theory. In the private sector of an economy in which all markets are highly competitive the cost of resources utilized in the production of products and services will be recovered from users in the long run. If this outcome cannot be achieved at any level of supply, the products or services will not be produced by the private sector unless subsidies are available. Likewise excessively high rates of return on capital cannot be sustained in the long run, since this results in additional supply from new entrants. In this type of economy only government, by means of taxation, subsidies and public investment is able to support the production of commodities and services which fail to recover their costs from their beneficiaries. There are of course exceptions which need to be made to this familiar statement of the connection between cost recovery and economic efficiency in resource use. In monopolistic or non-contestable markets, cost recovery is a lower limit since the prices established in these type of markets generate revenues which usually exceed costs.

The supply of roads has traditionally been a government rather than private activity and it may not be necessary for the costs of road supply to be recovered from road users. Governments have other means such as income taxation by which supply costs might be met. However, unless road users are confronted with the resource/opportunity costs related to road use, inefficiency in the use of road resources is likely to occur.

The standard theoretical approach for establishing efficient price and investment guidelines for a road authority is to treat the road supply industry as if it were a highly competitive industry (Walters, 1969). The road authority would set price equal to short-run marginal costs (SRMC) which are defined to include road damage and congestion costs. If it is also assumed that road supply is highly divisible then adjustments to capacity and road quality are made on the basis of profitability. In the long-run the benefit maximizing supply of roads would generate revenues equal to resource costs. The equilibrium price cost ratios for each part of the network would be equal to unity.

It is often argued that road supply is characterized by significant indivisibilities (Walters, 1969). Under these circumstances, the link between SRMC pricing and profitability as an investment criterion breaks down. Proper application of the theory retains the SRMC pricing rule but investment decisions are determined by the application of benefit cost analysis. But application of the SRMC pricing rule in the presence of significant indivisibilities will not guarantee cost recovery, some users will pay prices in excess of short run marginal costs if users are to meet the cost of road supply. In formal terms, the problem is to determine a level and structure of charges which maximizes benefits from road use, subject to the constraint that total revenues equal the cost of road supply.

Most road cost recovery applications fall short of the theoretical ideal represented by the above approach. With few exceptions such studies ignore the problem of congestion costs and focus attention on the practicalities of road supply cost allocation.[1] The practical problems are the identification of the components of road track costs and determination of the allocation among the various categories of road users. Road supply is a multi-product enterprise leading to a number of cost complexities. A major difficulty is the determination of costs which can be unambiguously assigned to the different vehicle types and those which are incurred jointly for all vehicle classes. In addition, there is the problem of valuing assets which have long service lives.

The solution to these and other practical difficulties has implications for the economic effectiveness of cost recovery policies. It is also important to recognize that unless road expenditure is allocated to projects which maximize user benefits, recovery of total expenditure from charges for road use will not lead to efficient or equitable outcomes. Since road suppliers are monopolists it is possible for cost recovery to be achieved despite expenditure decisions which fail to produce the kind of road programmes that users want and are willing to pay for. In addition, some road expenditure may be incurred specifically to produce benefits to non-users and this would suggest some payment from them to maintain a given quality of road. Government may determine that a contribution from general tax revenues is warranted given the inability to measure accurately or to capture such non-user benefits.

There are two main reasons for arguing that road users should not necessarily be required to meet all of the outlays on road projects. First, that some of the expenditure may not have been effectively directed at generating user benefits. Second, that some of the expenditure may have been effectively incurred for the creation of non-user benefits. If users are required to pay for road expenditures in full, they are paying for errors in the choice of investment projects, and for benefits generated for others.

In summary, cost recovery per se is not necessarily a policy objective which, if achieved, would ensure a reasonably efficient or equitable result. Apart from difficulties in cost estimation and problems in devising appropriate charging mechanisms, an essential requirement is that expenditure decisions be matched with user demands. To the extent that some expenditure is incurred for the purpose of generating benefits for non-users it is reasonable to argue that non users, should as far as is practicable, pay for such benefits. Further, where mistakes in investment have occurred (e.g. too much investment in some parts of the system) the appropriate economic response is to allow the level of quality to adjust to a lower standard.

3. BACKGROUND TO ROAD EXPENDITURE AND COST RECOVERY IN AUSTRALIA

In Australia responsibility for roads policy is shared by Federal, State and local government authorities. The constitutional responsibility for the construction and maintenance of roads resides with the States who, in turn, share this task with their respective local authorities. The States contribute to their roads budget mainly by imposing vehicle registration charges and licence fees. Some funding is derived from loans and following the abolition of State road maintenance taxes in 1979, five of the States imposed taxes on petrol and distillate by so-called Business Fuel Franchise Fees.[2] The local authorities bear responsibility for the construction and maintenance of the non-declared road system and derive funding from rates levied on property owners and from Federal and State grants and loans.

The Federal government has no specific constitutional powers in the roads sector, except for roads in Federal government territories or in Federal government property. However constitutional provisions such as S.51 (i) and S.96, enable the Federal government to play an important role in this area. S.51 states: "the Parliament shall, subject to this Constitution, have power to make laws for the peace, order, and good government of the Commonwealth with respect to: (i) Trade and commerce with other countries, and among the States." By virtue of this power, and subject to constitutional constraint, the Federal government, is at least in theory, the dominant authority in matters concerning interstate transport. However, until recently the federal government has shown little interest in using this power in the land transport sector.

S.96 states: "...the Parliament may grant financial assistance to any State on such terms and conditions as the Parliament thinks fit." S.96 "...was inserted in the Constitution to provide some flexibility in Commonwealth - State financial relations, ..., and to assist the smaller States which stood to lose most by the last minute compromise at the Premiers conference in 1899..."(Lumb and Ryan, 1979, p.346). Subsequent judicial interpretations have allowed the Federal government to adopt a wide a use of this section as it sees fit. The initial test case occurred in 1926 in Victoria v. Commonwealth (1926) 38 CLR 399 in which the question at issue was whether the Federal government was entitled to attach conditions to a grant to the States for roads. The legislation under challenge, the Federal Aid Roads Act 1926, authorized the adoption of a road aid agreement between the Federal government and the States under which financial assistance was made available to the States for the construction and reconstruction of roads. The agreement, inter-alia, specified the types of road which could be constructed and made future payments dependant on the requirement that the States maintain such roads at a standard acceptable to the Federal government. The High Court ruled in favour of the Federal government. The import of this decision was explained by Dixon CJ in Victoria and New South Wales (Second Uniform Tax Case) (1957) 99 CLR 575, as follows:

> This means that the power conferred by [s96] is well exercised although (1) the state is bound to apply the money specifically to an object that has been defined, (2) the object is outside the powers of the Commonwealth, (3) the payments are left to the discretion of the Commonwealth Minister, (4) the money is provided as the Commonwealth's contribution to an object form which the State is also to contribute funds. (99 CLR 399).

For most of the period since 1926 the major issues concerning roads policy in Australia have focussed on the supply side. They have involved such matters as the level of Federal funding, the distribution of grants among the States, and the extent to which the Federal government should use its powers under S96 to influence road expenditure priorities, especially where such influence conflicts with the interest of the States.

From the commencement of Federal involvement in the roads sector in 1922, and until 1969, Federal policy was mainly concerned with assisting the States and local government with the financing of their roads programmes. For the period 1931 to 1959 Federal grants were formally linked to the fuels tax and distributed among the States according to a rule-of-thumb which gave Tasmania 5 percent of the grant and distributed the remainder among the mainland States on the basis of 2/5 according to area and 3/5 according to population. In 1959 the government severed the nexus between fuel taxes and road grants and altered the distribution formula, as applied to the mainland States, to include motor vehicle registrations as a third and equal factor.

In 1969 a significant change in Federal roads policy occurred. The Federal government took steps to inject some measure of economic criteria into the road planning process on the advice of the then recently established Commonwealth Bureau of Roads (CBR). This was enshrined in the Commonwealth Aid Roads Act 1969 and resulted in a shift in the distribution of funds among the States away from the larger and less populated States to those where the demand for road space was greater, and provided for the distribution of grants by four categories of roads. Although the legislation did not mirror the CBR's recommendations, the major impact was a significant increase in the funding of urban road projects.

The Federal government's efforts to have a significant effect on the allocation of road funds reached its peak during the period of the Whitlam Labor government. Legislation introduced in 1974 extended the number of road categories from four to seven which included a national highways category to be funded entirely from Federal sources. Further, the legislation extended Federal government involvement by providing for a number of control mechanisms. These included provision of powers of approval for urban arterial projects, the specification of quotas for each road category (except national highways), and the requirement of Federal approval of the use of Federal funds for all other road projects and programmes.

This extension of Federal influence in the road expenditure decision making process resulted in a great deal of criticism from most of the States and the Federal Liberal-National Party Opposition. While the Labor government justified the 1974 legislation on arguments of economic efficiency, the protagonists saw such an extension of Federal power as an infringement of States' rights and specifically on the right of the States to determine road expenditure priorities from revenues derived from State charges and taxes. Following the defeat of the Whitlam labor government in November of 1975, the new Liberal-National Party government under Malcolm Fraser's leadership took steps to reduce the extent of Federal government involvement in the setting of road expenditure priorities. Thus amendments to the legislation in 1976, inter-alia, softened the requirements by confining these to urban projects funded by Federal grants. The amendment also removed the requirement of Federal approval of all urban rural local roads funded by the Federal government.

Subsequent legislation in 1980 and 1981 resulted in a further relaxation of Federal government controls over road investment decisions. However, this trend was reversed in 1982 with the enactment of the Australian Bicentennial Road Development Trust Fund Act 1982 (ABRD) and in 1985 with the introduction of the Australian Land Transport (Financial Assistance) Act 1985 (ALTP). While the former legislation was conceived as an additional source of funds to partly correct for the decline, in real terms, of Federal funding since the mid 1970's, it also provided for the re-introduction of project approval arrangements, and empowered the Minister to set standards for national highways. Further, the ABRD reintroduced hypothecation (earmarking) of excise and customs duties on motor spirit and diesel fuel. The initial rate of duty was set at 1 cent per litre, rising to 2 cents per litre after 30 June 1983. The ALTP Act extended hypothecation not covered by the ABRD Act. The rate was set initially at 3.66 cents per litre with indexing provisions to maintain the real value of the programme through to June 1990. The Act also extended to all Federal road expenditure the controls re-introduced in the ABRD Act, except for local roads.

The most recent change in Federal policy occurred in January, 1989 with the introduction of the Australian Centennial Roads Development Act 1989. The programme continues hypothecation of fuel excise, the initial charge on fuel being set at 4.95 cents per litre. Federal grants will be allocated to four categories of roads: national highways, national arterials, state arterials and local roads. While the distribution of funds by the latter two categories are designated in the Act, the allocation of funds to national highways and national arterials are to be based on an assessment of national priorities, and are subject to ministerial determination. Provision is made for project approval arrangements (for the national roads categories) and for the States to introduce "quality assurance" and pavement management systems. As argued elsewhere (BTE 1987, p.51), the various changes in programme approval arrangements, matching conditions and road categories which have occurred in Federal roads policy since 1969, "...probably reflect more than anything the success of the States in

circumventing constraints imposed by the Commonwealth, because of the inherent funding arrangements and the broad nature of overall Commonwealth objectives".

The subject of cost recovery emerged as a fundamental issue during the late 1970's for Federal road transport policymakers. This was in response to a complex of factors including grievances expressed by the road haulage industry concerning the growth and level of taxes imposed by the Federal government on their industry, and an anomaly brought about by the High Court's interpretation of S.92 of the Constitution. This section states that "...trade, commerce, and intercourse among the States, whether by means of internal carriage or ocean navigation, shall be absolutely free". In a decision brought down in Hughes and Vale Pty. Ltd. v New South Wales (No.2) (1955) 93 CLR, 127, the High Court declared that the States could impose a road maintenance tax on heavy vehicles engaged in interstate transport, and that no charges could be imposed for capital. This meant that vehicles engaged in both intra and interstate state transport paid the road maintenance tax as well as State registration fees, while vehicles engaged solely in interstate transport could be charged the maintenance tax and only a nominal registration fee.

The road maintenance tax proved costly to collect, was frequently evaded and viewed as inequitable by some segments of the industry. In response to a road blockade in 1979 the tax was removed by all of the States by 1980. The Federal government subsequently set up the National Road Freight Industry Inquiry (NRFII), which reported in September of 1984 on a number of issues affecting the road haulage industry including the level of cost recovery in road and rail transport. In June 1985 the recently resurrected Inter-State Commission (ISC, see below) was given the task of investigating matters relating to cost recovery arrangements for interstate land transport. The ISC presented its findings in April 1986 and recommended charges for vehicles (prime movers and trailers) engaged solely in interstate trade. The Federal Interstate Registration Scheme commenced on January 1987 and the registration charges levied under it were, with minor exceptions, those recommended by the ISC.

4. THE INTER-STATE COMMISSION AND ROAD COST RECOVERY

4.1 The Inter-State Commission (ISC)

The ISC was enacted by an Act of Parliament in 1912 and operated during the period 1913 to 1920. The ISC is a Constitutional body. Section 101 states that: "There shall be an Inter-State Commission, with such powers of adjudication and administration as the Parliament deems necessary for the execution and maintenance, within the Commonwealth, of the provisions of this Constitution relating to trade and commerce, and of all laws made thereunder." For a number of reasons the ISC did not appear on the Australian scene until many years later. The reestablishment of the ISC was initiated by the Whitlam government by an Act of Parliament

in October 1975 and Commissioners were appointed in 1984. The ISC's first task was an investigation of the Tasmanian Freight Equalization scheme which was completed in March 1985.

4.2 The 1985 ISC Cost Recovery Study

Terms of Reference. In 1985 the ISC was asked to make a recommendation for appropriate charges for freight and passenger vehicles engaged solely in interstate trade. The terms of reference required the ISC to consider the extent of cost recovery for vehicles engaged in interstate trade, solely or partially, to take account of the level of cost recovery for interstate rail freight and passenger services, and to have regard to the conclusions of the NRFFI so far as these concerned government charges on the road freight industry. A further requirement was that the ISC should treat as relevant Federal revenues the amounts hypothecated under the ABRD and ALTP as well as revenue payable under the government's proposed Interstate Road Transport legislation which arose from the NRFII recommendations. Thus the intention was to make explicit the Federal government's view that amounts earmarked under the above programs were to be defined as revenues derived from user charges, while other federal charges imposed on road users were to be regarded as taxes.

Constitutional and other Constraints. The ISC investigation and recommendations are essentially the first step towards the achievement of a reasonable measure of economic rationality in the pricing of road supply in Australia. Rationalization of road pricing is expected to occur over a period of time. In addition to technical difficulties, constitutional constraints restrict the power of the Federal and State governments. Various levels of government and road user groups also have difficulty in reaching agreement on various facets of the cost recovery scheme.

The High Court's interpretation of S92 in Hughes and Vale constrain the ISC recommendations for an appropriate charge for vehicles engaged solely in interstate trade to relate only to the road maintenance costs which such vehicles impose on the road system. While the High Court in Cole v. Whitfield (1988) 62 ALJR 303 (the Crayfish case) made a fundamental reappraisal of its interpretation of S92, the implications for road user charging policies are not yet clear.[3] So the present situation is that the Hughes and Vale decision still applies. The ISC was also faced with wide differences in State and Territory vehicle registration charges for the same user classes and between classes. For example, registration charges per annum ranged from $2753 for a representative six axle articulated vehicle in New South Wales(NSW) to $1280 in Tasmania and an estimated $376 per annum in the Northern Territory (ISC, 1986). While such differences in charges have little, if anything, to do with considerations of economic efficiency, it is clear that any charge recommended by the ISC would have to be near the lowest State registration charge.

Methodology: Costs and Revenues. There are two approaches to estimating the annual cost of road and rail transport. These are:

1. The Equivalent-Annual Cost (EAC) approach (also known as the Public Enterprise approach),
2. The Current Expenditure Approach or Pay-As-You-Go (PAYGO).

In the case of the EAC, 'annual costs' was defined by the NRFII (1984, p. 222) as "the sum of the year's current expenditure and the amortization of capital expenditure of past years." This approach is used by most private sector firms and many public enterprises. Applied to roads this approach is "...an attempt to devise for the road system a set of accounts comparable to a public or private firm." (U.K. Ministry of Transport, 1968, p.76). The PAYGO approach applied to roads was defined by the NRFII (1984, p.222) as "...being equal to the amount spent on road construction and maintenance during the year in question." Thus this approach treats capital expenditure as current expenditure.

The ISC adopted the PAYGO approach for determining the level of costs to be recovered. There are many difficulties with this approach. One is the assumption that the expenditure incurred is optimal in economic efficiency terms. Critics also claim that the annual level of road expenditure may have little direct relationship to the level of costs imposed on the road system. There is also the problem that capital expenditure incurred in the year in question is attributable to current users. However the ISC adopted the PAYGO approach because such a system is easy to implement and the data requirements are less demanding than those of the EAC approach. Further the ISC accepted the arguments that "In the case of a relatively mature road network, the two approaches may be expected to lead to similar estimates of annual costs" (NRFII, 1984, p.223).

There are also difficulties involved in the use of the PAYGO approach for comparing cost recovery levels in road and rail. A major problem is that application of this approach to road supply excludes private costs associated with the acquisition of vehicles such as operating costs, ancillary equipment and depots. In the case of rail the operating equipment and other assets cannot logically be separated from the track. Since private firms using the roadways must at least achieve cost recovery in order to survive, the appropriate comparison between road and rail is to include all road transport costs which are recovered by private operators. The ISC argued that there were significant difficulties in estimating all road transport costs, and used only estimates of total vehicle costs (ISC, 1986, pp.358-60). The omission of other costs, assuming they are fully recovered, produces a downward bias in the cost recovery rate for road when compared with that for rail. The ISC used the combination of road operating costs and road cost recovery estimates (see below) which gave the lowest cost recovery rate. For a typical six axle articulated vehicle of 38 tonnes gross mass, travelling 145,197 kilometres, the least favourable cost recovery rate was estimated at 72.5 per cent. The estimated overall cost recovery rate for interstate freight for all system was 66 percent. Inclusion of interstate passenger services lowered the rate to 59 percent. The ISC used these results in arriving at its

recommendations for registration charges for vehicles engaged solely in interstate transport.

Other costs of importance to the issue of efficient road pricing and cost recovery are the external costs associated with road use. These include the costs of road accidents, traffic congestion, noise and pollution. The ISC had no immediate need to address these issues in detail. In brief, the ISC argued that while such costs are important and in principle should be included in the estimate of total costs, there are a number of reasons for not taking them into account. Specifically:

> "The costs associated with external effects apply to all transport activities, whether interstate or intrastate, and some are likely to be relatively less important in intercity interstate transport than elsewhere. So long as they are not included, by appropriate charges, in the costs of intrastate transport, their inclusion only in interstate transport costs is neither practicable nor equitable and is likely to lead to constitutional challenge". (ISC, 1986, pp.137).

Having opted for the PAYGO approach the ISC examined the principles and issues involved in dealing with the problem of assigning road track costs among the various classes of vehicles. The ISC's approach was to review the major cost allocation studies undertaken in Australia since 1978. The methodologies reviewed use a variety of approaches to determine and allocate road supply costs. (see, ISC 1986, Chapter 12). As noted by the ISC (1986, pp.256-257) road supply costs are usually disaggregated as follows:

i. costs which can be unambiguously attributed to road user classes, and are often referred to as avoidable, separable, attributable or marginal costs. A major element of such costs is the damage to pavements caused by different vehicle types;

ii. costs which are common to a number of user classes but which can be assigned in principle to user classes in an objective way. These include elements of the variable costs of road supply which can be assigned to all user classes but which vary, in the long run, according to changes in the composition of traffic;

iii. those costs which are joint, or non-separable. They are incurred on behalf of all user classes and cannot be apportioned among user classes on a cost-occasioned basis. Included here are the initial purchase of the right-of-way, portions of road planning and design costs, maintenance costs which are a consequence of weather and climatic conditions, and the capital costs of the minimum quality of road necessary before any traffic is able to use it.

In the absence of charges for congestion an efficient allocation of road track costs requires that the following conditions be met. First, that each user class should, as a minimum, be confronted with the separable costs associated with maintaining and expanding the road network. Such costs include damage to road and bridge pavements caused by each vehicle type, and the long run capacity costs which can be attributed to such vehicles. The conventional wisdom is that pavement damage is generally related to the fourth power of axle load. However Kinder and Lay (AARB, 1988) reviewed research on pavement damage and conclude, inter-alia, that the 4th power law should not be applied without question to pavements of either sub or super standards. In the Australian context, pavement damage costs have been defined by the Bureau of Transport Economics (BTE) to include: routine maintenance costs, resulting from seal breaks and deformation, resealing costs resulting from wear and tear on seals, and reconstruction costs resulting from wear and tear on the entire road system (BTE, 1985, pp.7,8).

A second requirement concerns the recovery of joint costs. Such costs should be recovered from users on the basis of elasticities of demand and indeed such a principle is employed by other multi-product enterprises in the private and public sectors. However there are difficulties in the case of road supply and most road cost allocation studies have used various arbitrary methods for apportioning such costs. With regard to the recovery of the common costs of road capacity, the theoretical requirements have been translated in practical terms to the apportionment of such costs on the basis of passenger car equivalents, or passenger car units.

The ISC's approach to the problem of cost apportionment was to apply the methodologies adopted by each of the studies previously used in Australia as well as other jurisdictions which have dealt with the cost allocation problem. These included the approaches used in the European Economic Community (EEC), the United Kingdom (UK), and New Zealand (NZ), to 1984 financial data and 1981-82 travel patterns for vehicles on interstate registrations (IS plated vehicles). Road costs were defined as total Federal and State government expenditure on all national highways, rural arterial roads and urban arterial roads. Revenues were defined to include the hypothecated share of federal duties of customs and excise taxes on petrol and diesel fuels, as well as all State fuel franchise revenues and State registration fees.

The ISC's summary of results for all methodologies is shown in Table 1. The application of the various methodologies resulted in great differences in cost attribution for the various vehicle classes. For the IS-plated six axle articulated vehicle, the most common vehicle engaged in interstate transport, the cost differences ranged from 11.2 cents per arterial road kilometre, obtained from application of the Travers Morgan methodology to 37 cents per kilometre obtained from application of the BTE approach. The estimated revenue per kilometre was 5.6 cents, so the revenue shortfall ranged from 5.6 cents per kilometre to 31.4 cents per kilometre. It was the ISC's conclusion that "...it is not possible

TABLE 1

REVENUE AND EXPENDITURE ATTRIBUTED TO IS-PLATED VEHICLES ON AUSTRALIAN ARTERIAL ROADS, 1984-85

(cents per arterial kilometre)

Vehicle Type	Revenue	Expenditure						
		NZ/ EEC	UK	RoRVL (Victorian submission)	McDonell (NSW)	TEC (Tas.)	Travers Morgan (SA)	BTE
Cars and station wagons	1.2	1.5	1.5	1.1	1.1	0.4	1.9	0.8
Utilities and panel vans	1.1	1.9	1.6	1.0	1.1	0.4	1.9	1.2
Rigid trucks								
2 axles	2.2	5.3	5.7	8.6	7.2	17.0	4.4	7.1
3 axles	4.1	11.3	11.4	14.9	11.1	18.5	9.1	14.3
more than 3 axles	4.7	11.9	14.0	17.3	25.7	18.5	11.3	30.6
Articulated trucks								
3 and 4 axles	4.4	11.9	15.0	22.2	17.1	19.8	8.9	25.2
5 axles	5.2	15.7	19.9	29.1	19.6	20.8	11.9	32.0
6 axles	5.6	15.8	19.6	33.0	21.3	20.8	11.2	37.0
more than 6 axles	7.8	18.7	22.7	43.4	21.4	20.8	13.0	44.3
Buses								
2 axle microbus	2.0	1.9	1.6	1.2	1.7	0.4	2.2	1.2
2 axle other	4.1	4.6	7.2	5.4	5.8	17.0	5.9	9.4
3 axles	4.0	7.5	10.6	8.5	8.8	18.5	8.6	22.9

Source: ISC (1986).

to identify one study that provides a result which can clearly be judged to be superior to any of the others. It is likely, however, that the studies cover the range of reasonable results from the available data" (p.354). In effect the ISC's review of the various studies highlighted the need for more research in this area.

While the range of cost recovery results for the various classes of vehicles raises important issues regarding the development of a uniform approach to road cost recovery policy in Australia, such differences in results were not fundamental to the ISC's immediate problem of recommending a registration charge for vehicles engaged solely in interstate transport. The absence of a widely acceptable approach to the problem of assigning road costs by vehicle class meant that the ISC had to use its judgement. Further, in exercising that judgement the ISC had to take account of the cost recovery rate for interstate rail services, and work within the constraints imposed by the variations in the levels and structure of registration charges for State and Territory registered vehicles. The ISC was faced with a dilemma. While an increase in charges for IS vehicles would reduce the anomaly in charges between such vehicles and State and Territory registration charges, the increase would also widen the gap between interstate road and rail cost recovery rates. The ISC was of the view that, on second best grounds, increases in charges on interstate vehicles should be related to the cost recovery performance of interstate rail. Given such considerations, the ISC recommended a charge of $600 for a prime mover of a six axle articulated vehicle registered solely for interstate transport and $75 for any trailer. This was significantly less than the $1400 charge which had been mentioned by the government during the early stages of the ISC's investigations. The charges for other vehicles more or less followed the pattern in the States and Territories, so as to discourage transference from the Federal scheme to a State or Territory scheme.

4.3 The 1987 Inter-State Commission Cost Recovery Study

In January 1987, the ISC was directed by the Minister for Transport to review the federal registration charges for interstate vehicles, and to recommend the appropriate level of charges for 1988. The Terms of Reference were essentially the same as those established for the previous inquiry.

In their Report the ISC approached the problem of estimating cost recovery ratios for different classes of vehicles by focussing attention on cost recovery methodologies "...which have been operating for some time and have been found to be reasonable and effective" (ISC, 1987, p.4). The methodologies reviewed were: The United States method; the United Kingdom method; and the system operating in New Zealand. Since it was found that the USA methodology could not be directly applied to the Australian system because of differences in expenditure categories, the choice was between the other two. The New Zealand approach was chosen by the ISC as its currently preferred methodology on the grounds that its approach to the apportionment of joint and common costs had more to commend it in terms of economic logic than the UK approach. Whereas

the latter allocated such costs on the basis of distance travelled by vehicles, the New Zealand method makes a sharp distinction between distance related factors which are used for the purpose of attributing separable costs, and vehicle population characteristics (e.g. gross vehicle mass) which are used for the purpose of assigning common and joint costs among vehicle classes. The ISC also preferred the New Zealand method because road construction and maintenance techniques and methods are fairly similar to those in Australia.[4]

The New Zealand method was applied to the Australian arterial road system using expenditure and revenue data for the period 1985-86. The method was used to generate estimates of short-run marginal costs track costs by classes of interstate-registered vehicles and cost recovery ratios, including and excluding estimates of the private costs of operating such vehicles. In broad terms the results showed the following:

i. for fully distributed financial road user cost, cost recovery ratios for rigid trucks (of various load capacity), based on average distance travelled, ranged from 0.97 to 1.104. For six axle articulated vehicles the cost recovery ratio was estimated as 0.92 for the average distance and 0.89 for the ninetieth percentile distance.

ii. for all interstate registered vehicles the ratio of revenue to marginal economic costs is well in excess of unity. For the typical six axle articulated vehicle the cost recovery ratio for the average distance was estimated as 1.21.

iii. for interstate registered vehicles there are great differences in the ratio of attributable revenues to marginal economic costs. The results show that for light vehicles cost recovery ratios range from 2.23 (7 .0 to 12.0 tonnes) to 2.98 (2.7 to 3.5 tonnes). For the heavier categories of vehicles the ratios are significantly less than unity. The ratios for a six axle articulated truck, travelling the average distance was estimated as 0.39.

As in its previous Report such estimates formed part of the information which the ISC was required to take into consideration in determining the recommended levels of charges for interstate registered. However, registration charges for State registered vehicles had changed marginally since the previous study and there was only a slight improvement in the cost recovery performance of interstate rail freight services, and no change in that for passenger rail services. The ISC also discovered that the interstate road task share (when measured in tonne kilometres) is at least 70 percent greater than the share held by rail. The reason for this is that while road is able to compete for a large share of the rail task, rail is able to compete for only a small part of the road transport industry's market. In addition, the estimated public authority deficit of the for hire-and- reward interstate freight transport sector was $140 million for road and $170 million for

rail. Considering these realities, the ISC departed from its previous approach and decided to give less emphasis to relative road and rail cost recovery ratios in the formulation of recommendations for charges for interstate registered vehicles.

The recommended charges involved either no change or only a modest change for light vehicles and substantial increases for the heavier classes of vehicles. For example, the ISC recommended a charge of $1505, based on an annual imputed distance of 175,000 km., for a prime mover with three axles licensed to haul one trailer with a gross combination mass up to 38 tonnes. At the new level of charges it was estimated that light weight vehicles (rigid vehicles, two axles, 4.5 tonnes GVM) would achieve more than full cost recovery while heavier vehicles would produce cost recovery ratios as low as 45 percent, when attributable revenue is defined as required by the terms of reference.

5. AN EFFICIENT AND EQUITABLE CHARGING SCHEME: THE WAY AHEAD

Apart from the technical issues concerning the determination of the various components of road supply costs and their attribution among the various user classes there are other issues which need to be resolved if Australia is to achieve a reasonably efficient and equitable road user charging scheme.

So far as the efficiency requirement is concerned charges for each vehicle should at least equal the short-run marginal (avoidable) costs associated with a vehicle's use of the road system. These costs typically refer to the pavement damage costs occasioned by vehicle use. The best available engineering information indicates that for trucks road pavement damage is, inter-alia, a function of gross vehicle weight, the number of axles and axle configuration. Accordingly the level and structure of charges will need to take account of these factors. Vehicles should be fitted with a distance measuring device such as an odometer as, for example is currently the practice in New Zealand, and an option exercised by some vehicles registered under the Federal Interstate Registration Scheme. Further, the joint costs of road supply need to be allocated on the basis of elasticities of demand in order to minimize efficiency losses. However, estimation of these elasticities presents significant practical difficulties. For the foreseeable future it seems likely that such costs, as well as common cost elements, will need to be apportioned on the basis of rules-of-thumb which are acceptable to the major users of the road system, the trucking industry and the private motorist associations. In particular, the principles adopted for determining charges aimed at recovering joint and common cost components will need to be seen by users as non discriminatory.

It is also clear that the implementation of an efficient and equitable road user charging scheme requires the adoption of a common approach by Federal, State and Territory governments. As already indicated there are a wide variations in the structure and level of registration charges imposed by the State and Territory

governments. A great deal of co-operation will be required to overcome this difficulty. In addition, intermodal considerations require that increased efforts be made to improve the cost recovery performance of competing rail services.

Another important policy issue concerns the level of taxation imposed on the road haulage industry and the federal government's current definition of road user charges which the ISC is constrained to use when estimating cost recovery ratios. At present there are significant differences between revenues collected from road users and the amounts hypothecated for road construction and maintenance expenditure. While there is no economic basis for the contention that all tax revenues derived from those imposed on vehicles and their operation should be directed to expenditure on the road system, there are important issues concerning the level of taxation imposed on the road haulage industry and the role of the fuels tax in the development of a more efficient and equitable scheme.

So far as the burden of taxation is concerned available evidence (ISC, 1987) indicates that road transport inputs are taxed at a higher level than other modes of transport; the incidence of taxation on the road transport is almost twice that for rail. Such a policy is not conducive to the achievement of a more efficient allocation of resources between road and rail. Further, since the road transport sector contributes about 40 percent more tax than the average for all industries, significant increases in charges are unlikely to be acceptable to the road transport industry in the absence of adjustments to the tax structure, and would need to be gradual in order to allow adjustments within the industry to take place. As noted by the ISC (1988, p.172) a major problem concerning present arrangements is that road users are not able to distinguish between taxes and charges and tend to view all imposts as user charges.

The Industry Assistance Commission (IAC, 1985) has raised a number of objections to the use of the fuels tax as a component of a charging scheme, including the argument that taxation of intermediate inputs, such as the transport of freight, is undesirable on efficiency grounds. However, it is reasonable to expect that imposts on fuel will continue to be used for both charging for road use and general revenue purposes for some considerable time. The removal of taxes on inputs such as the fuels tax is unlikely to occur in the absence of a restructuring of the entire tax system, since it is difficult to contemplate the Federal government foregoing such a lucrative revenue source. Further, since the Federal government's power to tax fuel is clearly set out in the Constitution, taxes on fuel provide a convenient way of "coping" with the constraint imposed by the Hughes and Vale interpretation of S.92 of the Constitution. However, it is possible, that as a result of the High Court's judgement in the Crayfish case, that direct charges aimed at full cost recovery and imposed on vehicles engaged solely in interstate transport will be accepted by the Court provided that they are non discriminatory.

Finally, as mentioned in section 2, cost recovery per se will not necessarily guarantee significant improvements in equity and efficiency in resource use if road investment and maintenance decisions fail to place major emphasis on the objective of maximizing user benefits. Traditionally, State road authorities have allocated road funds to the various regions within their States on the basis of equity criteria. Patterns of road funding once established, are difficult to alter, at least in the short run. Given such constraints, there is clearly a case for the Federal government to ensure that a significant part of Federal funding is directed to the major arterial and interstate road system and that decisions for such expenditure be based primarily on efficiency criteria. The discussion in section 3 suggests that the Federal government is endeavouring to give more weight to this objective.

In the longer term the problem is to establish a closer connection between charges and investment criteria, and thus for road authorities to act more like commercial enterprises taking account of revenues generated on various parts of the road network and costs incurred (Kolsen and Docwra, 1987). Such information could then be used to assist decision makers in determining optimal quality levels. Such an approach also requires that the overall level of investment in road supply be more closely related to economic criteria. Given the adoption of more direct methods of charging it should be possible for road authorities to estimate expected revenues and incremental costs from upgrading parts of the road network, and on the basis of favourable comparisons convince the capital market that it is worthwhile to provide capital for expenditure on "profitable" roads. Obviously, there are many practical difficulties in emulating competitive market behaviour, but unless efforts are made to establish a strong connection between expenditure on roads and road user preferences, the achievement of cost recovery will mean very little.

6. CONCLUSION

An examination of road user charges and road investment policies in Australia highlights the wide gap that exists between the theoretical requirements for the achievement of an efficient allocation of resources to, and within, the roads sector and the practice of roads policy. There is little economic rationality to the levels and structure of charges which have been established by the States and Territories. And it is only since the early 1970's that successive Federal governments have recognized, with varying degrees of interest, that the Federal government needs to have some involvement in the planning of road expenditure priorities. Investigations by the ISC of cost recovery arrangements for interstate land transport in Australia draw attention not only to the unsettled methodological issues concerning the determination and attribution of road supply costs, but also to problems created as a consequence of the way in which the Australian Federal system operates.

In view of these problems, it seems likely that progress towards the implementation of an efficient and equitable road cost recovery policy will be a fairly long process. The achievement of this objective will depend on the ability of the States and Territories and the Federal government to develop a uniform cost recovery policy based on economic principles. The ISC plays an important role in this process through its research and identification of acceptable solutions to the many difficult problems.

REFERENCES

Bureau of Transport Economics (1985), Review of Australian Road Cost Recovery Studies and Alternative Estimates for 1981-82, Reference Paper 105 (Canberra).

Bureau of Transport Economics (1987), Assessment of the Australian Road System: 1984, Report 61, (Canberra: Australian Government Publishing Service).

Industries Assistance Commission (1986), Certain Petroleum Products-Taxation Measures, (Canberra: Australian Government Publishing Service).

Inter-State Commission (1986), An Investigation of Cost Recovery Arrangements For Interstate Land Transport, (Canberra: Australian Government Publishing Service).

Inter-State Commission (1987), A Review of Federal Registration Charges for Interstate Vehicles, (Canberra: Australian Government Publishing Service).

Kolsen H.M. and G.E. Docwra (1987), "Cost Recovery Policy in Theory and Practice", Forum Papers Twelfth Australian Transport Research Forum - Brisbane.

Lumb R.D. and K.W. Ryan (1979), The Constitution of the Commonwealth of Australia Annotated, (Sydney: Butterworths).

Kinder, D.F. and M.G. Lay (1988), Review of the Fourth Power Law, Australian Road Research Board Internal Report (Melbourne).

Ministry of Transport (UK) (1968), Road Track Costs-A Report By the Ministry of Transport, (London: HMSO).

National Road Freight Industry Inquiry (1984), Final Report, (Canberra: Australian Government Publishing Service)

Walters, A.A. (1969), The Economics of Road User Charges, World Bank Staff Occasional Papers No. 5 (Baltimore: John Hopkins Press).

ENDNOTES

1. See ISC (1986) for a review.

2. A Business Franchise Fee is a license fee imposed by State governments on wholesalers of petroleum products. Only the Federal government has the power to directly tax fuel.

3. The Crayfish Case involved a reappraisal of Section 92. This included an examination of the background of events and Convention Debates which led to the formation of the Australian Federation. One of the major objectives of the creation of the Federation was to promote free trade throughout Australia. Drawing ont his review, the Court concluded that Section 92 should be reinterpreted as providing immunity from State or Federal laws which are discriminatory in a protectionist sense.

4. The New Zealand system is a modification of the system adopted by the European Economic Community (EEC). Road expenditures are subdivided according to EEC cost categories and within each category, separable (avoidable), joint and common cost components are identified. Avoidable costs are allocated by use parameters appropriate to the cost category. Joint and common costs are allocated on the basis of vehicle characteristics (see ISC, 1987, Appendix X).

A LOGISTICAL ANALYSIS OF TABLE POTATO MARKETING IN MANITOBA

by

Barry E. Prentice and Jock Langford[1]

INTRODUCTION

Many foods move through the marketing chain from producer to consumer with only negligible changes in form. For example, eggs, apples and some seafood are purchased by consumers in virtually the same form as they are harvested. Given the inherently perishable nature of food products, and the distance that the majority of production must be transported to reach markets, packaging and product handling play a critical role in the logistics of marketing these goods. Food products that are delivered in a damaged condition, or in packages that are unsuitable to consumers, are subject to price discounts that can remove all profits from their sale.

Like many food products that retain their raw form, the cost of packaging and handling table potatoes is a substantial proportion of the final price. Consequently, there is significant interest amongst potato growers and marketing agents to reduce product losses and improve the efficiency of the logistical system. This paper reports the results of an economic analysis that was undertaken with the cooperation of the Manitoba Vegetable Producers Marketing Board (MVPMB) to identify the most efficient logistical system for marketing table potatoes in Manitoba.

The paper begins with a brief overview of the packaging and handling of table potatoes in Manitoba. This is followed by a systems analysis that examines the costs of alternative packaging and handling methods. The paper concludes with some general observations on the study of agribusiness logistics problems.

MARKETING OF TABLE POTATOES IN MANITOBA

Under its enabling legislation, the MVPMB has an effective monopoly on the commercial marketing of table potatoes and a group of other "controlled" horticultural crops grown in Manitoba. The regulations of the MVPMB are enforced through the use of delivery quotas that have been assigned to approximately 85 registered table potato growers. Based on these quota allocations, the Board issues delivery orders for the

---

[1] Professional Associate, University of Manitoba Transport Institute and VP Education, CAPIC (Winnipeg), and Graduate Research Assistant, Department of Agricultural Economics, University of Manitoba.

shipment of potatoes from farms to be packaged for wholesale distribution. Delivery orders state the time, place, quantity, and form of potato deliveries.

To help offset its costs, the MVPMB provides marketing services that add value to the products it handles. In the case of potatoes, the board offers washing and grading services, and packages potatoes into five, ten and twenty pound retail bags, which are called 'prepacks', as well as 75 pound jute sacks.

Although some potato producers are large enough to undertake a 'prepacking' operation of their own, this is prohibited by the marketing board. The only competitor of the MVPMB is a private wholesaler who was in operation prior to the organization of the marketing board and consequently has 'grandfather rights'.

Role of the 75 pound Jute Sack

The 75 pound jute sack, which is the traditional method of handling and selling table potatoes in Manitoba, performs three distinct functions in the marketing system. The primary function of the 75 pound jute sack is to provide a method of handling table potatoes from the farm to the two prepack operations located in Winnipeg. The second function is to serve as both a final package and as a method of handling potatoes from the farm and/or MVPMB through the marketing channel to the retail trade. The third function of the 75 pound jute sack is to serve as a unit for pricing and charging products and services of the MVPMB.

Potato Handling:

The origin of potatoes packed in jute sacks and the use of jute-sack packed potatoes are presented in Table 1. The majority of potatoes shipped in 75 pound jute sacks are bagged at the farm. Only four to six percent of jute sacks of potatoes bagged annually, originate from the MVPMB's washing and grading line.

Shipments to retail stores and the hotel, restaurant and institutional (HR&I) market account for 47.7 percent of all jute sacks. The other 52.3 percent of jute sacks are dumped and repacked in 5, 10, and 20 pound bags for retail distribution.

Table 1 Origin and Use of Potatoes Packed in Jute Sacks

Origin	Total Sacks Bagged	Percent of Total	Destination and Use	Total Sacks Used	Percent of Total
			75 pound units		
MVPMB Washline	19,560	3.9%	Retail, HR&I	236,391	47.7%
Farm Washlines	475,795	96.1%	MVPMB Prepacks	128,007	25.9%
			Private Prepacks	130,957	26.4%

Retail Sales:

Normally 75 pound jute sacks purchased for resale to consumers are opened and the potatoes are emptied onto retail display tables. The consumer usually pays a premium price for the privilege of buying potatoes in small quantities and for the opportunity to pick out only the best quality. The retail markup on loose potatoes is also higher than for prepack potatoes because of higher costs associated with spoilage and handling. At the present time, about one third of total retail sales of table potatoes are packed in 75 pound jute sacks, while the remainder is marketed in 5, 10, and 20 pound prepacks.

Product Pricing and Service Tariffs:

Prices charged to wholesalers and payments made to producers are a function of the MVPMB's list price for potatoes packaged in 75 pound jute sacks. With the growth of the prepack sales, however, jute sacks now represent the minority table potato tonnage and revenue. Consequently, the 75 pound jute sack is becoming less relevant as a method of handling and pricing table potatoes.

Similarly at the farm level other methods of handling have replaced the use of jute sacks for delivering table potatoes to the MVPMB. Five alternative systems of handling can be identified:

(1) washed and graded potatoes in 75 pound jute sacks;
(2) washed and graded potatoes in bulk form;
(3) dry, ungraded potatoes in bulk form;
(4) ungraded potatoes in jute sacks; and
(5) washed and graded potatoes in mulox bags.

These alternative handling systems differ in terms of the costs incurred on the farm and at the MVPMB facilities, as well as the type and level of charges assessed farmers by the MVPMB. Consequently, there is potential to reduce costs if the most efficient method of handling can be encouraged.

LOGISTICAL ANALYSIS

Logisticians recognize that partial systems analysis can lead to sub-optimization because costs may be shifted from one functional level of marketing to another. In practice however, it is seldom feasible to undertake a complete systems analysis. In this study, a modified version of the total-system concept is used. The system costs of alternative handling methods are assessed from the perspective of the individual producer as well as from the marketing board's point of view, to determine the least-cost system.

The analysis relies primarily on a comparison of the direct costs of each handling system. Indirect costs are less important because potatoes are a relatively perishable commodity. Packing operations at the wholesale level are operated on a "pull" basis, that involves minimal work-in-process or finished product inventories. All growers are required to have sufficient on-farm storage to maintain potato inventories following harvest. Consequently, the indirect costs of farm to retail movements are negligible.

Direct Costs of Potato Handling at the Farm Level

The factors affecting choice of alternative potato handling systems are: 1) costs incurred at the farm, 2) costs of transporting potatoes to Winnipeg, and 3) handling tariffs charged by the MVPMB. Unless water is a limiting factor, most of the medium-sized and large producers have installed wash and grading lines. Small producers rely on the grading and washing facilities at the Board. The use of jute sacks versus bulk trucks depends on the individual operation.

The quality of table potatoes is reflected by the number of cull potatoes that must be graded out and discarded. The percentage of grade-out in table potatoes is important because it affects the cost of storage, washing and grading, handling and transportation. The direct costs of five alternative potato handling systems are compared based on a 10 percent grade-out factor.

Washing and Grading Variable Costs:

The direct costs of washing and grading potatoes on farms are a function of the quality of potatoes, the method of handling, and direct expenses pertaining to containers. Farm washline speeds are usually not altered for different levels of grade-out, rather the quantity of labour used for grading is adjusted. The amount of farm labour needed on the washline is also affected however, by the method of handling/packaging for delivery to the MVPMB.

Farm cost data suggest that the bulk washed handling system is the least cost method for on-farm washing and grading. Systems that use jute sacks are the more expensive, with "new jute sacks" being the most expensive. Washing and grading expenses for bulk handling systems and "mulox bags" are about half the cost of the jute sacks.

Variable Costs of Loading Potatoes:

Loading potatoes onto trucks does not constitute a major cost item. In most cases table potatoes are handled only once at the farm level because industry practice is to pack to order. Wooden pallet boxes used at the end of washlines, however, require that potatoes be transported to the loading dock and subsequently dumped hydraulically onto a telescoping conveyor. This potato handling system is more labour intensive than other methods of loading trucks, although it does allow for the cold storage of potatoes in the pallet boxes.

The identifiable loading costs are labour, fork lift and conveyor expenses. Data indicate that the bulk handling bin system is the least cost loading method for farm to wholesale market delivery.

Costs of Farm Supervision and Administration:

Washing and grading potatoes at the farm level requires more supervision and administrative input than the shipment of ungraded potatoes to the MVPMB. For bulk unwashed deliveries, one hour of the farm operator's time is needed to coordinate the loading and delivery of a 45,000 pound truck load. If a farmer's labour is valued at $10.00/hr. and an allowance is made for cull potatoes, the cost of administering deliveries is approximately 2 cents per 75 pounds.

The operation of a washing and grading line requires the management of personnel, quality control, and mechanical breakdowns. Payroll and banking administration also increases with the use of on-farm washlines. In total, four hours of supervision are needed per truck load of graded potatoes. This allocation of administrative expenses is estimated to cost 6.7 cents per 75 pounds.

Delivery Costs:

The costs of delivering potatoes to the MVPMB vary with the distance potatoes are hauled, the amount of grade-out, and the capacity and fuel efficiency of trucks. The majority of potatoes are hauled in 45,000 pound (600 jute sack equivalents) loads from farms located approximately 70 miles from the Board. The average total cost of hauling potatoes to the MVPMB is estimated to be $190 for a 45,000 pound trailer load. In this case, the least cost handling system is palletized jute sacks, followed by the bulk washed system. The main difference in these transport costs can be attributed to the haulage of unmarketable cullage and shipping pallets, and the loading configuration of mulox bags.

MVPMB Tariffs:

Growers are charged a 'container' tariff for bulk potatoes that is equivalent to the estimated cost of bagging potatoes in jute sacks at the Board. This charge, which has remained at $.37/75 pounds for

several years, now lies between the cost of new jute sacks ($.43/bag) and the MVPMB sale price for used sacks ($.25 to $.30/bag).

Price discounts on potatoes delivered in Mulox bags differ, and are set at $.50/cwt or $.375.5/75 pounds. The Mulox bag, however, has not been readily adopted by Manitoba potato growers.

Charges for washing and grading at the Board are assessed to the producers who ship unwashed potatoes. In addition, quality controls are enforced more rigidly than by growers who wash and grade potatoes at the farm. Consequently, unwashed potatoes are subject to greater cullage.

Average Farm Costs of Alternative Potato Handling Systems:

The average variable costs to farmers of using different potato handling systems are determined by summing washing and grading expenses, loading, supervision, delivery costs, and MVPMB tariffs. These costs are presented in Table 2 for potatoes that have a 10 percent grade-out factor.

The costs to farmers of using the "bulk washed" handling systems and "used jute sacks" method of handling are the least cost alternatives. The use of mulox bags is significantly more costly, while shipping unwashed potatoes is twice as expensive as any other method of handling.

The important conclusion of this costing exercise is that potato producers may be indifferent to delivering potatoes as bulk washed, or in new or used jute sacks. The actual costs of packing potatoes into jute sacks may be less for some producers than suggested by these figures, because the data is based on average costs.

Table 2 Average Variable Costs to Farmers of Using Alternative Potato Handling Systems for Table Potatoes With 10 % Grade-out

Cost Item	Bulk Unwashed	Bulk Washed Onto Trucks	Bulk Washed Into Bins	Mulox Bags	New Jute Sacks	Used Jute Sacks
			Cents per 75 pounds			
On farm Washing and Grading	-	27.0	27.0	34.9	84.2	71.2
Loading	3.6	4.4	2.3	4.4	4.4	4.4
Supervision	2.0	6.7	6.7	6.7	6.7	6.7
Delivery	36.7	33.9	33.9	38.8	32.3	32.3
MVPMB Tariffs or (Gains)	157.7	4	4	20.3	(36)	(36-44)
Average Variable Costs	200.0	76.0	73.9	105.1	91.6	70.6-78.6

Direct Costs of Potato Handling at the MVPMB

The direct costs of utilizing alternative handling systems at the Board level are determined for the prepacking of red potatoes, which form the largest volume of deliveries.

Used Jute Sacks:

When washed and graded potatoes destined for prepacking arrive at the MVPMB facilities in new 75 pound jute sacks, an additional product - a used 75 pound jute sack - is created. This byproduct of the prepack line must then be processed for re-use on the washline or resale to farmers or wholesalers.

The initial handling of the used jute sacks cannot be differentiated from the primary task of handling potatoes. As potatoes are emptied onto the prepack conveyor, the piling of empty sacks onto a skid occurs while another employee is dumping potatoes. Similarly, the fork lift operator who moves the pallets of empty jute sacks to a storage area behind the washline, is also doing so during idle time while engaged on the potato prepack line. For costing purposes, the labour involved in these initial two operations, is not considered as a direct cost of processing used jute sacks.

Approximately 128,000 used jute sacks were handled and sold during the crop year. Used jute sack inventory increases throughout the winter to the point where approximately 50 pallets of empty sacks congest the warehouse between May and September. In costing for warehouse area, a 15 pallet or 300 sq. ft. average storage area is assumed. This allocation of warehouse space translates into an average cost of .51 cents per used jute sack.

Used jute sacks are sorted into bags to be discarded, those to be used on the washline, and those to be resold. Jute sacks that are ripped or stained cannot be used to sell potatoes and so they are usually discarded. Used jute sacks that are not damaged are either piled on a pallet for future washline use, or piled 25 high on a table for eventual resale. These empty bags are moved from the table and placed in an upright jute sack. Bundles of used jute sacks are piled in rows of five on pallets to a height of seven bundles. These pallets are first moved to storage and then loaded onto trucks when sales are made. Approximately 120 sales of used jute sacks are made annually.

Timing estimates indicate that 15 seconds are required to sort, pile, bundle, and pile each used jute sack. Since labour is valued at $.1772 per minute ($10.63/hr) the average cost to process used sacks is $.044/jute sack. On average, about 15 minutes of labour is needed to move pallets to storage, to load sacks onto trucks, and make invoices for each jute sack sale. At a total cost of about $310, there is an additional selling cost per empty jute sack of $.0025/bag.

The MVPMB practice is to pack 26 sacks into a bundle, assuming that some of the used jute sacks will not be fit for re-use at the farm level. Consequently, there is an additional cost of 4% of used jute sack sales or approximately $.011 per used jute sack sold. Once the costs of handling and processing used jute sacks are deducted from the MVPMB's selling price, the value of a used sack more closely approximates $.21/bag. A breakdown of these costs is presented in Table 3.

Table 3 Average Return to MVPMB From Sales of Used Jute Sack Sales

	$/Used Jute Sack
Used Jute Sack Average Sale Price	$.2750
Direct Labour Costs of Processing Used Jute Sacks (15 sec.x 17.72 cents/min.)	($.0443)
Selling Expense	($.0025)
Storage Cost Allocation (300 sq. ft.)	($.0051)
Loss Due to Damaged Sacks (1%)	($.00275)
Loss Due to Bundling 26 Sacks (4%)	($.0110)
Total Costs of Processing and Selling	($.06565)
Net Return from Jute Sacks Sales	$.2093

Given the value of used jute sacks, and the associated MVPMB tariff structure, the prepack department will be more profitable if:

(1) more washline potatoes are prepacked;
(2) more bulk washed potatoes are prepacked;
(3) deliveries of potatoes in jute sacks for prepacking are discouraged; and,
(4) the volume of washline potatoes bagged into jute sacks is minimized.

Method of Handling Potatoes:

The method and/or container used to move potatoes to the MVPMB's prepack line directly affects the Board's operating costs in the warehouse. Potatoes must first be received at the warehouse, moved to the prepack area, and then transferred onto the prepack line conveyor. Costs to the MVPMB vary depending on the effort, especially labour requirements, necessary to perform each of these functions using different handling systems.

Direct labour costs to the MVPMB incurred in the handling of palletized potatoes in jute sacks are approximately 1.0 cents per bag to receive and 1.1 cents per bag to transport to the prepack line. The labour requirements to perform these functions for potatoes delivered in Mulox bags are assumed to be similar.

Potatoes handled on the prepack line in jute sacks are more labour intensive than the alternative systems. For example, the bulk washed method is estimated to cost 12.44 cents per 75 pounds. Employing

handling systems using containers such as wooden pallet boxes and Mulox bags, where potatoes can be hydraulically transferred to the prepack conveyor, also reduces the prepack labour requirements. Compared to using jute sacks, the average cost saving for these methods is estimated to be 3.57 cents per 75 pounds. The savings to the MVPMB of handling potatoes destined for prepacking using the alternative physical distribution systems to palletized jute sacks are presented in Table 4.

Table 4 Average Costs of Alternative Potato Prepack Handling Systems At the MVPMB

	Palletized Jute Sacks	Palletized Mulox Bags	Washline Wooden Bin	Washline Bulk Bin	Bulk Washed
			$ per 75 pounds		
Revenue Generated from Container Charges	-	.375	.37	.37	.40
Net Income from Used Jute Sacks	.21	-	-	-	-
Savings in Direct Labour	-	.036	.057	.145	.145
Depreciation Allocation	(.004)	(.004)	(.005)	(.029)	(.029)
Net Revenue and Savings	.206	.407	.422	.486	.516
Net Revenue minus Revenue From Used Jute Sacks	0	.201	.217	.305	.335

Total Direct Costs of Potato Handling

Shipping washed and graded table potatoes in jute sacks results in higher on-farm labour and container costs that are passed on to the MVPMB through the tariff structure. Jute sacks require greater handling on the Board's prepack lines and these additional costs are not reflected in current MVPMB prepack costing or container charge tariffs.

Similarly, there is a loss to the potato industry associated with the value of jute sacks used in the marketing of table potatoes. Farmers purchase new jute sacks for approximately 43 cents. The resale value of used jute sacks, when considering the additional costs of handling and selling these containers, is estimated to be roughly 21 cents. The actual value of the table potatoes packaged in jute sacks should be represented by the MVPMB list price minus the value of a used jute sack to the retailer.

Mulox bags were found to be cost effective relative to using jute sacks in the potato prepacking process. The price discount that independent packers demand for potatoes delivered in mulox bags, however, makes this handling system uneconomical.

The greatest loss of efficiency occurs when potatoes are shipped from farms in new jute sacks for repacking into consumer packages (5,10, and 20 pound bags) at the MVPMB. Estimates of the direct or average variable costs of handling and packing potatoes with 10 percent grade-out are presented in Table 5. The least cost alternatives for the potato industry are to ship graded potatoes conveyed from existing farm washlines into bulk holding bins and/or directly onto bulk unloading trailers.

The use of jute sacks as a method of handling imposes a substantial additional cost on the industry. Based on combined farm and MVPMB costs, every new jute sack that is dumped for repacking in 5, 10, and 20 pound bags, removes between $.492 and $.55 per 75 pounds from the profits of the industry.

Table 5 Total Direct Costs of Utilizing Alternative Handling and Processing Systems in the Prepacking of MVPMB Red Table Potatoes With 10% Grade-out

Cost Items	Bulk Unwashed[1]	.. Bulk Washed .. onto Trucks	into Bins	Mulox Bags	New Jute Sacks	Used Jute Sacks
			Cents per 75 pounds			
Washing and Grading	56.2	27.0	27.0	34.9	84.2	71.2
Loading and Supervision	5.6	11.1	9.0	11.1	11.1	11.1
Delivery	36.7	33.9	33.9	38.8	32.3	32.3
Resale Value of Used Jute Sacks	-	-	-	-	(20.9)	(20.9)
MVPMB Labour Savings on Receiving	(1.0)	(1.0)	(1.0)	-	-	-
MVPMB Labour Savings on Warehousing	(1.1)	(1.1)	(1.1)	-	-	-
MVPMB Labour Savings on Prepack Handling	(3.6)	(12.4)	(12.4)	(3.6)	-	-
MVPMB Labour Savings on Prepack Grading	(6.8)	-	-	-	-	-
Total Direct Costs	86.0	57.5	57.5	81.1	106.7	93.7

[1] The washing and grading direct costs at the MVPMB are calculated for red potatoes washed into pallet boxes that used on the prepack line.

INDIRECT COSTS AND INTANGIBLE FACTORS

The indirect costs of handling potatoes are mainly associated with capital investments. In most instances, telescoping conveyors and bulk unloading trailers which exist on farms are also used for shipping processing potatoes. Consequently, the indirect costs of these capital

investment are not independently determined. For the purposes of this analysis, these indirect costs are ignored.

Intangible costs

Intangible factors are difficult to quantify, but may affect both farm and MVPMB operations. Changes in methods of physical distribution may affect: the MVPMB's price competitiveness; customer service levels; product quality; total MVPMB table potato sales; and labour efficiency and warehousing costs in other MVPMB operations.

Increasing MVPMB Sales:

Utilizing the least cost bulk handling system could result in increased sales of MVPMB table potatoes and/or greater returns to the Manitoba potato industry. If potato prepack costs are reduced, there is the potential to discount poly bag prices and increase the volume of prepack sales. A favourable shift in the product mix towards more potato prepacks and an increased penetration into more distant markets could translate into greater sales volumes for the MVPMB. Depending on the price elasticities and the costs for providing the various MVPMB potato products, an optimal pricing strategy could be devised to maximize the total returns to the industry given the most efficient methods of packing and handling potatoes.

Improved Customer Service:

The choice of a handling system for potato prepacks can also affect customer service. The lead times for delivering bulk unwashed and bulk washed potatoes to the Board are shorter than that for delivering potatoes in jute sacks. A delivery order for ungraded potatoes can be at the MVPMB the morning after the order was placed. The potatoes could then be prepacked during that same day. An order for bulk washed potatoes could conceivably arrive at the Board facilities in the afternoon following the day the order was placed. Jute sack deliveries, however, are likely to be delivered no earlier than the morning of the second day after the farmer has been notified.

Eliminating Congestion:

Increasing the proportion of MVPMB prepack potatoes delivered in bulk form could help reduce congestion problems at the warehouse dock and adjacent aisles. Congestion in the warehouse has been exacerbated by: the lack of space at the docks to marshall loads; prepack shipments with low weight to bulk ratios; and the handling and processing of used jute sacks. Converting completely to a bulk washed potato prepacking system could reduce the number of fork lift unloads by over 3,000 wooden pallets annually.

Congestion within the MVPMB facilities increases warehousing costs. Full capacity utilization of storage areas next to the receiving docks

results in double handling of some potato prepacks and other produce. Similarly, crowded aisles cause forklift operators to reduce speeds and results in increased transport times per load. Congestion along the eastern corridor in the MVPMB warehouse has encouraged normal traffic flows to be diverted to alternate routes that are less direct and involve longer total distances. Congestion may also impact on production costs since the available storage space for prepacks is a constraint that affects the quantities and mix of 5, 10 and 20 pound bags of prepacks which can be stockpiled and the length of the prepack production runs.

Quality Considerations:

Quality issues are intertwined with the MVPMB's policies and the method of handling potatoes for prepacking. The level of potato bruising, the overall quality level and the control and enforcement of minimum grading standards are important marketing variables. The costs to the MVPMB from poor quality potatoes may consist of increased operating expenses, a reduction in the MVPMB's prepack market share and/or prepack price levels and a shift in consumer preference to potato substitutes.

Potato bruising and mechanical damage are influenced by the marketing system, but most deep bruising and other damage occurs during the harvesting operation. Although bulk handling does cause some damage to the product, the retail quality of table potatoes is not affected noticeably. Bulk handling damage is primarily of a superficial nature and is removed by consumers when peeling table potatoes. Table potatoes are not stored after prepacking but are moved to retail positions directly so bruising damage from bulk handling does not develop fully prior to consumption. When the issue of potato bruising from bulk handling is put into its proper perspective, this damage is a minor concern when compared to quality concerns dealing with the cultivating, harvesting, storing and grading of table potatoes.

GENERAL OBSERVATIONS

Logistics account for a significant proportion of the total costs of marketing agricultural products. These products often require specialized handling and/or packaging to maintain their quality. In addition, the low weight to bulk ratio that is characteristic of food products makes transportation and storage costs relatively high. Consequently, the efficiency of the logistical system has a direct impact on the returns to producers and the size of the market in which these producers are competitive.

Some products, such as table potatoes, incur no change in their natural form as they move through the marketing system. All increases in the value of these products can be attributed to costs and returns of performing logistical functions. Although the MVPMB operates as a non-profit organization, the incomes of potato producers are directly affected by the efficiency of the board's management of the logistical

system. Any inefficiency in the operations of the Board are passed on to producers in the form of increased handling charges.

The handling charge structure also plays a role however, in determining the efficiency of the marketing system. If the rate structure reflects the actual operating costs, producers will be encouraged to adopt the handling system that optimises the use of the marketing board's facilities. If the rate structure deviates from true costs, producers will be encouraged to utilize handling methods that may serve their own needs best, but increase the total system costs.

Canada has a large number of agricultural marketing boards. While only a few are as involved in the direct handling of agricultural products as the MVPMB, most marketing boards do influence the charges assessed for transportation and other logistical functions. This research has illustrated the impact that the handling charge structure can have on the efficiency of agricultural marketing. This should encourage other commodity marketing boards to conduct similar reviews.

EPILOGUE

Since the study was completed in 1987, the MVPMB tariffs on bulk deliveries have been reduced approximately $.20 per 75 pound jute sack equivalent. Also further capital improvements have been undertaken to facilitate receiving of bulk deliveries. At the present time, about 75 percent of deliveries for prepacking are now delivered in bulk form.

POTENTIAL SAVINGS THROUGH THE ELIMINATION OF EMPTY TRUCK MOVEMENTS

The Cost of Regulation

W. Raney & K. Siwak
Ontario Ministry of Transportation*

A. INTRODUCTION

During the summer of 1987, over 10,000 interviews were conducted with truck drivers at inspection stations throughout Ontario. Initial analysis of survey data on a single corridor revealed that a substantial percentage of trucks were travelling empty, and that significant savings in transportation costs and trucking kilometres driven were attainable through improved matching of loads.[1] Such reductions in empty movements have implications for reducing transportation costs for shippers, and for addressing some of the traffic congestion problems on Ontario's highways.

In order to determine the applicability of earlier findings to other areas of Southern Ontario, data from inspection stations on Highway 401 near Gananoque, the Queen Elizabeth Way near Stoney Creek, and Highway 400 north of Toronto were isolated and analysed in terms of volume of traffic, route distribution, occurrence and cost of empty movements, and potential savings through improved load matching.

B. SURVEY RESULTS

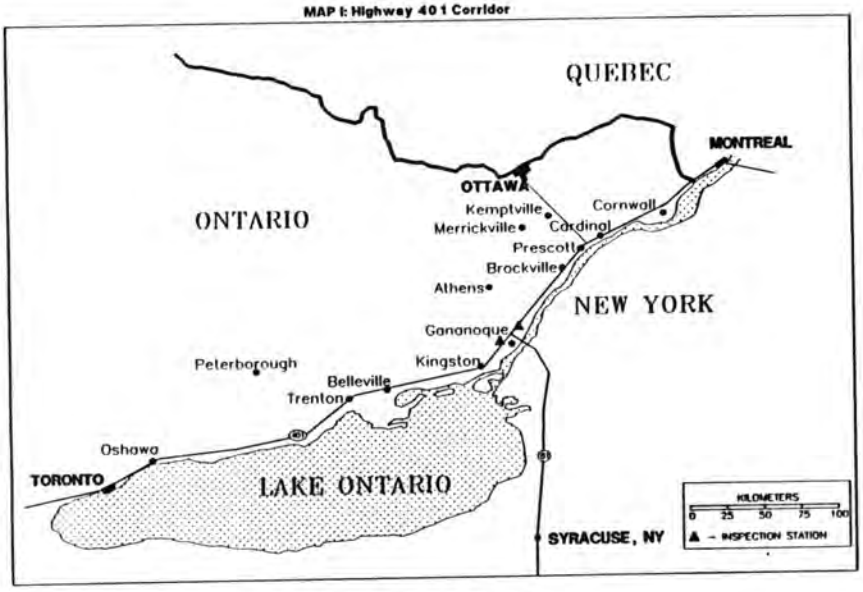
i. Corridor Profiles

The analysis was performed on the three corridors leading north, east and south from Toronto. Maps I through III illustrate the area surrounding each of the survey points. For convenience, the corridors will be referred to in this paper by their highway names. The number, size and population of cities and towns in the area play a significant role in the type and volume of truck traffic which passes the stations, which in turn affected the survey results. Generally, the volume of local truck traffic in southern Ontario increases in direct proportion to the population density in the area.

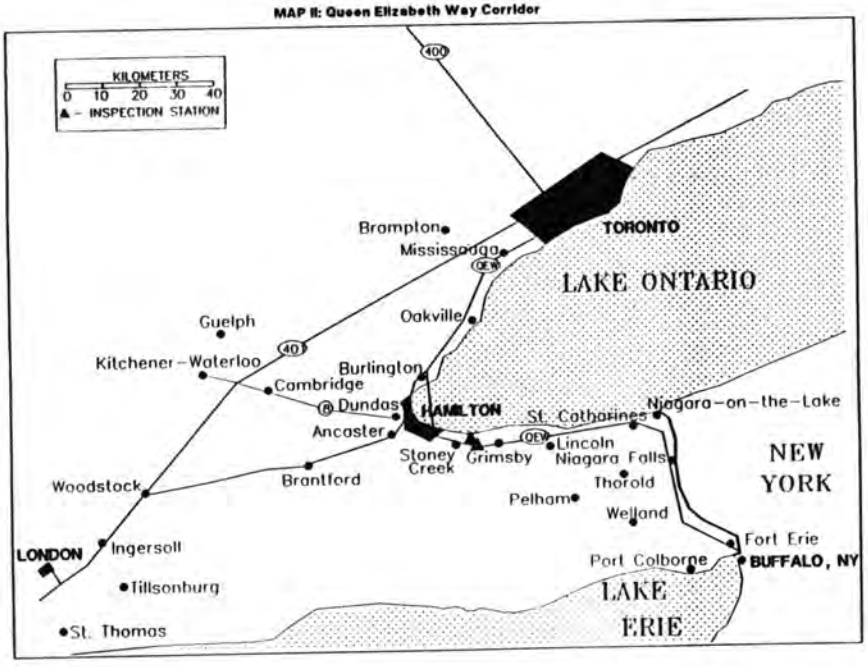
---

* The views expressed are those of the authors and not necessarily those of the Ministry

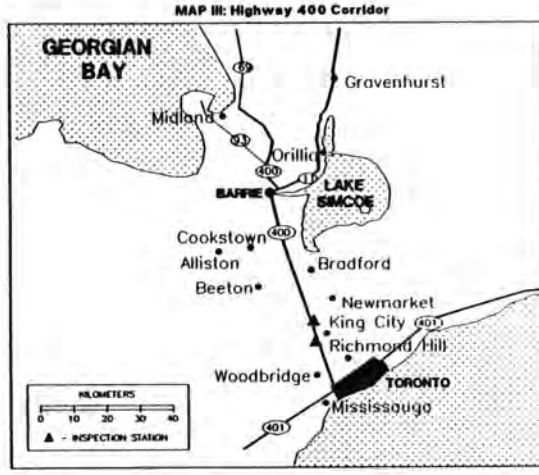
MAP I: Highway 401 Corridor



MAP II: Queen Elizabeth Way Corridor



MAP III: Highway 400 Corridor



The Highway 401 stations are located in a predominantly rural area. There are few large towns nearby, with Brockville being the largest to the east (50 kilometres away), and Kingston the largest to the west (25 kilometres away). Approximately half of the total population in the two surrounding counties resides in rural areas. In contrast, both the Highway 400 stations and the Queen Elizabeth Way stations are located close to several large cities and towns. The surrounding counties have a much higher population density, with the vast majority of the population residing in urban and suburban areas.

Because of the proximity of the survey points on the Q.E.W. and Highway 400 to major metropolitan centres, a high level of local truck traffic was captured by the surveys conducted at these points. The data for the Highway 401 eastern corridor, in contrast, includes few local movements. These differences in the type of truck traffic captured by the survey is reflected in the outcome of the analysis in terms of traffic volumes, origin/destination patterns, and average trip distances.

Origin and destination data were extracted from the survey interviews for each of the corridors, and have been summarized in Table I: Trip Distributions, which gives a breakdown of traffic flows between regions of Canada and of the U.S.A. As the figures in Table I reveal, a significant proportion of truck movements surveyed on the Queen Elizabeth Way and Highway 401 originated and/or were destined for a location outside of Ontario.

TABLE I: TRIP DISTRIBUTIONS

a) HIGHWAY 401 EASTERN CORRIDOR

BETWEEN		REGIONS EAST OF SURVEY POINT			
		EASTERN PROVINCES	EASTERN U.S.A.	EASTERN ONTARIO	TOTAL
REGIONS WEST OF SURVEY POINT	WESTERN CANADA	0.4%	*	*	0.4%
	WESTERN U.S.A.	6.0%	0.3%	0.8%	7.1%
	NORTHERN ONTARIO	0.2%	*	*	0.2%
	SOUTHWEST ONTARIO	20.8%	0.5%	3.5%	24.8%
	TORONTO AREA	35.1%	1.9%	7.2%	44.2%
	CENTRAL ONTARIO	12.4%	3.8%	7.1%	23.3%
	TOTAL	74.9%	6.5%	18.6%	100%

b) QUEEN ELIZABETH WAY CORRIDOR

BETWEEN		REGIONS SOUTH OF SURVEY POINT		
		OUT OF PROVINCE	NIAGARA PENINSULA	TOTAL
REGIONS NORTH OF SURVEY POINT	NORTHERN ONTARIO	0.5%	1.3%	1.8%
	EASTERN ONTARIO	1.7%	2.4%	4.1%
	GOLDEN HORSESHOE	31.2%	36.7%	67.9%
	SOUTHWEST ONTARIO	6.3%	8.5%	14.8%
	OTHER PROVINCES	0.9%	1.9%	2.8%
	U.S.A.	6.4%	2.2%	8.6%
	TOTAL	47.0%	53.0%	100%

c) HIGHWAY 400 CORRIDOR

BETWEEN		REGIONS SOUTH OF SURVEY POINT				
		OUT OF PROVINCE	EASTERN ONTARIO	TORONTO AREA	SOUTHWEST ONTARIO	TOTAL
REGIONS NORTH OF SURVEY POINT	NEWMARKET AREA	1.5%	0.2%	15.5%	5.3%	22.5%
	NEAR NORTH ONTARIO	4.2%	1.4%	28.6%	8.6%	42.8%
	NORTHEAST ONTARIO & QUEBEC	1.7%	0.2%	15.2%	7.0%	24.1%
	NORTHWEST ONTARIO	*	*	1.1%	0.5%	1.6%
	WESTERN PROVINCES & STATES	0.4%	0.1%	6.6%	1.9%	9.0%
	TOTAL	7.8%	1.9%	67.0%	23.4%	100%

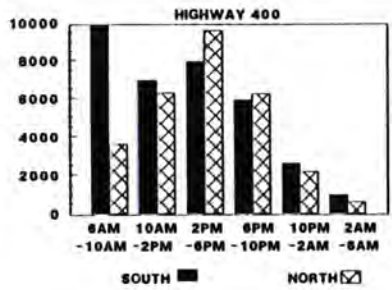
* - LESS THAN 0.1%

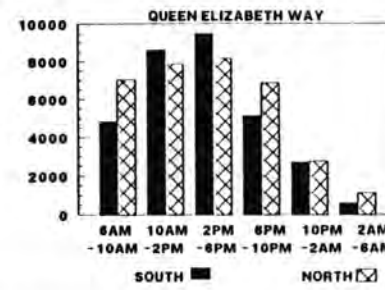
In contrast, very few of the movements on Highway 400 involved endpoints outside of Ontario. The predominance of extraprovincial and bridge movements on these corridors has implications for the successful implementation of load matching in Ontario.

ii. Traffic Volumes

In addition to the survey interviews, an hourly vehicle count was conducted for each of the corridors, categorized by vehicle type. Diagram I illustrates the pattern of total traffic flow in each of the three corridors over a twenty-four hour period, based on the data obtained from these counts. The graphs in Diagram I illustrate that the Q.E.W. and Highway 400 survey points experienced high traffic levels throughout the day, with peaks and troughs reflecting morning and evening rush hours.

DIAGRAM I: TOTAL TRAFFIC VOLUMES





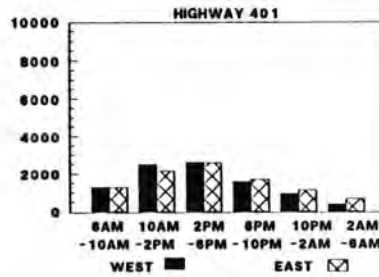
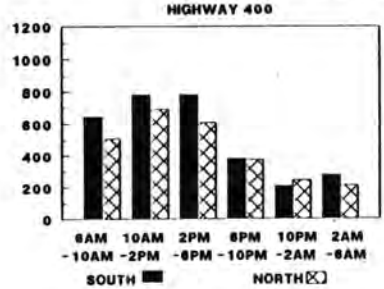
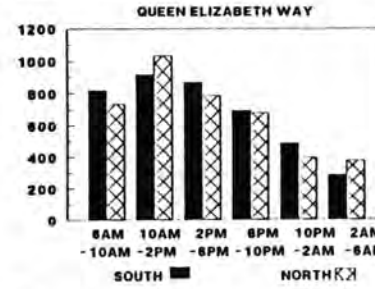
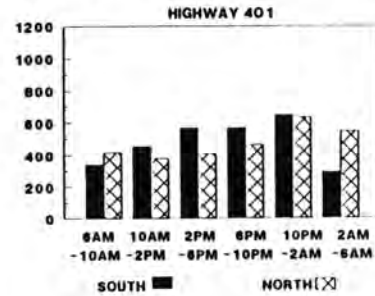


DIAGRAM II: TRUCK TRAFFIC VOLUMES







On average, more than 28,000 vehicles passed these two survey points in each direction in a twenty-four hour period. Traffic volumes at the Highway 401 survey point were comparatively low throughout the day in both directions, averaging approximately 9,500 vehicles in each direction in a twenty-four hour period.

While total traffic levels were much lower on the Highway 401 eastern corridor than on the other two corridors, truck traffic levels were only slightly lower. An average of 2,850 trucks passed the Highway 401 survey point in a twenty-four hour period, accounting for 30.1% of the total traffic volume. This compares to 4,000 trucks on the Q.E.W. (12.4% of the total traffic volume), and 3,000 trucks on Highway 400 (9.4% of the total traffic volume).

Diagram II isolates the pattern of traffic volumes for trucks in each of the three corridors. The truck traffic patterns for the Queen Elizabeth Way and the Highway 400 corridors are similar to the total traffic pattern as illustrated in Diagram I. This means that trucks in these two corridors are competing for road space during the time of day when total traffic levels are highest.

In contrast to the other two corridors, truck traffic levels on the Highway 401 eastern corridor peaked during the evening, when total traffic levels were low. This indicates that, at the survey point for Highway 401, truck traffic is not competing head to head with car traffic during high use hours.

iii. Empty Movements Versus Total Movements

In order to benefit from potential load matching, trucks must be able to transport heterogeneous freight. Specialized vehicles such as cement mixers, automobile carriers, and other trucks designed for a specific use are generally unable to backhaul other types of freight, and were therefore excluded from the survey interviews. Thus, interview data was obtained for straight trucks with or without an additional trailer and tractors with at least one trailer. Annual figures used in the following tables have been projected from interview survey data and apply only to these types of vehicles,[2] and may vary slightly from the results of the classification portion of the survey.

Table II contains the projected number of one-way truck moves and one-way empty truck moves passing each of the three survey points annually. The Queen Elizabeth Way corridor experiences a higher level of truck traffic of than either Highway 400 or Highway 401. Volumes on the latter two corridors are similar.

TABLE II:
NUMBER OF ONE-WAY MOVES ANNUALLY
(000)

CORRIDOR	EMPTY MOVES	TOTAL MOVES	PERCENT EMPTY
HIGHWAY 401	175	1,212	14.5%
HIGHWAY 400	330	1,170	28.2%
Q.E.W.	415	1,623	25.6%

It was observed in the previous study that the percentage of trucks which are empty decreases in proportion to the length of the haul. It can therefore be expected that corridors with a high level of local truck traffic will experience a higher percentage of empty movements. This expectation is borne out by the projected annual figures for empty and total truck movements. At the Highway 400 and QEW survey points, which are located close to metropolitan centres, over one-quarter of all truck movements involved empty vehicles, while less than fifteen percent of vehicles passing the Highway 401 survey point were empty.

Using the origin and destination data obtained in the survey, one-way downtown to downtown distances were determined, based on the most likely route passing the inspection station at which the interview took place. Where other provinces or states were given as an end point, the major centre in that jurisdiction closest to Ontario's border was used. The projected total number of annual kilometres driven by all trucks and by empty trucks is outlined in Table III.

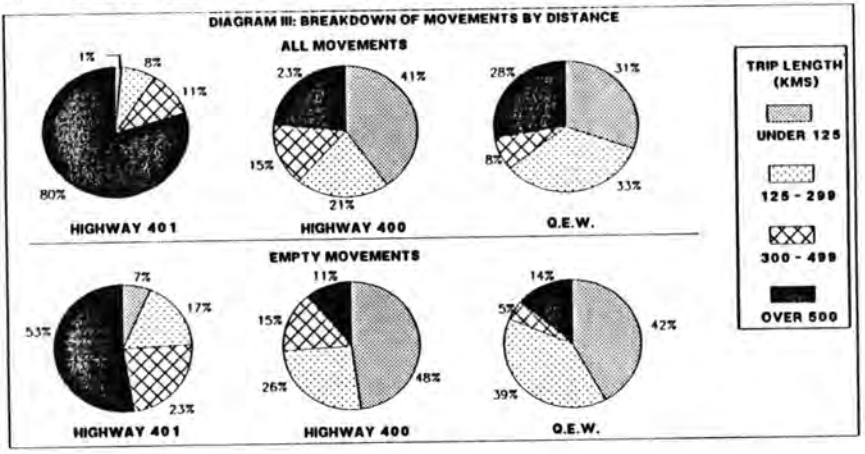
TABLE III:
ONE-WAY KILOMETRES DRIVEN ANNUALLY
(000,000)

CORRIDOR	EMPTY KM'S DRIVEN	TOTAL KM'S DRIVEN	PERCENT EMPTY
HIGHWAY 401	89	792	11.2%
HIGHWAY 400	84	635	13.3%
Q.E.W.	109	606	18.0%

The higher occurrence of local truck traffic on the Q.E.W. and Highway 400 is reflected in the total number of kilometres driven by the trucks passing these stations annually. The truck traffic for these two corridors involve a much lower total number of kilometres in comparison to Highway 401.

The percentage of kilometres driven empty is lower than percentage of movements which are empty for each corridor. For example, while 28.2% of trucks passing the Queen Elizabeth Way survey point are empty, these vehicles account for only 18.0% of kilometres driven by trucks in this corridor.

Diagram III on the following page illustrates the breakdown of total movements and empty movements by distance.

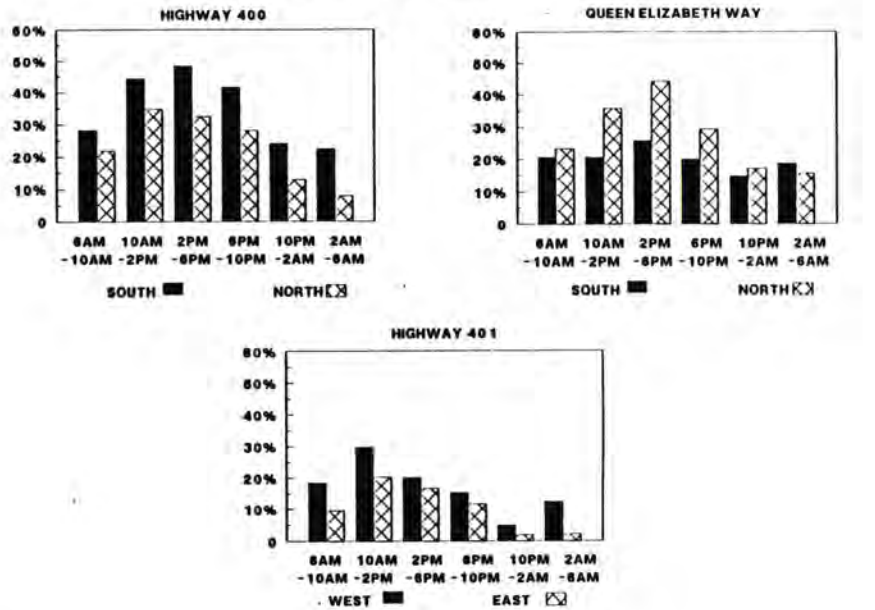


Over 75% of truck movements on the Highway 401 eastern corridor involve one-way trip lengths of 500 kilometres or more. Very few trips surveyed on this corridor involved distances of less than 125 kilometres. This contrasts significantly with the results for the Queen Elizabeth Way and the Highway 400 corridors, where less than one-third of the trips surveyed were over 500 kilometres.

In all three corridors, shorter distance trips account for a higher proportion of empty moves than of total moves. Very long distance trips (over 500 kilometres), on the other hand, make up a proportionately smaller share of empty moves than of total moves in all three corridors. This again confirms the observation that the occurrence of empty moves is inversely related to the length of haul.

Diagram IV illustrates the percentage of total trucks surveyed which were empty. These charts indicate that, in all three corridors, a high proportion of trucks operating during the day are empty. This means that a reduction in the number of empty truck movements through load matching would likely result in a reduction in total traffic volumes during peak use hours. This would particularly benefit the Highway 400 and Queen Elizabeth Way corridors, where a significant proportion of trucks are empty, and where truck traffic competes head to head with car traffic during daylight hours, as illustrated in Diagrams I and II.

DIAGRAM IV: PERCENT OF TOTAL TRUCKS WHICH ARE EMPTY



C. POTENTIAL REDUCTION IN TRUCK TRAFFIC VOLUMES THROUGH THE ELIMINATION OF EMPTY MOVEMENTS

i. Methodology

In the initial analysis of movements between Northern and Southern Ontario, it was assumed that the potential existed to eliminate one round trip where an empty movement occurred in both directions between the same locations. Using this rationale, empty movements were matched for each of the three corridors.

The data for empty movements at each inspection station were sorted by origin-destination, service type (for-hire/private) and vehicle type. For each corridor, matches were made between similar empty movements in opposite directions, with each movement being used only once. Each matched pair is equivalent to one round trip which could potentially be eliminated. All matches which would be possible under current licensing restrictions were made first, then additional matches were made, assuming that such restrictions were not in place.

ii. Potential Reduction of Round Trips

The projected potential number of round trips which could be eliminated annually through load matching is outlined in Table IV. As these figures indicate, all three corridors have substantial potential for the reduction of empty movements. The majority of these reductions are possible only through alterations to licensing regulations in existence at the time of the survey.

TABLE IV:
POTENTIAL NUMBER OF ROUND TRIPS ELIMINATED ANNUALLY
(000)

CORRIDOR	WITH RESTRICTIONS	ADDITIONAL, WITHOUT RESTRICTIONS	TOTAL
HIGHWAY 401	11.8	45.7	57.5
HIGHWAY 400	33.2	74.1	107.3
Q.E.W.	44.3	68.1	112.6

In terms of absolute numbers, the potential for reduction of empty movements is smallest on the Highway 401 eastern corridor. This is largely due to the relatively low occurrence of empty vehicles on this route. However, as Table V indicates, all three corridors have the potential to reduce empty movements by at least 50% annually, representing at least a 9.5% reduction in the total number of movements in each corridor.

TABLE V:
PERCENTAGE OF TRIPS ELIMINATED

CORRIDOR	PERCENT OF TOTAL TRIPS	PERCENT OF EMPTY TRIPS
HIGHWAY 401	9.5%	65.6%
HIGHWAY 400	18.3%	64.9%
Q.E.W.	13.9%	54.3%

iii. Potential Reduction of Empty Kilometres

The sum of round trip kilometres saved through matching loads yields the potential number of empty kilometres which could be eliminated for trips surveyed. Table VI outlines the projected number of empty kilometres which could be eliminated annually on each corridor.

TABLE VI:
POTENTIAL NUMBER OF ROUND TRIP KM'S ELIMINATED ANNUALLY
(000,000)

CORRIDOR	WITH RESTRICTIONS	ADDITIONAL, WITHOUT RESTRICTIONS	TOTAL
HIGHWAY 401	12.8	39.7	52.5
HIGHWAY 400	7.0	31.3	38.3
Q.E.W.	15.8	28.0	43.8

Despite the low number of trips which could be eliminated on the Toronto to Montreal section of Highway 401, this corridor has the greatest potential for reduction of empty kilometres, due to the relatively long average trip length for movements in this corridor. However, all three corridors have the potential to reduce the number of kilometres driven by empty trucks by at least 38.3 million annually.

As Table VII indicates, the number of kilometres which could be eliminated account for a high of 59.2% of empty kilometres on Highway 401, and a low of 40.3% on the Q.E.W.

TABLE VII:
POTENTIAL NUMBER OF ROUND TRIP KM'S ELIMINATED ANNUALLY
(000,000)

CORRIDOR	WITH RESTRICTIONS	ADDITIONAL, WITHOUT RESTRICTIONS	TOTAL
HIGHWAY 401	12.8	39.7	52.5
HIGHWAY 400	7.0	31.3	38.3
Q.E.W.	15.8	28.0	43.8

For all three corridors, total truck traffic could be reduced by at least 6% percent through the reduction of empty movements, with a high of 7.2% reduction in total truck traffic in the Queen Elizabeth Way corridor, which experienced the greatest percentage of kilometres driven empty.

iv. Cost Analysis

Transportation costs were calculated using the Ontario Ministry of Transportation Truck Costing Model [4]. Potential savings were derived from the cost of empty kilometres driven which could be eliminated through matching loads, less pick-up and delivery costs to transport the second load, based on an additional travelling distance of 40 kilometres.

Table VIII outlines the cost of empty movements versus the cost of all movements annually. In all three corridors, at least ten percent of the cost for all movements surveyed is incurred by empty movements. The Queen Elizabeth Way had the highest absolute cost of empty movements, and the lowest cost of all movements on this corridor.

TABLE VIII:
COST OF EMPTY MOVEMENTS VERSUS COST OF ALL MOVEMENTS ANNUALLY
(000,000)

CORRIDOR	COST OF EMPTY MOVEMENTS	COST OF ALL MOVEMENTS	% OF TOTAL COST INCURRED ON EMPTY MOVEMENTS
HIGHWAY 401	71.4	652.8	10.9%
HIGHWAY 400	66.3	517.8	12.8%
Q.E.W.	86.2	491.1	17.5%

The potential annual money savings resulting from the reduction of empty movements through load matching is outlined in Table IX. The reduction in empty movements through load matching could potentially result in a savings of at least $26,000,000 annually in each of the three corridors, with a high of $40,900,000 for the surveyed portion of Highway 401.

TABLE IX:
POTENTIAL SAVINGS
($000,000)

CORRIDOR	WITH RESTRICTIONS	ADDITIONAL, WITHOUT RESTRICTIONS	TOTAL
HIGHWAY 401	10.1	30.8	40.9
HIGHWAY 400	5.2	21.5	26.7
Q.E.W.	11.2	20.4	31.6

As Table X indicates, the potential money savings resulting from load matching represents at least a 36.7% reduction of costs incurred for empty movements. Highway 401, which had a very high average length of haul for empty movements, has the potential to reduce the costs for empty movements by 57.2%. In all three corridors, the savings amounts to a reduction of over 5% of costs incurred for all movements.

TABLE X:
PERCENTAGE OF COSTS SAVED

CORRIDOR	PERCENT OF TOTAL COSTS	PERCENT OF COSTS OF EMPTY MOVEMENTS
HIGHWAY 401	6.3%	57.2%
HIGHWAY 400	5.2%	40.4%
Q.E.W.	6.4%	36.7%

D. CONCLUSIONS

The initial analysis of movements between Northern Ontario and Southern Ontario involved data gathered for intraprovincial movements on Highway 400. The earlier study concluded that, with better matching of loads, significant savings in transportation costs and trucking kilometres driven were achievable. These savings were deemed possible only with "substantial change to market entry constraints", and with "the establishment of information services which would enable the effective matching of loads".

The present study was undertaken to determine the applicability of these conclusions to other parts of Ontario. The analysis of survey data obtained for intraprovincial and extraprovincial movements on Highway 400, Highway 401 and the Queen Elizabeth Way has demonstrated that the earlier conclusions are true for corridors leading north, east and south from Toronto. There are, however, significant variations in truck traffic patterns and movement characteristics on these three corridors.

The Queen Elizabeth Way experienced the highest volume of truck traffic of the three corridors, approximately one-quarter of which was found to involve empty vehicles. The movements on this corridor were generally short in nature, both for loaded and for empty trucks. Truck volumes on this corridor were particularly high during traditional "rush hour" periods, at which time up to 40% of trucks were empty. Approximately one-half of truck traffic on the Q.E.W. had an origin or destination outside of Ontario. 7.3% of trucks travelling in this corridor were using Ontario's roads as a bridge only, and neither originated nor were destined for points in Ontario.

Highway 400 experienced much lower truck traffic volumes compared to the Q.E.W., but had a similar proportion of empty vehicles. The empty movements on this corridor were generally short in nature, while loaded movements involved much longer distances. As with the Q.E.W., truck volumes on this corridor peaked during "rush hour" periods, during which times the percent of trucks which were empty ranged from 33% to more than 50%. Very few movements on this corridor were extraprovincial in nature.

Truck traffic volumes at the Highway 401 survey point were comparable to Highway 400, but accounted for a higher proportion of total traffic. The movements on this corridor were generally very long in nature, with more than 75% involving distances greater than 500 kilometres one-way. Truck traffic was relatively low during "rush hour" periods, peaking in late evening. As with the Q.E.W., a very high proportion of movements on this corridor involved endpoints outside of the province. At least 6.7% of truck movements on this corridor both originated and were destined for points outside of Ontario. This percentage could be higher, since data could only be obtained for eastbound movements between the U.S. and points east of Gananoque, due to the location of the westbound station.

In all three corridors, there is a significant potential to reduce empty movements through improved load matching. Over 50% of empty trips could be eliminated annually in each of the three corridors, reducing the number of kilometres driven empty by at least 40%. This would amount to at 9.5% to 18.3% reduction in truck traffic volumes at the survey points, and a 6.0% to 7.2% reduction in total kilometres driven annually. These reductions would result in reduced truck traffic levels during "rush hour" periods, when the percentage of trucks which are empty is highest. The costs incurred for empty movements would similarly be reduced by 36.7% to 57.2%, amounting to a 5.2% to 6.4% reduction in the costs of truck movements on these corridors. This translates into a savings of at least $26,700,000 in each of the three corridors annually.

As was found in the earlier study, the majority of these potential savings are possible only through changes in current market entry constraints. Less than one-quarter of the savings would be possible under market restrictions in place at the time of the survey. It will be interesting to perform a similar survey and analysis in 1991, in order to study the effects of Ontario's new Truck Transportation Act (effective January, 1989), which eased market entry restrictions for for-hire trucking in Ontario.

Because of the high level of extraprovincial truck traffic at the Q.E.W. and the Highway 401 survey points, load matching information services would have to be interprovincial and/or international in scope in order to fully realize potential savings in these corridors.

The location of the survey points had a considerable influence on the nature of the data which was obtained. The level of local truck traffic affected the values derived for traffic volumes, origin/destination patterns, and average trip distances, and percentage of vehicles which were empty, so that these values may not be applicable throughout the corridor. However, the savings derived in this analysis can be regarded as a minimum level possible under ideal load matching conditions in these corridors. Alternate survey points would find additional, short-distance empty movements which could potentially be eliminated.

REFERENCES

1. Costs and Potential Savings of Empty Truck Movements Occurring Between Northern and Southern Ontario, William Raney, Goods Distribution Systems Office, Ministry of Transportation, 1988.

2. Annual figures were derived as follows:

ANNUAL NUMBER = 250 x DAILY NUMBER
DAILY NUMBER = DAILY FACTOR divided by INTERVIEW FACTOR x NUMBER OF INTERVIEWS
DAILY FACTOR = Adjustment to 24 hour time period, where survey was conducted for more than 24 hours
INTERVIEW FACTOR = Percent of eligible trucks interviewed, based on the vehicle count conducted during each survey period.

3. There are several factors which will reduce the amount of potential savings that could be achieved. Some loads will move regardless of empty move costs because of service considerations. In some situations, a load will have to move immediately before a backhaul is found. Timing and scheduling may prevent the matching of other loads. For example, drivers may not have sufficient time to complete an additional pick up or delivery and keep within allowed hours of work.
On the other hand, this analysis does not take into consideration the possibility of matching partially loaded trailers. Approximately 13% of the non-empty trucks on Highway 401, 20% on the Q.E.W. and 15% on Highway 400 were less than fifty percent loaded. Thus, although the potential savings shown in this report represent an optimum elimination of empty movements, it would appear that the potential savings projected are realistic, and could theoretically be exceeded if space on partially loaded trailers was utilized.

4. The Ontario Ministry of Transportation costing model calculates costs separately for straight truck moves and for tractor trailer moves.

1987 ONTARIO TRUCK OPERATING COST PER KILOMETER

	STRAIGHT[1] TRUCK	TRACTOR[2] TRAILER
EQUIPMENT		
Variable[3]	$.211	$.290
Fixed[4]	$.124	$.298
LABOUR		
Wage[5]	$.175	$.185
Benefits[6]	$.058	$.061
TOTAL COSTS	$.568	$.834

1. Cost for straight truck based on a new truck with a van box mounted on a 7.3 metre chassis, powered by a diesel engine and equipped with a 5 speed transmission and power steering.

2. Cost for tractor trailer unit based on a new tractor powered with the equivalent of a 315 diesel Cummins engine and equipped with a 9 speed transmission and 40,000 lb. rear axle. The trailer costs are based on a new 48' 102" tandem axle van trailer.

3. Equipment variable costs: include costs for maintenance, tires and fuel. Fuel costs are based on fuel consumption and the price of diesel fuel.

4. Equipment fixed costs: include depreciation, interest, licence, insurance, cleaning and miscellaneous costs. Annual projected fixed costs are converted into cost/km by assuming 70,000 kms/year for straight trucks, 140,000 kms/year for tractors, and 50,000 kms/year for trailers.

5. Labour wages: developed assuming an average rate of $12.25 per hour and an average speed of 70 kms/hour.

6. Labour benefits: include an allowance for overtime, fringe benefits, vacation pay and statutory holidays.

SLOW BUT SURE: RESPONSIBILITY FOR DELAY IN THE DELIVERY OF MULTIMODAL CARGOES

by

Hugh M. Kindred*

INTRODUCTION

Everyone recognizes the seachange in multimodal cargo handling wrought by the introduction of containerization. But the great increases in speed and efficiency in the delivery of goods thereby achieved have not eradicated the problems of delay. Indeed, the advances in transportation may have exacerbated the significance and the consequences of a delay. Reliability of service has always been an important feature of commerce. Now, the levels of efficiency accomplished by the use of intermodal containers have raised the standard of service relied upon. Prompt carriage and timely delivery are expected of and by the transportation industry. What, then, is the measure of responsibility that carriers bear for the failure to fulfil these expectations? This paper examines the legal liability for delays in multimodal movements of goods, particularly as they commonly occur in connection with the sea leg of the journey.

ORIGINS OF LEGAL RESPONSIBILITY

Law imposes four fundamental obligations on the marine carrier. He must provide a seaworthy ship, navigate the voyage without deviation, care for the cargo, and deliver it with dispatch.[1] These obligations originated in times when ships were built of wood and powered by sail, and cargoes were manhandled piece by piece in and out the holds. Not surprisingly, the law reflected these conditions of marine transportation.

Distinctions were made between these obligations. In particular, they were accorded different degrees of importance, which were signified by differing standards of responsibility. Each obligation had to be fulfilled to a certain degree of exactitude. The level of responsibility was directly proportional to the risks involved in the voyage. No one doubts that carrying goods in wooden sailing ships was a very risky business to engage in. Not without reason, the early participants

were known as merchant adventurers. In support of their adventures, the law required that the vessel be "tight and staunch and in every way fit" for the intended voyage. This was a strict obligation of seaworthiness, from which the carrier could not excuse himself even for breaches that were not his fault, except in a very few limited circumstances. They were traditionally enumerated as "Acts of God, acts of the Queen's enemies, and inherent vice of the goods."[2]

The duty to care for the goods was likewise a strict obligation.[3] Thus the carrier was liable for any loss or damage to the cargo that was caused through the inadequacy of his ship or the insufficiency of his case. As a result, the common carrier was frequently likened at law to an insurer.[4] This comparison was not accurate but served well enough to depict the high standard demanded of the carrier in ensuring the safety of the goods entrusted to him.

The voyage itself had to be conducted without deviation and with dispatch. Liability for deviating was, if anything, even stricter than responsibility for the condition of the ship and the cargo. Any significant deviation from the agreed or customary route rendered the carrier liable for all subsequent cargo losses, whether they were caused by the alteration in the voyage or not.[5] The only exception made was for deviations of necessity, such as to save lives, to seek a port in distress, or to make essential repairs. The rule against deviation is usually said to have arisen from a principle of insurance. A policy of insurance was ordinarily arranged for a particular voyage, so the ship and the cargo were not covered for a different journey. Since a deviation constituted a changed voyage, the insurer was released from his commitments, and so the defaulting carrier was required to stand in his place.

It is harsh enough, though sometimes appropriate, to hold someone responsible for an injury caused through his acts but without his fault. This degree of responsibility was deemed necessary in the case of the ocean carrier with respect to the safety of the goods in his ship. It was even more severe to make the deviating ship liable when its movements were not the cause of the cargo loss. These requirements stand in sharp distinction to the obligation to carry the goods with dispatch. The carrier was never required to do more than make reasonable efforts to avoid delay.[6] Reasonable conduct is not an absolute standard of responsibility but something rather less. It also inherently limits liability to those occasions when the carrier was at fault and his actions caused the loss complained of. Thus it can be seen that a premium was placed on the security

of the ship and the cargo. Rather less concern was accorded to the speed of the voyage and the timeliness of the delivery. In short, the fundamental obligations of the marine carrier were met if his performance of the carriage was excusably slow but sure.

The original standards of legal liability in marine transportation did not remain immutable, but were modified as time and conditions changed. Of particular concern was the alteration of the common law by the adoption of uniform international rules. The most widespread set is the Hague Rules,[7] adopted by convention at Brussels in 1924 and applied by statute in Canada since 1936.[8] A number of countries, in particular the United Kingdom, applied the Hague Rules as amended by the Visby Rules in 1968.[9] The most important recent developments have been the adoption of the Hamburg Rules in 1978,[10] to replace the Hague and the Hague/Visby Rules, and the signing of the U.N. Multimodal Convention in 1980.[11]

The single most important impact of the Hague Rules was to reduce the severity of the obligations on the carrier. The freedom to contract, which law enshrines as a principle, had always allowed carriers to include clauses in their conditions of carriage that reduced, or limited, or even excluded their liability for breach of their strict legal obligations. The reduction in their obligations by the Hague Rules was, therefore, nothing new in the commercial world of carriage by sea, but the carriers responsibilities became once again regularized. The Hague Rules may have set lower standards but they also established mandatory ones. The carriers received the benefit of the relief from their strict obligations in exchange for obligatory minimum standards of responsibility and maximum limits of liability, from which they could make no further derogations by private agreement.[12]

In effect, the Rules reestablished a fixed allocation of the risks of marine transportation between the carrier and the cargo owner. This allocation to a degree reflected the developments in the shipping industry that iron hulls, steam power, and improved navigational aids had brought about, but it also represented a political compromise between the major maritime powers and the principal cargo interests. As time passed the Hague Rules in their turn have become outdated. They no longer accord with normal methods of transportation now in use, typified by intermodal container traffic. Nor do they now represent the political balance between cargo and ship owning interests. Their divergences were the principal cause and impetus for reform, which has been realized, under the aegis of the United Nations, in the

form of the Hamburg Rules for sea carriage and the Multimodal Convention for intermodal transport. However, since these sets of rules have not yet been brought into force for lack of ratification by enough countries, the carriers' responsibilities continue to be governed by the Hague (or Hague/Visby) Rules for the time being.

Under the Hague Rules the carrier's obligations are "to exercise due diligence" to provide a seaworthy ship,[13] to keep, carry and care for the goods "properly and carefully,"[14] and to conduct the voyage without deviations unless "reasonable."[15] The Hague Rules do not expressly mention dispatch or delay. It is abundantly clear from these phrases that none of the carrier's obligations are strict ones any longer. In each case the language approximates a standard of reasonable care. The omission of the carrier's fourth obligation is puzzling, but, since the standard of dispatch has always been merely to deliver the cargo without unreasonable delay, there was no change necessary.

The lack of a reference to delay does not mean the subject is outside the regulation of the Hague Rules. Since they are made to apply to every aspect of loading, stowing, carrying, caring, and delivering cargoes covered by a bill of lading for movement by sea,[16] it has to be assumed that the timeliness, as well as the manner, of performance of the transportation is included in their scope of application. The main effect of applying the Hague Rules to questions of delay is to give the carrier a set of exemptions and limitations to his liability.[17] Since the Hague Rules are silent about his responsibility for delay, the existing legal standard of reasonable dispatch continues to operate. Consequently, it is necessary to explore in more detail what this standard entails, and then to consider how it may apply to typical incidents of delay under the modern practice of multimodal transportation.

LEGAL OBLIGATIONS TO AVOID DELAY

The marine carrier's primary obligation is to make a reasonable effort to deliver the cargo in a reasonable time.[18] This standard means the ship must transport the goods with reasonable dispatch. It also implies several subsidiary obligations that will arise in the course of carrying the goods if delaying events occur. The carrier ought to inform the cargo owner of any foreseeable sources of delay[19] and to take reasonable measures to avoid their effects. For instance, he should not let his ship dally in a port that is fast becoming ice bound.[20] If a delay takes place, the carrier must exercise such reasonable care for the cargo as the situation demands. For example, if the goods are perishable and the delay is

likely to be lengthy the carrier may have to tranship and forward them. He should also make reasonable efforts to overcome the cause of the delay,[21] and, in any event, he must afterwards resume the voyage with reasonable dispatch.

In all these obligations, the carrier's conduct is measured by a standard of reasonable effort and attention. Only where the carrier guarantees a date of departure or of arrival is he put to any higher standard of responsibility. If he does give such a guarantee, he will be liable for the consequences of any delay without excuse.[22] A schedule of sailing and arriving times, such as liner services usually publish, should not by themselves be regarded as guaranteed. They more likely represent the intentions of the carrier which he will wish to try and keep to in the interests of efficient operation of his business as well as satisfying his customers. In any case, the carrier may well protect himself by the inclusion in his conditions of carriage relief clauses such as "on or about" a stated date and "weather permitting."

What is reasonable time and effort is a question of fact that depends on the circumstances of the voyage. The question contains both objective and subjective elements. Objectively, whether the voyage was delayed will be assessed by comparing its actual duration with the time usually taken by other like ships on similar transits at the same time of year.[23] Subjectively, due allowance will additionally be made for particular difficulties in the voyage,[24] such as unexpectedly bad weather or an unforeseen government embargo. The subjective assessment is a way of recognising that, even though the voyage was delayed because it took longer than it normally should have, the circumstances were beyond the carrier's control. If he made reasonable efforts to cope with the cause of the delay and to continue the voyage, he will not be held liable. The carrier is only responsible for unreasonable delays.

In the face of a hindrance in the voyage, what constitutes a reasonable effort to overcome, and thus to limit the effects of, inevitable delay may depend not only on the degree of influence the carrier has over the intervening events but also on the importance of speed and punctuality in the performance of the carriage. If timely performance is important, the carrier will be held to a higher standard of effort to fulfil his obligations than if it was not. For example, if the carrier is engaged to transport perishable or refrigerated goods, the nature of the cargo is enough to indicate the significance of prompt delivery and thus to oblige him to make strenuous efforts to overcome any delay.[25]

Even when the carrier is responsible for an unreasonable delay, he may still be excused from liability by reason of the Hague Rules. They contain an extensive list of exemptions from liability on which the carrier may rely.[26] Most of these "excepted perils," such as fire, wind and waves, war, rebellion, civil disturbance, government orders, quarantine, strikes, inherent vice of the cargo, insufficiency of packing, inadequacy of marks and other neglect of the shipper, are events or circumstances beyond the carrier's control. Since they are not his fault, he will not be responsible for the consequent delay, provided he made reasonable efforts to limit its effects. Hence the enumeration of these exceptions in the Hague Rules is not strictly necessary; it only illustrates the operation of the existing obligation of reasonable dispatch. This interpretation is supported by the final, catch-all exception. It declares that the carrier is not responsible for loss arising from "[a]ny other cause arising without the actual fault or privity of the carrier, or without the fault or neglect of the agents or servants of the carrier ...."[27]

Amongst this range of excusable causes of delay and loss, however, there is one exception of great importance and benefit to the carrier. He is exempted from responsibility for the "[a]ct, neglect, or default of the master, mariner, pilot, or the servants of the carrier in the navigation or in the management of the ship."[28] This incredible clause permits the marine carrier to avoid taking responsibility for the carelessness of his master and crew. In what other industry can an employer, who is faced with a claim for injury and loss, successfully defend himself by pleading the negligence of his employees?

It is no surprise that the courts have applied this excuse restrictively. In particular, a carrier can only take advantage of it where the master or the crew are negligent "in the navigation or in the management of the ship." He cannot avail himself of the exemption when their acts causing delay constitute carelessness towards the cargo.[29] Thus, a ship, which sought refuge in port from bad weather for longer than was necessary so that its cargo of fruit deteriorated, was liable for the loss through delay. The master's failure to sail as soon as was safe was not an error of judgment in navigation but simply an unjustified neglect of his responsibilities, including his duty to care for the cargo.[30] The distinction is sometimes difficult to make. The test which the courts seem to apply is whether the negligent acts in question were directed towards the ship itself, or were failures to use the ship, its machinery and its equipment for the protection of the cargo.[31] In the

latter event, the carrier will be liable.[32]

LEGAL RESPONSIBILITY IN TYPICAL INCIDENTS OF DELAY

The legal obligations incurred nowadays by the marine carrier exude reasonableness, but the real test of their worth is whether they induce sensible results in the event of delay. It is illuminating to consider the application of the law to a few typical incidents of delay. Some of the most prominent causes of delay in the operation of containerized services by modern shipping lines are press of business, ship repairs, hindrance by others and, most of all, port congestion. The legal responsibilities involved in each situation will be discussed in turn.

Cargo owners understandably become upset if their goods are left behind in the loading port or at some transhipment point because the carrier has accepted more containers than his ships or terminals can cope with. Carriage on another ship at a later sailing results in delayed delivery. However, the carrier will not be held liable for the delay if he had adequate equipment and facilities to handle the ordinary volume of business available to him. If the press of business arises from an unexpected and unforeseeable increase in traffic he will be excused responsibility for the delay.[33]

This is another way of saying that the carrier has to make only reasonable efforts to avoid delay. If he continually accepts more business than he has capacity for, he will be liable for any ensuing delay.[34] Yet one may legitimately doubt whether the law's approach is really so reasonable. After all, what compelled the carrier to accept the unexpected extra business in the first place? No doubt, all shipping lines are anxious to increase their profitable activities and loathe to turn away good business, but if they accept more than they can ordinarily handle surely they should live with the consequences. The owner whose cargo is shut out has every right to the same treatment as the owners whose goods are preferred by being carried on time. It would be more sensible to require the carrier either to make alternative arrangements for the overload of cargo, or to pay for the consequences of his delay.

Ship's repairs are something that cannot be left undone and, in fact, provide the benefit of safety to vessel, crew and cargo alike. Nevertheless, they inevitably result in delay. If the need for repairs was not caused by some fault of the carrier, he is not liable for the resulting delay.[35] However, he still has rights and responsibilities towards the cargo in the meantime. His principal right is his continuing agreement to carry

the cargo and thus to earn the freight. Since he has done nothing wrong, even though the cargo has been delayed, the law respects his entitlement to complete his contract as soon as he may and to receive his payment. This principle is underscored by the consequence that the shipper may remove his cargo from the ship in order to expedite it some other way, but he will still have to pay the freight due to the original carrier.[36]

The choice of actions open to the carrier in this situation is equally as expensive as the shipper's dilemma. Normally, the carrier may not tranship the cargo unless previously agreed by the shipper. He is expected to carry the goods directly from the loading, to the discharging, port. Their transhipment midway is a deviation from the agreed voyage, which is regarded in law as a serious breach. However, where repairs to the ship are necessary and the voyage is delayed, the carrier may tranship the goods at his cost. From a practical point of view, he will only choose this alternative if the on-carriage can be arranged for less than the freight he will earn, so that he is not put to any expense.[37] As a result, the law works to keep the ship idle and the cargo stranded. It is hardly sensible that the cargo owner should be made to suffer the delay or pay twice for transportation.

Two instances of hindrance caused by others recently occurred in Canada in connection with the use of the St. Lawrence Seaway. In the first, the mechanism of a bridge failed, obstructing vessels in the Seaway. In the second, the wall of a lock collapsed, inhibiting passage. After both incidents serious delays were incurred by many ships. Events of this kind in busy and restricted waterways, whether the results of human error or pure accident, are very disruptive of marine transportation. Obviously the hindered ship is not responsible for the consequences to its cargo for the delay.[38] Indeed, the carrier suffers along with the cargo owner from the delay. But the carrier does become obliged in the face of a long delay to consider alternative arrangements for the delivery of the cargo. In effect, he may tranship the goods to avoid the obstruction rather than wait out the delay. But if he does so, he faces the same financial disincentives apparent in the transhipment of cargo from a ship under repair.

Port congestion is probably the single most important source of delay in marine transportation today. Delay occurs wherever local port facilities and inland transport infrastructure have not caught up with the containerized methods of cargo handling practised by modern shipping lines. The problem is rife throughout the developing countries. The delays are very costly to

carriers and cargo owners alike, and the present law is no help.

The carrier's obligation is to sail to the agreed destination.[39] In the absence of a liberty clause in the agreement for carriage, he must proceed to the named port, even though it is congested, and there wait out the delay.[40] Any deviation to a neighbouring port where he might discharge the cargo and tranship it by road or rail is regarded as a serious breach of his obligations. As discussed previously, the carrier was very strictly liable for a deviation. Although by the Hague Rules reasonable deviations are now allowed, the reduction in the carrier's standard of responsibility does not seem to encompass the changing of the port of discharge, even when it would be in the cargo's, as well as the ship's, interest. Reasonable deviations en route may be justifiable, but unilateral changes in destination are not.

The courts are understandably suspicious that deviations are made for the benefit of the carrier. With the prospect of his ship lying idle in a congested port for any length of time, the carrier's decision to deviate to another point of discharge is undoubtedly self-interested. But if the alternative discharging port permits earlier delivery of the goods than would otherwise be possible by awaiting the ship's turn in the queue of congestion, that would seem to be the commercially preferable course of action. It is ridiculous to subject the ship and the cargo to delay longer than is unavoidable.

In face of this possibility, carriers frequently include a clause in their conditions of carriage that gives them the liberty to change discharging ports and to tranship cargoes. In other words, they try to solve the problems of possible port congestion by giving themselves the freedom to make practical rearrangements as circumstances demand and permit. While the law will respect the agreed terms of carriage,[41] it is rather suspicious of a broadly worded liberty clause, which may amount to a power to deviate under disguise. Accordingly, the courts only apply liberty clauses very restrictively.[42] In any case, if the carrier invokes a liberty clause in order to circumvent a congested port, he once more takes upon himself the risk of becoming responsible for any delay. While the law allows him to let his ship sit out the delay in the congested port without liability, if he elects an alternative course of delivery he incurs full responsibility for the consequences. As a practical matter, this predicament is more likely to hinder, than encourage, the willingness of the carrier to avoid the delay.

Only in the transportation of perishable goods does law impose a duty on the carrier to make alternative arrangements for their delivery. The reason is obvious; the carrier must try and prevent the loss of the cargo.

CONCLUSION

The difference in the carrier's obligation for perishable cargo epitomizes the law's attitude towards the risks of marine transportation. Maritime law always emphasized security over speed. That balance was adjusted by the Hague Rules, but has not been given its full measure in legal practice. The experience with typical incidents of delay recounted here show that the law still, unnecessarily, tends to favour the safety of the cargo over the speed of its delivery. The legal obligations of the carrier can encourage inefficiency at the very time that containerized multimodal services provide the most reliable means of transportation ever offered.

ENDNOTES

*Professor of Law, Dalhousie University, Halifax, Canada. The author acknowledges with appreciation the ideas shared by Dr. Max Ganado, his collaborator in a larger work on marine cargo delays.

1. Payne and Ivamy's Carriage of Goods by Sea, (12 ed. E.R.H. Ivamy) London: Butterworths (1985) 13; Scrutton on Charterparties and Bills of Lading (19 ed. A.A. Mocatta, M.J. Mustill, and S.C. Boyd) London: Sweet and Maxwell (1984) 81.

2. See e.g. Scrutton, id. at 201.

3. Paterson Steamships Ltd. v. Canadian Co-operative Wheat Producers Ltd., [1934] A.C. 538, at 544-545 (P.C.).

4. Ibid.

5. Davis v. Garrett (1830), 6 Bing 716, 130 E.R. 1456.

6. Hales v. London & N.W. Rly. Co. (1863), 4 B. & S. 66, 122 E.R. 384; Cohn v. U.S.S.B.E.F.C., [1927] A.M.C. 1646 (6th Cir.).

7. Found in the International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading.

8. Carriage of Goods by Water Act, R.S.C. 1985, c.C-27.

9. Found in the Protocol to Amend the 1924 International Convention, supra n.7, done at Brussels, and enacted by the United Kingdom in the Carriage of Goods by Sea Act 1971, c.19 as amended.

10. Found in the United Nations Convention on the Carriage of Goods by Sea, 1978.

11. The United Nations Convention on International Multimodal Transport of Goods, done at Geneva.

12. This is the combined effect of Arts. III and IV.

13. Art. III(1).

14. Art. III(2).

15. Art. IV(4).

16. Arts. II and I(b).

17. Contained in Art. IV(2) and (5).

18. Supra n.6.

19. Gray v. Seaboard Air Line Ry. Co. (1918), 102 S.E. 512 (S.Ct., S.Cal.).

20. The Wilhelm (1866), 14 L.T. 636 (Adm.).

21. American Ry. Express Co. v. Ewing Thomas Converting Co. (1923), 292 F. 335 (3rd Cir.).

22. Cranston v. Marshall (1850), 5 Ex. 395, 155 E.R. 172; Chicago and Alton R.R. Co. v. Kirby (1911), 225 U.S. 155; The Sotir and The Angelic Grace, [1982] 2 Lloyd's Rep. 202 (Q.B.).

23. The Panola, [1925] A.M.C. 1173, at 1183 (2nd Cir.).

24. As Lord Herschell said in Hick v. Raymond and Reid, [1983] A.C. 22, at 29 the determination of a reasonable time depends upon "the circumstances which actually exist."

25. See Fruitex v. GTS Eurofreighter, [1980] A.M.C. 2710 (D.C., S.D.N.Y.).

26. Art. IV(2).

27. Art. IV(2)(q).

28. Art. IV(2)(a).

29. Kalamazoo Paper Co. v. C.P.R., [1950] S.C.R. 356.

30. The Renée Hyaffil (1916), 32 T.L.R. 660 (C.A.).

31. Goss, Millerd Ltd. v. Can. Govt. Merchant Marine (1928), 32 Ll.L. Rep. 91 (H.L.).

32. The Hamburg Rules and the Multimodal Convention, when they come into force, will not substantially alter the basic obligation of the carrier to avoid delay. Unlike the Hague Rules, they expressly refer to delay, but do so in language that is very similar in effect to the existing general law. Article 5 of the Hamburg Rules and Article 16 of the Multimodal Convention are almost identical in establishing liability "for loss resulting ... from delay in delivery ... unless the carrier proves that he, his servants or agents took all measures that could reasonably be required to avoid the occurrence and

its consequences." The most important change is the omission of the list of exceptions contained in the Hague Rules, in particular the exemption from responsibility for the negligence of the master and crew in the navigation and management of the ship.

33. Davis v. Graham (1924), 225 P. 789, at 793 (Wyo).

34. Ibid.

35. By the Hague Rules the carrier has an overriding obligation to exercise due diligence to make his ship seaworthy. If he readies his ship for the voyage with this degree of care, and yet it still needs to be repaired in the course of the transit because of a latent defect not discoverable by his diligent preparation or as a result of some negligent act by the master or the crew in its navigation or its management, he will not be liable for unseaworthiness. See Articles III(1) and IV(2)(a) and (p) and Maxine Footwear Co. v. Can. Govt. Merchant Marine, [1959] A.C. 589 (P.C.).

36. The Plow City (1937), 23 F. Supp. 548 (D.C., E.D.Pa.). However, the circumstances may give rise to a right to a contribution in general average.

37. Only "when the vessel is wrecked or otherwise disabled in the course of the voyage and cannot be repaired without too great delay and expense" or, it is suggested, when the goods are perishable is the carrier bound to tranship the goods, and then at the expense of the shipper as his agent of necessity to preserve the cargo. See The Jason (1912), 225 U.S. 32, at 55; and The Plow City, ibid.

38. City of New Orleans v. Southern Scrap Material Co. Ltd. (1980), 491 F. Supp. 46 (D.C., E.D.La.).

39. Diana Maritime Corp. of Monrovia v. Southerns Ltd., [1967] 1 Lloyd's Rep. 114 (Q.B.).

40. American Steel Co. of Cuba v. Transmarine Corp., [1929] A.M.C. 1516 (D.C., S.D.N.Y.).

41. Subject to the restraint that the carrier may not lower his responsibilities below the standards set by the Hague Rules. See Art. III(8).

42. See, for instance, Leduc v. Ward (1888), 20 Q.B.D. 475 (C.A.); Glynn v. Margetson, [1893] A.C. 351 (H.L.); Stag Line, Ltd. v. Foscolo, Mango & Co. Ltd., [1923] A.C. 328 (H.L.); and Vancouver Milling & Grain Co. v. U.S.S.R.E.F.C., [1924] 1 W.W.R. 662 (B.C.C.A.).

PUBLIC/PRIVATE SECTOR FINANCING TECHNIQUES FOR URBAN TRANSIT IN CANADA

R.G. Rice and Torill Kove
School of Urban Planning
McGill University

1. INTRODUCTION

Over the past several decades it has become commonplace to regard the provision of urban transportation facilities and services as the exclusive responsibility of the public sector, to be financed as required from available tax sources. This concept of public service has been applied to urban public transit since 1965-70, with dramatically shifting patterns of financial support by level of government over the years since then. More recently, however, in the face of inflationary pressures, economic recession and a new fiscal and political conservatism, provincial and state governments in North America are pressuring transit properties and local governments to assume greater responsibility for the financing of transit services.

Urban transit services in general, and rapid transit systems in particular, are expensive to construct and operate, and it is becoming more essential that the financing requirements of these systems be met from a wider set of public and private sources. With the recognition of the more diverse role being played by public transit, considerable attention has quite logically been devoted to the identification and quantification of user and non-user costs and benefits associated with these systems. By understanding more about user and non-user impacts, it becomes possible to seek revenues to finance the system from those sectors of the economy which proportionally benefit from the service. In regard to transit users, this becomes a matter of fare policy and structure (differential fares by time of day, distance and quality of service), while for non-users, it becomes an issue of taxation policies which can be sensitive to the differential benefits received by private developers, commercial enterprises and automobile users.

In the United States increasing attention has been directed to the development of a wide range of public/private sector cooperative financing arrangements, so that the private sector assumes a "fair share" of the costs it imposes on the general community. These alternative arrangements are either **cost-sharing** schemes or **benefit-sharing/value-capture** schemes. In either case, "the intent is always the same: to shift more of the cost of transportation infrastructure from the general public to those who benefit from the public investment". (Orski, 1986, p.11).

It is the general intent of this paper to assess the transferability of the U.S. experience with cost-sharing and benefit-sharing transit financing strategies to the Canadian context. Attention is directed specifically to public/private sector financing schemes, thereby excluding many other types of what has been termed "innovative financing" methods. The specific objectives of the paper are as follows:

1. To review the U.S. experience with cost-sharing and benefit-sharing urban transit financing strategies,

2. To test the relationship between travel demand and benefitting land uses, using the Montreal Urban Community as a case study, and

3. To assess the appropriateness of cost-sharing and benefit-sharing arrangements for the Canadian urban transit context, with particular reference to the Montreal region.

The structure of the paper has been developed to correspond directly with each of these objectives in turn.

2. REVIEW OF U.S. EXPERIENCE

In the recent past, public transit systems were typically financed from a limited number of sources: user payments, local or municipal subsidies, and provincial or state subsidies. However, given even more recent trends relating to increasing costs, lower growth rates, and a general rise in fiscal and political conservatism, major attention has focussed on the development and application of new types of financing techniques. This phenomenon has occurred primarily in the United States, due to a large degree, to two major Urban Mass Transit Administration (UMTA) policy changes. These were the Young amendment of 1976 and the issuing of UMTA's notice concerning the new Major Capital Investment policy in 1984, both of which incorporated incentives for transit agencies to include private participation in the financing of transit services.

The central notion of the new financing techniques for public transit relates to methods by which contributions towards transit costs can be obtained from the benefitting non-user groups. Private developers and property owners are the most frequently targeted groups, both because they are considered to be the primary beneficiaries of transit systems and because their budgets are least vulnerable to extra costs imposed upon them. It is apparent from the literature that the aspect of affordability is less controversial than the issue of equity, since developers and property owners already contribute to the cost of public services through municipal taxation.

The available literature on this subject area is very extensive, but the key publications would at least include Orski (1986), Frank & Rhodes (1987), Johnson & Hoel (1987), Nicholas & Nelson

(1988), Transportation Research Board (1985), U.S. Department of Transportation (1979), (1986a) and (1986b).

Essentially, there are two basic types of financial techniques relating to public/private cooperation:

1. **cost-sharing techniques:** representing the most direct techniques, typically involving the public/private sharing of specific facility investment costs.

2. **benefit-sharing or value-capture techniques:** representing procedures relating to transportation benefits, which tend to be more difficult to quantify than costs.

Within each of these two classifications, there are a number of relevant procedures, the most important of which are the following:

1. **Cost-sharing techniques**

   (a) **system interfacing:** an arrangement between a private developer seeking a direct connection to a transit facility (subway or bus station) and the public transit agency. The connector fee for the right of access may be based on the capital or the annual cost of the physical connection.

   (b) **land-use controls:** public/private negotiations conducted on an ad hoc basis, whereby private contributions to public system costs are obtained for special density or zoning bonuses.

   (c) **development impact assessment fees:** impact requirements may be imposed on private development, whereby developers contribute to the costs of expanding or providing public services related to the estimated impact of the proposed development.

2. **Benefit-sharing techniques**

   (a) **joint development:** the leasing or sale of development rights on publicly owned land or air space related to transit right-of-way or major terminal provision.

   (b) **tax increment financing:** a property taxation method whereby the increase in property value over a base-year is assessed and earmarked for the financing of a specific facility improvement deemed to cause incremental land-value benefits.

   (c) **special benefit assessment:** the assessment of a special tax or surcharge on parties within a defined special benefit assessment district and assumed to benefit more from a certain service or facility than

other areas. Assessment is typically based on a formula which may include distance from the public facility and size of property.

(d) **voluntary contributions:** an ad hoc approach to either cost or benefit sharing, in which private developers are requested to contribute to public improvements demonstrated to be required or desirable due to proposed private projects.

In order to assess the practical characteristics and limitations of this extensive range of financing procedures, a field visit to selected US cities was undertaken. Those cities with the most relevant experience in regard to transit-related cost-sharing and benefit-sharing techniques were deemed to be New York, Los Angeles, San Francisco and Denver. Overall, these four cities represented a wide range of "innovative" financing techniques.

In New York, the Metropolitan Transit Agency (MTA) and the City Planning Commission negotiate with private developers, and exchange floor-area-ratio (FAR) bonuses for subway station improvements. Within certain areas,the MTA may also require that improvements are made without any obligation to offer development incentives.

This approach is quite unique in that the basic legal framework for developer-funded station improvements was available when the need for privately funded projects began to make itself felt in the late 1970's. Achieving the necessary degree of inter-agency cooperation was facilitated by the common acceptance of the subway as an essential service, with its wide ranging user and non-user benefits.

In contrast to New York, both Los Angeles and San Francisco have been through major legal and administrative hurdles and constraints associated with the implementation of their techniques. The Southern California Rapid Transit District (SCRTD) needed special legislation for the Special Benefit Assessment District, as did San Francisco in regard to the downtown Transit Impact Development Fee (TIDF).

Since the respective cities' legislation has been approved, further legal complications have surfaced. The TIDF has so far been challenged in court twice, first on the fee's general legality and later on its applicability to developers who were granted building permits prior to approval of the fee in 1982.

Denver's 16th Street Transit Mall is among the most successful examples of transit-related private/public partnership recorded to date. Heavily funded by the Urban Mass Transit Authority (UMTA) both for capital as well as operation costs, much of the Mall's success is attributed to the Denver Partnership. Formerly known as Downtown Denver Inc., the Partnership initiated the idea of the special benefit assessment district

and administers the funds collected for the Mall's maintenance expenses.

Although conditions in the four cities visited vary greatly, some general conclusions can be drawn from their experience. Firstly, where benefit-sharing techniques have been successfully implemented, the agencies involved have worked together with a clear understanding of the mutual benefits associated with the techniques. In New York, for instance, the MTA reaps benefits in terms of cost free station improvements, while to the City, the FAR bonuses exchanged for the station improvements lead to increased property tax revenues.

Secondly, revenue-generating techniques that target existing properties within a specific area on a continuous basis, such as benefit assessments, are more reliable as well as lucrative, than exaction-type techniques. Since 1982 San Francisco's Municipal Transit (MUNI) has collected only about $20 million from the TIDF.

Finally, observations indicate that the contribution of benefit sharing techniques relative to other, more conventional funding sources, is quite low. In seeking to obtain 10% of the capital costs associated with Metro Rail's first segment from special benefit assessments, the SCRTD is unusually ambitious. In San Francisco the TIDF generates less than 1% of the annual operating budget, while the estimated revenues from various joint development techniques in the Bay Area Rapid Transit (BART) counties account for approximately 5% of total operating revenues.

It is quite apparent, then, that the seven general categories of financing techniques defined earlier have differing advantages and disadvantages for the Canadian and Montreal contexts. The primary evaluation criteria which are relevant include expected revenue generation, ease of implementation, equity, impact on development incentives, and impact on transit system design. Table 1 provides a general summary of the advantages and disadvantages of the techniques, excluding joint development, which is thought to be less relevant for the Montreal situation at the present time.

In summary then, from the review of the literature and from visits and interviews with selected US city officials, the following general conclusions may be drawn:

1. There is a wide-spread interest in a broad range of new financial techniques as applied to public transit systems, and these have been actively developed and, in many cases, implemented over the past 10-15 years.

2. The most promising techniques are special benefit assessment, various types of joint development, tax increment financing, and zoning regulations, due to their relative ease of implementation and their revenue potential.

3. In the US, the development and application of innovative transit financing techniques varies with

the age and growth rates of urban areas. This pattern has a definite east coast/west coast division, with the frequency of tax increment financing and exaction fees (growth-oriented techniques) being higher on the west coast, and established legal mechanisms (such as zoning) being higher in the older cities of the east coast.

4. The successful application of these new techniques requires a carefully-structured, comprehensive process of negotiation with a range of public and private sector interest groups.
5. In spite of the enthusiasm for new financing techniques, there are relatively few success stories to support the original optimism. In addition to the legal, political and institutional constraints associated with the implementation of techniques, practical experience also indicates that the financial potential of most techniques is quite low and rarely rises above 5-10% of total revenues.

TABLE 1 - COMPARISON OF FINANCIAL TECHNIQUES

Technique	Advantages	Disadvantages
Cost-Sharing		
1. System interfacing	.In existing use in Montreal .Ease of estimation	.Limited scope .Possible inequity
2. Land-use controls	.Flexible in nature .Legal precedence in Montreal	.Ad hoc & inconsistent .Lack of public input
3. Development impact	.Consistent analytical base for determination	.Special legislation .Cooperation between municipality & transit .Potential development disincentive
Benefit-Sharing		
1. Tax increment financing	.Relatively equitable .Good revenue potential	.Special legislation .Base year determination .Difficulty of boundary definition .Influence of public services other than transit
2. Special benefit assessment	.Flexible & direct in nature	.Special legislation .Ad hoc & inequitable .Development disincentive
3. Voluntary contribution	.No institutional requirements	.Unreliable .Low revenue potential

3. MONTREAL CASE STUDY

3.1 Introduction to the Study

At the present time the Montreal metropolitan area has one of the healthiest CBD's in North America, with 250,000 of the 1.4 million employment base located in the core area. Transit ridership is correspondingly high, with 188,000 daily transit trips to the CBD and an annual ridership rate of 223 trips per capita. In Montreal the financial base and structure of support for the public transit system has changed dramatically over the past two decades. In this period, user revenues have declined from 96% of total revenues to 41%, while provincial government subsidies have increased from 0% to 35% in 1986. Consequently, it has been essential for both the municipal level of government (which must assume the remaining 24%) and the regional transit agency (STCUM) to actively seek alternative sources of funding for the transit system. (Bouvrette, 1986).

The most active area of participation by the STCUM over the recent years has been its involvement in capital cost-sharing with private developers in regard to connections to Metro stations. This system interface role has been very critical in the evolution of the highly-successful Montreal underground pedestrian network, and presently involves 42 direct and 11 indirect connections to the Metro system, representing more than $5 million of capital investment. While this public/private cost-sharing program is a successful one, it is limited to initial capital costs (maintenance and operating costs become the responsibility of the STCUM), and represents only one form of cost-sharing and benefit-sharing techniques. Accordingly, a study was undertaken in 1988 to review the level of support provided for public transit by the private sector, through conventional municipal taxation in the Montreal Urban Community. These existing private sector contributions were compared to the transit demand levels and the costs associated with the provision of the required transit service.

3.2 Data Assembly

For the purpose of the study, information was assembled in regard to both travel demand and land-use activities, on an individual metro station area basis. Since time did not permit an analysis of all 65 stations in the metro system, the data collection task was limited to a sample of 7 stations (see Table 2), 6 of these being in the core area.

Three major categories of information were required for the Montreal study:

1. **Annual station operation and maintenance costs**

   Early in the study it was necessary to define the costs intended for recovery from benefitting land owners. It was decided that the recovery costs should at lease include the direct and indirect station operation and maintenance costs, amounting to $65.04

million in 1987 (44% of the total metro operations cost of $147.63 million). Table 2 summarizes the individual station costs.

2. **Origin-destination information by trip purpose, time of day, and station.**

It is essential to know the location and distribution of trip origins and destinations for all passengers using each of the selected metro stations, so that the usage of the facility and the associated costs can be related to the type and distribution of land-use activities. Information was obtained for metro users on an average 1982 weekday basis, for six trip purposes and four time periods, in relation to 72 destination zones. These traffic zones comprised several city blocks each, with 4 to 10 zones being within walking distance of each metro station in the CBD. Table 3 provides a summary of the travel demand information. As a measure of the relative importance of the metro system an analysis was made of the percentage of travellers in each of the seven station catchment areas travelling by metro. Figure 1 indicates the results for the work trip. In Montreal, the metro system carries from 23% to 53% of the work trips, from 32% to 72% of the school trips, and from 2% to 61% of the shopping trips. The implied walk trip frequency distribution for the work trip for the seven sampled stations combined is provided in Figure 2. The mean walk trip lengths are 744 ft. for work trips, 696 ft. for school trips, and 303 ft. for shopping trips.

Table 2 - Annual Station Costs for 1987

Station	Engineering Cost direct	indirect	Operating Staff & Surveillance	Total
Guy-Concordia	$ 363,973	$ 264,948	$ 546,008	$1,174,930
McGill	742,759	592,850	792,167	2,127,776
St. Laurent	277,114	197,250	253,466	727,830
Berri-UQAM	1,951,631	1,510,467	1,119,239	4,581,338
Place d'Armes	288,343	218,008	450,548	956,898
Bonaventure	588,779	497,106	550,091	1,635,976
Henri-Bourassa	495,350	317,989	329,815	1,143,154

Table 3 - Annual Station Volumes by Trip Purpose in 1982

STATION	WORK	SCHOOL	SHOP	OTHER	TOTAL
Guy-Concordia	2,311,500	2,641,700	330,200	1,320,900	6,604,300
McGill	10,077,600	3,286,200	6,791,400	1,752,600	21,907,800
St. Laurent	1,261,200	1,595,100	259,700	593,500	3,709,500
Berri/UQAM	4,372,200	5,015,200	900,200	2,571,900	12,859,500
Place d'Armes	4,274,200	257,500	103,000	515,000	5,149,700
Bonaventure	6,832,700	354,900	621,200	1,064,800	8,873,600
Henri-Bourassa	187,100	78,800	4,900	221,600	492,400

Figure 1 - Percentage of Work Trips Using the Metro

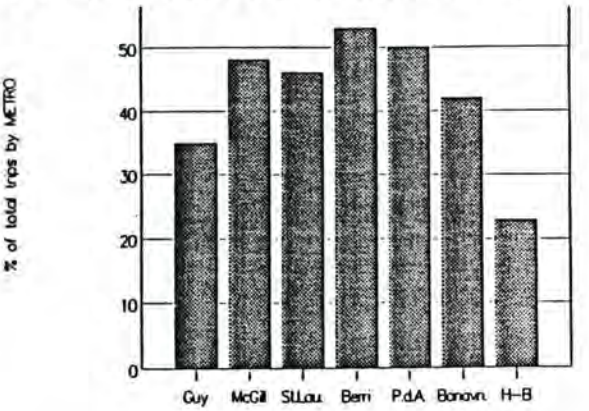
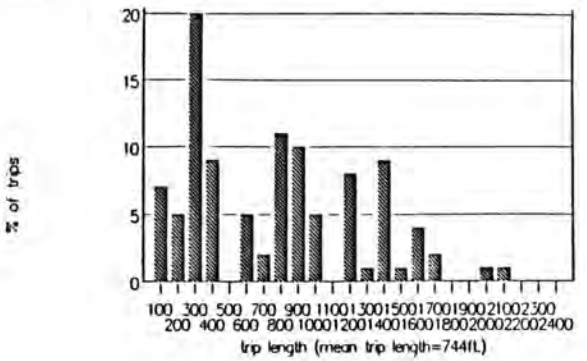


Figure 2 - Walk Trip Length Frequency Distribution for Work

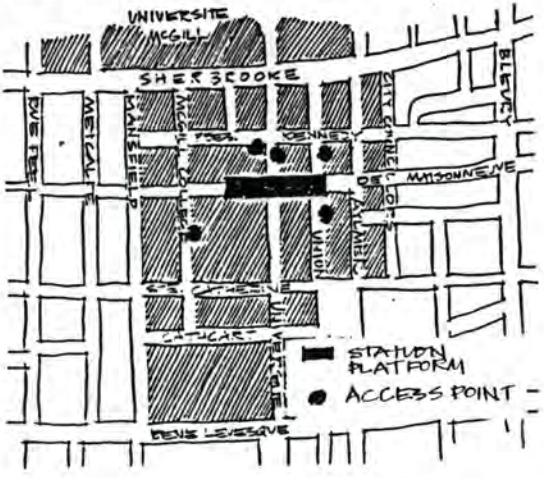


3. **Land-use information by quantity and type of activity.** In order to develop a measure of land-use activity within metro station catchment areas, data on amount, type and assessed value of all properties in the seven sample station areas was collected from standard assessment files of the Montreal Urban Community. Unit rental values were also collected for properties in the McGill and Bonaventure station areas.

In order to define each of the station catchment areas consideration was given to walking distances (600-750 ft.), an integral number of city blocks, the exclusion of residential uses, and the proximity of adjacent stations. As an example, the defined catchment area for the McGill station is shown in Figure 3.

The mix of land uses is highly variable between the seven selected stations, ranging from the high office concentrations at the McGill and Bonaventure station areas, to the commercial concentrations at Guy, Berri-UQAM, Place d'Armes and Henri-Bourassa. In addition, the station areas of Guy, McGill, St. Laurent and Berri-UQAM have significant amounts of "assessment-exempt" lands, relating to clusters of government and institutional uses. Table 4 summarizes the land building assessment values for the seven station areas.

Figure 3 - McGill Station Catchment Area



Of particular interest to this study, is the calculation of the municipal tax contributions deriving from each of these station areas. A dedicated proportion of the municipal property tax for all non-exempt uses is assigned to the support of

transit, and may be estimated by applying a tax rate ($.0016/$ fiscal potential) to a "fiscal potential" estimate obtained as a composite of assessment and rental values. Time only permitted the analysis to be done for the McGill and Bonaventure areas, where the 1987 estimates of the transit contributions are $2.12 million and $1.54 million respectively.

Table 4 - Station Area Characteristics

Station	Catchment Area (ft)	Total Assessed Value
Guy-Concordia	1,780,063	$ 242.7 million
McGill	4,263,618	483.8
St. Laurent	1,877,313	65.8
Berri-UQAM	4,322,950	322.6
Place d'Armes	2,600,384	321.7
Bonaventure	2,316,010	586.8
Henri-Bourassa	1,834,254	21.4

3.3 Analysis of Relationships

The final stage of the analysis requires the assessment of the relationship between the degree of usage of the metro system and the level of financial support for the system obtained through local tax contributions. These comparisons can be conducted at two levels: a total comparison of transit contributions and total station costs by station catchment area, and a comparison of the distribution or share of assessment levels by land-use type with the trip purpose distribution of users by station area. Tables 5 and 6 summarize the results of the first type of comparison. Table 5 indicates that the metro station costs per station user vary from $0.13 to $0.48, with a CBD average of $0.28. From Table 6 it is evident that the contribution per local metro user (where the local users are those with destinations in the station catchment ares, rather than all station users) ranges from $0.21 to $0.39. As a percentage of <u>total</u> transit costs, this contribution accounts for 14% to 26% of total metro costs ($1.52 per user trip, including operating and capital debt charges).

The results of the comparison at the second, more disaggregated level are more inconclusive, due both to inconsistencies between the property-specific assessment data and the larger traffic zones, and the lack of direct comparability between trip purpose divisions (work, school, shopping, and other) and land-use

categories (office, exempt, commercial & other). In general, it would appear that office uses contribute less than their proportionate share of metro costs and commercial users more, although there are particular areas that are exceptions in each case. Institutional uses would appear to be more in balance with their share of metro usage (with exceptions), but of course in this case, revenues are not obtained from the local tax assessment base for these types of uses.

Table 5 - Metro Station Costs per User

Station	1987 station volume(1)	1987 station costs	cost/user
Guy-Concordia	6.68m	$ 1.17m	$ 0.18
McGill	11.81m	2.13m	0.18
St. Laurent	1.70m	0.73m	0.43
Berri/UQAM	9.54m	4.58m	0.48
Place d'Armes	3.66m	0.96m	0.26
Bonaventure	4.15m	1.66m	0.40
Henri-Bourassa	9.07m	1.14m	0.13
Other CBD stations(2)	24.0 m	6.20m	0.26
Total CBD stations	$ 61.54m	$ 17.4m	$ 0.28

1 from Table 2
2 CBD is defined as the general area bounded by Atwater, Pine, La Visitation and St. Antoine.

Table 6 - Dedicated Transit Contributions

Station	1987 transit contribution	1987 station users*	contribution per local user	% of metro cost per user	% of system cost per user
McGill	$ 2.12m	9.88m	$ 0.21	14%	13%
Bonaventure	1.54m	3.92m	0.39	26%	23%
All CBD	21.85m	57.9 m	0.38	25%	23%

*estimated station users in 1987 with local destinations

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 General Conclusions

While it is apparent that a study of this nature must inevitably be limited by time and budget, there are a number of general observations and conclusions which can be made.

1. Based on the sustained interest and growing experience with public/private cost and benefit-sharing techniques, there is an active concern for the issue of equity regarding the financial support of public transit systems.

2. A review of US experience indicates that there is a wide range of financial techniques available for public transit, but that implementation is both difficult and time-consuming, due to legal, political and institutional constraints. The overall financial potential is relatively low, and rarely rises above 5% of total revenues.

3. Given the existing market value-based, land assessment system for municipal taxation already in place in major Canadian cities, there is a very suitable foundation for developing a more equitable and refined transit support mechanism. In the Montreal case, a municipal property tax base which reflects both land value and business activity is currently used to determine a designated, non-user transit contribution to the operating costs of the system. In 1987, this contribution amounted to 22.4% of the annual costs of the transit system, relative to the transit users' share of 41%. On an individual station basis, the range of non-user support is from 13% to 23% of total costs.

4. From the point of view of ease of implementation, a cost-based approach to the public/private sharing of financial responsibility is much easier in terms of measurement and identification than is a benefit-based approach.

5. The concept of a metro station catchment area in a central core district is viable, and can be defined using standard travel demand information. In the Montreal case, these catchment areas are large in size, so that in the aggregate they cover the "downtown core area". This generally supports the rationale for special benefit assessment districts, as defined, for example, in downtown San Francisco. From the 1982 origin/destination survey in Montreal, 54% of all daily trips to the combined areas arrive by public transit.

The key question deriving from the study, then can really be stated as follows: Is it worthwhile, and how is it possible, to

define and implement a more equitable, public transit financial support system, in regard to non-user or municipal contributions? The response to this question has two dimensions. The first has to do with the level of contribution which is appropriate. On this point, the split between user versus non-user support for public transit service is a political decision, and it is probably best if it remains that way, given the complexities of identifying the corresponding user and non-user benefits. In Canada, this decision, plus the subsequent division of the non-user component into the municipal and provincial share, is taken by these two levels of government.

From a theoretical perspective, the immediate benefits generated by a new rail transit facility may be divided into three components:

1. direct user benefits to those public transit users on the new facility,

2. secondary user benefits to those transit and auto users who do not use the new facility, but benefit due to reduced congestion on their facilities, and

3. non-user benefits to those who may not travel at all, but benefit because of reduced environmental effects (air pollution, noise levels, energy consumption, etc.)

Over time, however, the direct and secondary user benefits of improved accessibility may be recovered through increased land rent by land owners in the transit corridor. In a perfect market, land values would increase due to the new facility, and all user benefits would become capitalized in, or be transferred to, adjacent property owners.

In terms of pricing policy, then, the argument could be made that the full costs of the transit system should be recovered from the ultimate beneficiaries: the land-use activities that are serviced by the transit infrastructure. In fact, however, it is most expedient to seek some payment from the transit user, and some from the benefitting land owner, with the essential requirement being that the basis for such payment be, as much as possible, a fair measure of benefit received.

Therefore, due to the difficulty of identifying and quantifying these ultimate benefits, it is suggested that a cost-dependent basis be used, relating to those transit system costs which can be attributed to local station catchment areas.

The second dimension of the response to the question as to whether or not a more equitable, non-user transit contribution method can be developed, has to do with the distributional aspects of the non-user payment. On the basis of the Montreal study, it would appear that it is quite feasible to define a demand-based, metro station catchment area, and to apply a tax structure to pay for the local costs of providing transit

service, such that the distribution of payment is a function of current land values. This contribution allocation scheme has substantial advantages over the arbitrary designation of a special benefit assessment district and an associated flat fee, such as $50/ft2 per year, to cover an unspecified portion of annual rail transit costs.

4.2 Recommendations

Given the conclusions of the study, potential directions for change may be identified, not just in relation to the Montreal system (Rice & Kove, 1989), but more generally in regard to urban public transit systems in major Canadian cities. In developing these recommendations, it is assumed that there is a need to define an explicit, stable base for transit financing. From a political point of view, it may, in fact, be more desirable to be obscure. The US experience with new transit financing techniques, however, points in the opposite direction, and supports the argument for shifting more of the cost of public transit to adjacent land owners who benefit most from the public system.

The recommendations deriving from this study may be best summarized as follows:

1. Greater advantage should be taken of the existing municipal tax structure and its market-value assessment base, by refining special benefit assessment procedures to include local service catchment areas and transit contributions to cover pre-determined costs.

2. Existing direct capital cost-sharing arrangements between the public and private sector for station access connections should be continued, and even expanded to include the sharing of annual operating and maintenance costs.

3. Public/private joint development agreements at major transit terminals should be undertaken on a more extensive scale by transit agencies, so that there is a greater degree of public sharing of transit benefits.

4. All major CBD site development proposals should include a transit impact assessment (as well as the typical traffic and parking impact analyses), as a basis for public improvement cost-sharing. Further, the transit agency should be a major participant in the review of major development proposals (eg - floor area ratio greater than 4).

5. Consideration should be given to the establishment of a development fund for the provision of new incremental transit services in local areas, such as the development of a local downtown distributor system.

In closing, it is worth noting that, even with the inherent difficulties associated with accurately allocating public transit system support to benefitting groups, it does appear to be possible to improve on existing procedures, whether this be through differential fare structures, auto user taxes (gas, parking and licensing taxes), or designated urban development contributions.

Acknowledgement - The authors are grateful to the STCUM for the support of this research, and to Anthony Frayne, Director of Special Projects, and his steering committee for the benefit of their guidance and wisdom throughout the project.

References

Bouvrette, Jacques, "Le Financement du Metro de Montreal", paper presented at the International Public Transportation Conference, Sao Paulo, Brasil, 1986.

Frank, James E., and Rhodes, Robert M., eds., **Development Exactions**, American Planning Association, Chicago, 1987.

Johnson, Gary T., and Hoel, Lester A., "Review of Financing Options for Highways and Transit", **Journal of Transport Engineering**, Vol. 113, no. 1, January, 1987.

Nicholas, James, and Nelson, Arthur C., "Determining the Appropriate Development Impact Fee Using the Rational Nexus Test", **Journal of the American Planning Association**, Vol. 54, no. 1, January, 1988. pp. 56-66.

Orski, Kenneth, **Urban Traffic Congestion: What Does the Future Hold**, Part 1 - "Toward a Policy for Suburban Mobility", Institute of Transportation Engineers, Washington, 1986,

Rice, R.G., and Kove, T., "Etude de Secteurs Speciaux d'Evaluation de Stations de Metro à Montrèal", report to la Sociètè de Transport de la Communautè Urbaine de Montrèal, March 1989.

Transportation Research Board, "Strategies to Implement Benefit-sharing for Fixed Transit Facilities", report #12, National Cooperative Transit Research Program, Washington, 1985.

U.S. Department of Transportation, "Innovative Financing Techniques for Transportation: A Catalog and Annotated Bibliography", report I-79-20, Washington, 1979.

U.S. Department of Transportation, "A Guide to Innovative Financing Mechanisms for Transportation: An Update", report I-86-24, Washington, 1986a.

U.S. Department of Transportation, "Alternative Financing for Urban Transportation: State of the Practice", report I-86-30, Washington, 1986b.

HIGHWAY FINANCE - THEORIES, PRINCIPLES, CONTROVERSIES

Prof. B.G. Bisson
Eric Hildebrand
UNB Transportation Group

1.0 INTRODUCTION

The observations presented in this paper are based on an extensive review of Canadian and American literature on the subject of highway finance.

There exists a fair degree of consensus in the literature as to the economic principles upon which a highway finance framework should be based. This is somewhat surprising given the widespread controversy that surrounds this topic, and the lack of evidence of underlying economic principles in many if not most of the highway finance regimes in existence today.

It is generally accepted that the objective of government in respect of the services it provides is to maximize the net socio-economic benefits the public obtains from these services. This of course implies an efficient allocation of resources.

Applying this rationale to highway services, two subordinate goals have been identified:

"1) to maximize net benefits to all who are dependent upon or employ highways for any reason, and
2) to optimize economic output from targeted commercial uses of the highway plant (1:28)"

With respect to the charges government imposes to recover the costs of highways, most economists agree on two important principles:

1) that road charges should be such that marginal revenues equal marginal costs i.e. the charge for use of the highway for one more trip should equal the incremental highway costs occasioned by that trip;
2) the government should adopt a position of competitive neutrality in establishing user charges for commercial users.

The concept of establishing charges on the basis of marginal costs occasioned is derived from the notion that if road taxes are too high, excessive transportation costs will be incurred by the public. Conversely, if they are too low, the public will ultimately have to absorb the burden of highway costs not compensated by users, and further, artificially lowprices will encourage sub-optimal use of the facility. In either case the goal of maximizing net public benefits is not being met.

With respect to competitive neutrality, the belief is that government should not grant an unfair competitive advantage to commercial highway users by failing to recover from such users, their fair share of the costs associated with their use of the highway. There is widespread agreement on the principle of

competitive neutrality. However, there is no consensus on what costs should be allocated to commercial highway users or for that matter on an appropriate methodology for allocating these costs. This is addressed in greater depth at a later point.

Despite the existence of generally widespread agreement on the principles of highway finance there is little agreement on what is an appropriate framework for putting these principles in practice. The following sections discuss some of the specific controversies related to the application of these principles. They are organized into three groups; 1) cost measurement, 2) cost allocation, and 3) user charge instruments.

2.0 Cost Measurement

The inherent difficulty in measuring highway costs is perhaps the biggest single contributor to the confusion over the degree of cost recovery which is being achieved with present methods of taxation. The determination of all relevant costs, the question of optimizing the life cycle costs of a highway and the presence of economies of scale represent three specific issues which contribute greatly to this confusion.

2.1 Relevant Costs

Most discussions/debates on the subject of highway cost allocation focus on pavement damage costs caused by large trucks. While these costs may be significant, there are other categories of costs which must be considered in a highway finance framework.

In general, highway costs can be categorized into two groups; 1) those associated with the consumption/deterioration of the highway, and 2) spillover social costs such as pollution, accidents, etc.

Consumption/deterioration costs can be further categorized into costs related to capacity (eg. number of lanes, horizontal and vertical alignment), costs related to pavement durability (eg. materials, drainage, pavement thickness) and costs related to ordinary maintenance and repairs. These costs can vary widely by class of road and indeed from section to section on any given roadway.

Costs can also be classified in terms of the physical components of the highway system -i.e. pavements, bridges, shoulders, climbing lanes, drainage, etc.

The obvious conclusion to be drawn from the above observations is that before any attempt can be made at developing a reasonable approach to cost allocation, it is necessary to design a cost accounting framework which clearly defines categories and components of costs, their determinants and interrelationships. When a particular interest group alleges that a certain class of road user is not paying its fair share of costs, the statement is effectively meaningless without a proper definition of costs.

2.2 Optimization of Life Cycle Costs

The principle stating that net benefits to the public will be

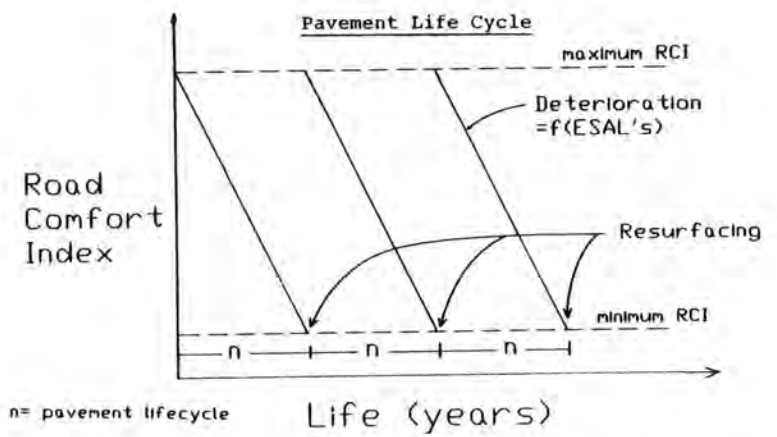
maximized when marginal revenues equal marginal costs is based on the assumption that highway investment is optimized -in other words, the highway is designed in a fashion which yields the lowest possible equivalent annual cost over the life of the highway. If the government is recovering costs through taxation which are excessive in relation to those that would be incurred in an optimally designed facility, the public is not realizing the maximum possible net benefits from the investment.

Three recently published articles by Small and Winston (2, 3, and 4) raise serious doubts about the optimality of pavement durability design of North American highways.

Pavement design practices throughout the world have been heavily influenced by the renowned AASHO (American Association of State Highway Officials) Road Test conducted in the late 1950's. These defined pavement wear in terms of a unit referred to as the equivalent single axle load (ESAL), which is the amount of wear caused by a single axle bearing 18000 lbs. The ESAL value or load equivalent factor of a given truck configuration was determined by the AASHO Road Test to be the sum for each of its axles of (W/18) to the fourth power, where W is the weight on each axle in thousands of pounds. This is the so-called "4th power law (5)". While not disproven, this relationship continues to be questioned.

A pavement may be designed to withstand a given number of ESAL applications or it may be based on the experience of the agency. Pavement condition is generally represented by a measure known as the Road Comfort Index (RCI). As illustrated in Figure 2.1, a given section of pavement has the maximum possible RCI (normally a rating of 10) when it is new. As it is exposed to use a number of ESAL repetitions and the environment, the RCI deteriorates until it reaches some minimum threshold which triggers the need for a re-surfacing. Ultimately after a number of re-surfacing cycles, the pavement may have to be rebuilt or at least the grade adjusted at key locations.

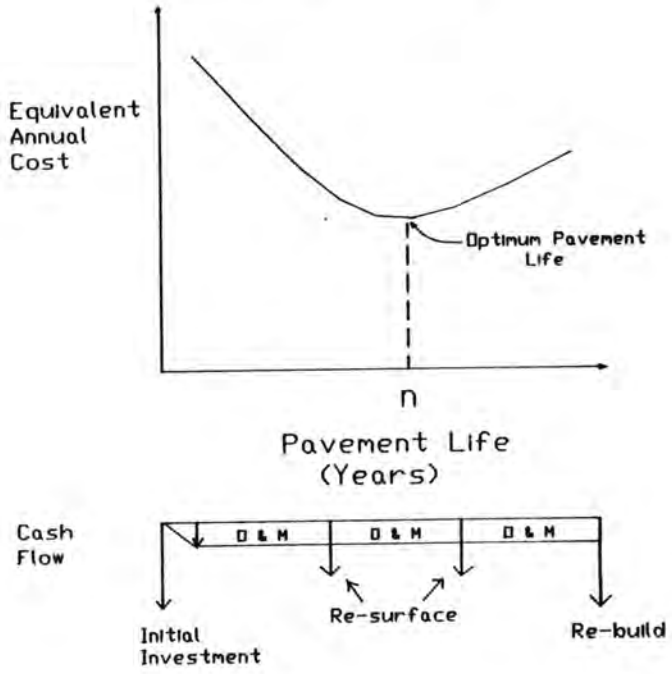
Figure 2.1



The strength or durability of a pavement is affected by a number of factors including materials, construction techniques, quality control, pavement thickness and environmental conditions. The strength of a pavement is very sensitive to pavement thickness. In terms of optimizing pavement durability design, the objective is to find the pavement thickness which will produce a pavement performance which yields the lowest equivalent annual cost. Increased pavement thickness causes a higher initial capital cost, but this is offset by reduced expenditures on maintenance and resurfacing taking into account the time value of money (i.e. resurfacing expenditures are deferred due to longer pavement life and are therefore discounted more heavily). This is illustrated in Figure 2.2.

Figure 2.2

Pavement Life Cycle Costs



In the first of the three Small and Winston articles (2), the authors investigated the welfare effects of instituting nationwide marginal-cost pricing for heavy vehicles in the U.S., with marginal costs being expressed in terms of the contribution of different vehicles to repaving costs. Using the AASHO Road Test empirical

relationships, the authors did an analysis which lead them to the conclusion that existing heavy-vehicle taxation was too low. They estimated that higher heavy-vehicle taxes would result in reduced highway maintenance expenditures attributable in part by a shift from truck to rail and in part by an expected greater use of trucks with more axles. The savings in maintenance expenditures would be offset to a degree by higher shipping costs and lost consumers' surplus, but overall there would be a net welfare gain of approximately $1.2 billion annually (2).

In the second article (3) Small and Winston investigated the problem of optimizing pavement durability. In their analysis, the specified empirical relations between capital cost and pavement thickness, and between pavement thickness and pavement life. The results of their work indicated that the optimal thickness is substantially greater than current practice and that the divergence between the two becomes even more dramatic at higher traffic levels. Their work also demonstrated that pavement lives for thick pavements were substantially overestimated by the AASHO statistical procedures (by nearly a factor of 3 in some cases) (3). This explains why many interstate highway sections may have deteriorated much more rapidly than expected.

In the third article (4), the two researchers further investigated the optimization of highway durability by developing a cost model using modern econometric techniques. In the course of their analysis they discovered what they consider to be serious flaws in the AASHO mathematical formulations. Furthermore they found that the relationship between pavement life and axle loadings is closer to a third-power law than the fourth-power law derived from the AASHO tests. Additionally the equations developed by Small and Winston predicted pavement lives as much as 65 percent shorter than the AASHO equations (4) confirming their previous findings. Most importantly, they found that net cost savings of approximately 40 percent of the present value of outlays in resurfacing could be realized by building thicker, more durable pavements.

It is important to note that the analysis which Small and Winston performed to arrive at these conclusions is probably not directly transferrable to the Canadian context. Their analysis focuses on high volume inter-state freeways, many of which have rigid pavements which are not common in Canada. Notwithstanding these limitations, the issue that is being raised in their research -re. the need for more rigorous optimization of highway investment is valid and is of crucial importance to highway finance.

The public policy implications of these findings in terms of cost based road taxation are to say the least, profound. First, if indeed the durability characteristics of existing highways are sub-optimal, then pavement consumption costs are higher than they should or might be. It follows that in the development of any highway cost allocation framework, considerable attention should be given to the question of optimization of investment. It is worth repeating that marginal cost pricing must be based on optimized costs if maximum net benefits to the public are to be realized. Small and Winston concluded (in sharp contrast to the first article) that "if marginal-cost pricing were accompanied by optimal investment, the

nation's highest-volume roads would have user charges that were lower, for most vehicles, than existing fuel taxes (4)". Conversely, low volume roads would regime higher revenues.

If indeed, existing highways are sub-optimally designed in terms of durability, it begs the question as to who should bear the burden of the resultant excessive costs, until such time as the problem can be corrected by the use of revised standards in future highway investments. Small and Winston argue that in the interim period, user charges should be based on short-run marginal costs (reflecting existing design standards) in order to preserve the integrity of existing highways as long as possible. They suggest that the charges should vary steeply with axle weights, and in-sofar as practical by class of road so as to account for the large differences in vulnerability to large trucks between thin and thick pavements.

Such an approach is obviously not attractive to the trucking industry. However, the important point is that if the critical issue of optimality of highway investment is to be addressed in the public policy debate on highway user charges, this will necessarily involve the development of transitional strategies to move from the current state to a more optimal state.

2.3 Economies of Scale

Given the high proportion of fixed costs inherent in highway systems, economies of scale pose a significant problem in the estimation of marginal costs as a basis for efficient road pricing. The problem is further complicated by the fact that highways are jointly used by the general public and commercial users.

There is little dispute in the literature that vehicle classes (eg. heavy trucks) should pay for any special highway features they require. However, there is controversy about the treatment of costs under increasing returns to scale.

One controversy is whether user charges should be based on average costs rather than marginal costs when economies of scale exist. Again economic principles argue in favor of marginal costs.

The marginal cost of highway capacity utilization is another problem. Costs of additional capacity in highways are usually incurred in large increments at irregular intervals (eg. the addition of a climbing lane, expansion from 2 to 4 lanes, etc.). Two issues are relevant here; how do you account for long run capacity costs, and who is the marginal user? On congested highways, truckers are often perceived to be the cause of the congestion even though they may represent less than 20 percent of the traffic at the critical periods. (Note congestion effects are non-linear).

Changes in vehicle weight and dimension regulations also feature economies of scale. The railroad industry argues that the productivity gains from such changes exceed user charges and therefore create an unfair competitive advantage for the trucking industry. The real issue in this regard is whether the vehicles which reap the benefits of such changes are paying user charges equal to the marginal costs associated with their use of the highway. If they are, the fact that they may be realizing benefits which

exceed costs is consistent with the objective of maximizing net benefits to the public, and is not prejudicial to the principle of competitive neutrality.

2.4 Summary

Measurement of costs is an essential first step in the design of any highway cost allocation framework. This is fraught with many difficulties including the need for a nomenclature, the importance of determining optimum investment strategies, and the resolution of problems associated with the economies of scale in highway systems.

3.0 Cost Allocation

Highway cost allocation is as the phrase suggests, a process of assigning the costs of a highway system to various groups who bear some responsibility for the costs. The primary purpose of highway cost allocation is to establish a reasonable basis for road-related taxation. It is critical therefore that cost allocation methods be consistent with sound economic principles.

Cost allocation is perhaps the most controversial aspect of highway finance. Although there are differences of opinion on whether road users should be expected to bear all of the costs, the debate is usually focused on how to allocate costs among the different classes of users.

Numerous methods for allocating various components of highway costs to users have been developed (particularly in the United States) in the past fifty years. It is not surprising therefore that there is much debate about what is the most appropriate result in different cost responsibilities and ultimately different user charges.

The most widely acclaimed method of cost allocation is the so-called "Incremental Method" which was used in the original U.S. Federal Cost Allocation Study in the early 1960's and in many states over the years.

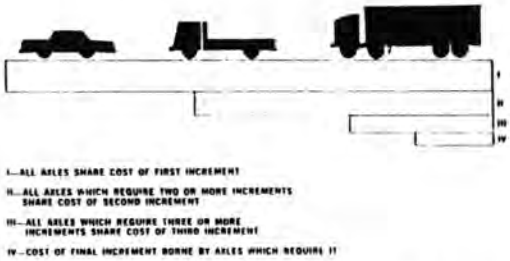
The incremental method begins with a basic road faculty which can be defined as follows: "What would be thegeometric, structural and operating features of the facility that would practically be built if there were no commercial use of highways involving vehicular size and weight features for which extraordinary provisions need to be made?"(1). This "basic" facility can vary by class of road.

Once the basic facility is established, any additional provisions that must be made to accommodate marginal size, weight or operating characteristics of other classes of vehicles are then identified.

According to this method, all vehicles share in the costs of the basic road. The cost of incremental provisions are shared by vehicle classes which require them. This is illustrated in Figure 3.1 (1:63), in relation to the pavement component of highway costs.

Figure 3.1

Incremental Concept for Pavements



The main reason that the incremental method has been so widely used is that it is closely aligned with the "marginal cost" principle of highway finance. Although it is conceptually straightforward and easy to understand, its application is somewhat complex in that it is highly technical and requires extensive data.

One of the major criticisms of incremental method is that it is fundamentally a design - based method, oriented towards the design of new highways. Critics argue that it does not produce sound allocations of pavement rehabilitation or replacement costs, which are representing an increasing proportion of highway expenditures.

Indeed it was this criticism which contributed to the development of a new cost allocation methodology in the U.S. Federal Highway Cost Allocation Study completed in 1982 (6). The principle difference in the two methods is in the treatment of pavement costs.

Proponents of the new method claim that since the incremental method relates pavement thickness to expected axle loads, it does not produce accurate cost allocations for pavement rehabilitation because overlay thickness is not heavily influenced by axle loads. The new method differentiates between new pavements and pavement rehabilitations and uses different cost allocation methodologies for each.

The new federal method has also been severely criticized from a number of perspectives in several published articles. It allegedly makes incorrect use of the AASHO Road Test in its pavement cost allocations. Its concept of the "basic road facility" has been criticized as being unrealistic. It ignores climatic and environment effects on pavement deterioration. Cost allocations for bridges, shoulders, grading and drainage are considered by some critics to be unrealistic and in some instances seriously flawed.

It would serve little purpose to describe in detail other cost allocation methods which have been developed. The major conclusions which can be drawn from a review of the several methods are as follows:

1) there is a remarkable consistency in the literature in terms of support for the notion of an "incremental" approach to cost allocation;

2) there appears to be strong support for a cost-occasioning approach - ie. specifying causal relationships between highway costs and vehicle characteristics;
3) the major differences in the various methods (and they are substantial) appear to be in relation techniques for measuring costs occasioned as well as philosophies regarding cost responsibilities of the different classes of users;
4) the criticisms directed at the various methods generally fall into one of the following categories:
   - violation of fundamental economic principles,
   - the cost measurement techniques lack a sound empirical basis and/or technical accuracy.

4.0 User Charges

Numerous forms of taxation have emerged over the years which are perceived to be road user charges.

Most of the controversy that is evident in the literature with respect to such charges is focused on two issues: 1) the equity/efficiency aspects of user charges and 2) the concept of dedicated funding.

The efficiency dimension of user charges is really a question of how effective they are in terms of fostering an optimum allocation of public resources. In general road taxes are considered to be efficient if they recover the costs resulting from incremental use of the highway. The major area of disagreement appears to be with respect to the time dimension of the costs to be recovered. Should road users be charged for costs incurred in some present time period, some future period, or some average for all time periods? Should charges be based on short-run costs, marginal or average costs. Short run is generally defined as the time period during which the highway infrastructure is essentially fixed. Long-run refers to downstream changes in the highway which will be necessary to meet expected demand at that time. The 1980 State of Oregon Motor Vehicle Cost Responsibility Study defined these different costs as follows:(7)

> Short-run marginal costs are those that would be avoided were the vehicle not to use the road. These costs include roadway wear, certain maintenance items, and certain privately-borne costs. Short-run average costs include the same categories of costs as short-run marginal costs plus a charge for interest and nonuse-related depreciation of the capital stock.
>
> Long-run average costs include every category of costs mentioned above for short-run average costs except they are calculated not for existing capacity but for some optimum, planned, or desired levels of capacity/service. Long-run marginal or incremental costs are the additional costs of expanding capacity to some optimum, planned, or desired level.

Designing user charges to meet the efficiency objective is clearly a difficult task. Apart from the definitional problems,

there is the difficulty of costs which are constantly changing. Indeed, efficient capacity use-related would ideally change by time of day. The other obvious difficulty which is certainly a critical one in the Canadian context, is the matter of achieving consistency in the efficiency characteristics of user charges across the numerous jurisdictions which are establishing them.

Equity concerns with respect to user charges are generally of two kinds - "vertical" and "horizontal" equity. Vertical equity refers to the relationship between the tax instrument and the costs that are being recovered. Horizontal equity refers to the progressivity or regressivity of a tax or user fee - ie. the distributional impact among income groups (8).

Many of the major contributors of road user revenue are strongly criticized in terms of both their vertical and horizontal equity impacts. Motor fuel taxes, one of the primary sources of revenue is widely used because of administrative simplicity, but bears little relationship to costs occasioned and is regressive with respect to the income of road user groups. Even the widely acclaimed "weight-distance" taxes which have been introduced in several states in the U.S. as a means of taxing heavy trucks for the damage they cause to the highways, are criticized because they are based on the weight of the truck rather than axle loadings, the major determinant of pavement damage.

The dilemma which highway administrations face therefore in setting road user charges is that there is a conflict between what,on one hand, might be a conceptually sound design for a particular tax/fee/charge, and what on the other hand, might be administratively and/or politically feasible. The administrative ease of a revenue source can "make or break" its feasibility. If collection and compliance is too complex or cumbersome, the method will become too expensive to be viable. Political and public acceptance of a revenue source are also crucial. Generally the closer the relationship between who pays and who benefits, the easier it is to find support. However, there must be a clear perception of what the benefits are and a belief that the benefits outweigh the costs.

The other major controversy with respect to user charges is that their linkage to highway expenditures and in particular, the pros and cons of dedicated funds.

The concept of dedicated funding -i.e. earmarking road- related taxes for highway funding (e.g. U.S. Highway Trust Fund) has the effect of establishing the highway system as a quasi-private enterprise which has to pay its own way.

Opponents of dedicated funding argue that government, in establishing such funds is abdicating general budget control and is losing flexibility in terms of the allocation of government resources so as to achieve maximum public benefit. If the highway system operates as a pseudo-private enterprise, the objective will be to maximize the use of the plant. This might not necessarily be in the public interest because greater use of highways produces negative externalities such as accidents, pollution, reduced land area, etc.

Those who support dedicated funding argue that the concept is consistent with sound principles of public finance. It establishes a closed system in which expenditures can be related to revenue

generation and in which financing can be linked to the life of the asset. Revenues which go into the fund are clearly recognized as being charges for use of the highway. In contrast, when road related taxes are deposited to general revenues the linkage to road costs/ expenditures is weak. Indeed some argue that highway taxes are simply general taxes to support the functions of government, of which the operation of highways is only one of them.

The dedicated funding concept is very appealing to those who favor an efficiency-oriented approach to highway finance -i.e. one in which highway user charges are related to costs occasioned. Indeed, in the absence of a closed financial system, it is virtually impossible to measure the degree to which the use of highways is being optimized so as to maximize net public benefits.

Another issue with respect to dedicated funds is the relationship between highway expenditures and highway costs (i.e. costs arising from the use/consumption of the highway). The likelihood is that efficiency-based user charges (i.e. marginal cost pricing) would produce revenues higher or lower than budget expenditures. Indeed the U.S. Highway Trust Fund operates on a "pay-as-you-go" principle where expenditures are tied to revenues, but the taxes producing the revenues are not cost-based user charges, nor are the users able to affect the prices they are charged. It is considered that the level of expenditures is a proxy for the economic costs of road use and further that the expenditures can be allocated among classes of users according to cost occasioning principles.

A final observation which also relates to the "pay-as-you-go" approach is the problem of "double charging". One of the major criticisms of the new U.S. Federal Highway Cost Allocation Method is that the pavement rehabilitation costs which were introduced represent a charge for consumption of an asset which users have already paid for. Under the "pay-as-you-go" approach, taxes are established on the basis of anticipated future expenditures. It follows that existing highways have been paid for by past taxes. Therefore, it is argued that pavement rehabilitation costs applied to existing highways represents a form of double taxation. This argument can be countered to some extent by saying that there was no provision or guarantee that all future costs would decrease.

In summary, aswith all other aspects of highway finance, user charge issues are extremely complex. The attractiveness of efficiency-based user charges in terms of principles of public finance is mitigated by their administrative complexity and cost. The concept of dedicated highway funding is also appealing in theory, but has some practical drawbacks.

5.0 Conclusions

Following is a summary of the major conclusions of the authors of this paper as derived from an extensive review of literature pertaining to highway finance.

1) It is evident that considerable research and public policy effort has been devoted in recent years towards reform in traditional approaches to highway finance. This can be explained for the most

part by the massive investments, which are and will be required to rehabilitate and upgrade road and street systems in most countries - investments which are needed at the same time governments are struggling to control and reduce deficits. The increasing emphasis on competition in the transportation industry has also aroused interest in the effects of highway user charges on inter-modal competition. Taken together, these factors suggest continuing pressure for reform in highway finance.

2) Highway cost allocation techniques are being used increasingly as a basis of road taxation. The literature reveals significant differences in the numerous cost allocation studies which have been published in terms of definitions of cost components, disaggregation of costs, cost measurement techniques and cost allocation methodologies. Not surprisingly, therefore, the studies have produced widely ranging estimates of the cost responsibility of different classes of highway users.

3) There appears to be considerable consensus in the literature as to the economic principles upon which highway finance policies should be based. Of particular note is the widespread support for cost-based road pricing with prices reflecting costs occasioned by the incremental use of the highways. Despite this apparent consensus, these principles are not evident in many existing highway finance regimes. This can be explained in part by the many inherent practical difficulties in implementing cost-based pricing such as the dynamic nature of costs, administrative complexities in collecting and enforcing such charges and the usual problems of multiple jurisdictions having responsibility for highway finance.

4) In sharp contrast to the consensus on economic principles, the literature reveals significant divergence of opinions and controversey over the application (or misapplication) of these principles in practice. Numerous complex issues are consistently discussed in the literature. The most common issues are listed below:

Cost Measurement

- determination of relevant costs to be recovered from users
- the importance of optimizing highway investments (re: minimizing life cycle costs) and the serious doubts which have been raised about the optimality of pavement durability of existing highways
- the treatment of economies of scale inherent of highway systems

Cost Allocation

- the appropriate disaggregation of components of highway costs
- the treatment of rehabilitation as opposed to new construction costs for pavements
- the technical accuracy and validity of mathematical relationships for estimating "costs occasioned"
- the data requirements to support cost allocation methodologies

User Charges

- the appropriate time dimension of costs to be used in cost-based pricing (eg. past/present/future; short-run/long-run; marginal/average)

- "vertical equity" characteristics of user charges - ie. the relationship between the user charge and the cost occasioned by the vehicle class
- "horizontal equity" - ie. the distributional impact of user charges among income groups
- the administrative feasibility of user charges
- the advantages and disadvantages of dedicated highway funding
- the linkage between revenues collected from cost-based user charges and budgeted highway expenditures
- the issue of "double charging" for existing highways funded on a "pay-as-you-go" approach

In conclusion, it is the opinion of the authors of this report that the "state-of-the-art" of highway finance is still somewhat immature, particularly in Canada, despite the fact that strategies for funding highways have been evolving for several decades. The vernacular of highway finance suffers considerably from a "Tower of Bable" syndrome - ie. numerous meanings for commonly used terms. The application of theoretical principles of public finance to highways is inherently difficult to achieve in practice and fraught with many complex issues. Notwithstanding these problems, continued pressures for reform can be anticipated and emerging technologies will facilitate the process of reform. The challenge from a public policy perspective is to improve existing highway finance policies in a manner consistent with accepted principles so as to foster greater economic efficiency. The literature demonstrates that this is by no means an exact science. The relative influence of interest groups will have a significant inpact on the evolution of future directions.

List of References

1. "A Primer on Highway Cost Allocation, Part I Histories, Philosophies, and Methods", Council Trans Inc., Washington, D.C.

2. K.A. Small and C. Winston, "Welfare Effects of Marginal-Cost Taxation of Motor Freight Transportation: A Study of Infrastructure Pricing", Studies in State and Local Public Finance, The University of Chicago Press, 1986.

3. K.A. Small and C. Winston, "Efficient Pricing and Investment Solutions to Highway Infrastructure Needs", Papers and Proceedings of the 98th Annual Meeting of the American Economic Association, The American Economic Review, May, 1986.

4. K.A. Small and C. Winston, "Optimal Highway Durability", The American Economic Review, June, 1988.

5. "Adequate Highways -A Key to Regional Economic Development", New Brunswick Department of Transportation, N.B., 1988.

6. "Final Report on the Federal Highway Cost Allocation Study", United States Department of Transportation, Federal Highway Administration, May, 1982.

7. Oregon Department of Transportation, "Motor Vehicle Cost Responsibility Study, 1980", Final Report, March, 1981.

8. A.R. Kane and T.W. Cooper, "A Preliminary Evaluation of Potential Sources of Revenue for Highway Finance", in Transportation Research Record #1124, The 66th Annual Meeting of the Transportation Research Board, Washington, 1987.

Frequent Flyer Programs: Marketing Bonanza or Anti-Competitive Tool?[1]

by

Michael W. Tretheway
Associate Professor
Faculty of Commerce and Business Administration
University of British Columbia
Vancouver, BC V6T 1Y8

1. Introduction

As airline deregulation began in the United States in the late 1970s, carrier executives were faced with the need to reformulate the business strategies they were going to use to survive and prosper in the new environment. One of the questions they must have asked in this process is "What is the fundamental marketing nature of the service we sell?" In examining the characteristics of their services, executives at many of the carriers must have come to the same conclusion: air transportation is a "commodity". The most important characteristic of a commodity is that consumers have little, if any, brand loyalty. For example, in purchasing grain of a particular grade, consumers have no preference between the product of Farmer A and that of Farmer B. The same seems to have been true for air transport as deregulation dawned. Consumers had no particularly strong preference for the services of one airline over the other. As prices were the same between carriers (both before and after deregulation) consumers were more apt to choose an airline based on which had the most convenient schedule for a particular trip. Differences in things such as meal quality, seat width and the vague marketing images promoted by carriers seem to have had minor impacts.

The executives at the new airline, People Express, decided to pursue the appropriate strategy for selling a commodity. That is, sell the product at the lowest possible price, and forget all of the inconsequential service improvements which consumers apparently did not value. Thus, they pursued a strategy of a low-cost operation in order to offer low prices. This strategy appears to have worked for a number of years, as the carrier reported profits in its first years of operations.

---

[1] The author acknowledges financial support from SSHRC grant 494-85-0007 and comments from C. Layer.

At the same time, the executives at American Airlines made the same observation that air travel was a commodity with little or no brand loyalty. Unlike People Express, who chose to pursue an appropriate strategy for a commodity, the executives at American took a very different approach. Rather than pursue a commodity strategy, they would introduce a marketing innovation which would lead to brand loyalty for the consumer. What was needed, was a differentiation of their service which would make the consumer favor their airline over any other airline, even if fares were higher or schedules less convenient. Thus was born the AAdvantage Program. This plan rewarded the traveller for patronage of American Airlines by offering free personal air trips as a reward for repeated patronage. This program was especially attractive to the coveted frequent business traveller who would find it easy to accumulate "points" and earn free trips.

American Airlines' experiment was a runaway success. Members of its program indeed developed brand loyalty. Some observers claim that programs such as AAdvantage have resulted in an increase in an individual carrier's business by 20-35%.[2] The programs have been so successful that every North American air carrier of any significance has been forced to either offer its own program or to join the program of another major carrier.

Are these programs beneficial to the airlines and to their consumers? Are they really quantity discounts? What role have they played, if any, in the consolidation of the airline industry and do they have anti-competitive impacts? This paper analyzes frequent flyer programs from four viewpoints: the airline, the air traveller, the employer paying for the air traveller's ticket, and from the viewpoint of public policy. The paper discusses why frequent flyer programs are not the same as quantity discounts, and how they in fact may have anti-competitive effects detrimental to the consumer.

B. Background

Definition. A frequent flyer program (FFP) is a purchase incentive plan which rewards the traveller with a free trip (or a promise of a free trip) for repeat patronage of the services of a particular air carrier. Typically, a passenger receives "points" for each flight taken, where the number of points is related to the distance travelled.[3] In order to reward travellers paying the

---

[2] "Does the Frequent Flyer Game Pay Off for Airlines?", *Business Week*, August 27, 1984.

[3] Some carriers, such as Northwest Airlines, awarded points based on the number of trips taken, rather than the mileage flown. Many carriers awarded a minimum number of points regardless of the number of miles flown. In the U.S., most of these minimum point awards disappeared in 1989. See "The New Ground Rules for Frequent Flyers" (1988), *Business Week*, December 19, 1988, p.110-111.

highest airfares, the airlines typically award multiples of the basic mileage rates for travel on full fare or first class tickets. Additionally, the airlines give multiple frequent flyer awards for travel on particular routes that are being promoted (such as a new route), use of the airline's own credit card, etc. In many cases, air travellers receive points for the use of participating hotels, rental cars, valet parking services, etc. The hotels, rent-a-car companies, etc. pay the airlines a fee for the right to award frequent flyer points to their customers.[4] This is because the participants are able to take advantage of the brand loyalty built by the airlines, and the airlines charge a fee for this privilege.

As the traveller accumulates frequent flyer points, the traveller cashes these in for airline services. Typically at a low level, such as 10,000 miles, the traveller can receive a free upgrade from coach to first class. At higher mileage levels, the passenger is able to receive free trips. The reward scale accelerates. For example, 75,000 points might be required for one free trip to the Orient, 125,000 for two free trips, and 175,000 for four free trips. When a passenger cashes in all of his/her points, the slate has been wiped clean and the traveller presumably could shift to another carrier's program. In order to avoid this, many airlines will give back to the consumer a certain portion of their points. Thus, once an award is claimed, the customer is already on the way toward a new award and brand loyalty is maintained.

History.[5] Airlines have given perks to frequent travellers for a number of years. For example, following World War II most of the major airlines established VIP clubs for their most frequent travellers. Originally these clubs were free of charge to travellers who were deemed by the airline to be repeat customers. Later, the airlines were forced to charge non-discriminatory fees for these services. Until deregulation, carriers were not allowed to offer free airline tickets, although promotional flights for new services could be exempted in certain circumstances. Following deregulation, Western Airlines introduced its "Travel Pass" which offered the customer a cash voucher, after five trips on selected route segments, toward Western Airlines tickets. American Airlines launched its AAdvantage Program in May, 1981. This program differed significantly from the Western program in that it did not apply just to selected routes, but rather to the whole system. In addition, it rewarded travellers on long flights more than those on short flights. Finally, the reward structure was not a simple linear or constant dollar voucher, but rather an accelerated schedule targeted specifically at the most frequent (and most lucrative to the

---

[4] These companies pay as much as US$20 per 1000 miles for these awards. See R. Layer and D.R. Reid (1988), "Have the Frequent Flyer Programs Defeated the Purpose of Deregulation and How Much are They Costing Your Firm?", *Business Travel Review*, June, p.16-19.

[5] This section draws on material in F.J. Stephenson and R.J. Fox (1987), "Corporate Attitudes Toward Frequent Flyer Programs", *Transportation Journal*, Fall, p.10-22.

airline) travellers in terms of free airline trips. American Airlines enjoyed an advantage with its program in that it took a considerable number of months for other carriers to duplicate it to the same degree. Nevertheless, the concept did spread as carriers losing traffic to American introduced similar programs. "By November, 1986, 24 of the U.S. industry's 27 jet carriers operated or participated in frequent flyer programs".[6]

Some Basic Facts. Stephenson and Fox, in their article on frequent flyer programs, gathered the following facts:

- 54,000,000 adults in the U.S. took at least one airline trip in 1986.
- 32% were classified as business travellers (i.e., the employer paid for the trip).
- 46% of all airline trips were business trips.
- Business trips accounted for 68% of industry revenues.
- 3% of air travellers were frequent flyers (i.e., take more than 12 trips per year).
- These frequent flyers accounted for 27% of the airline industry trips.
- From the latter two facts, it can be determined that frequent flyers accounted for a minimum of 40% of the industry's revenues.
- In 1985, 10,000,000 individuals were members of U.S. frequent flyer programs.
- 70-75% of all business travellers were members of at least one program.
- These members received $1 billion worth of free travel and accrued an additional $2 billion in free travel.
- The value of the frequent flyer awards represent approximately 7.5% of the industry's revenues, and the liability for 1985 alone represented 5% of 1985's revenues.
- In 1986, frequent flyers sold $75 million in awards to brokers.[7]

---

[6] Stephenson and Fox, p.12.

[7] "Frequent Flyer Awards Tougher to Sell as Airlines Tighten Rules, Press Brokers" (1988), *Wall Street Journal*, 6 September, p.31.

- 3% of passengers on any given flight are likely to be frequent flyers cashing in a free ticket.[8] This figure could "jump as high as 15% if people started to burn off points".

C. The Consumers' View

The airline consumer is likely to view frequent flyer programs as a real bonanza. Even customers who pay for their own fares see the frequent flyer reward as some form of rebate from the airline.

As the facts in the previous section showed, over two-thirds of airline revenues come from business travellers (i.e., travellers for whom the ticket is paid for by the employer). These passengers may well view the frequent flyer bonus as something for nothing. However, the purchaser of the ticket, the employer, is not receiving the rebate. The benefit, the free air pass, accrues to the individual traveller. This is a case which economists refer to as the principal-agent problem. Agents, employees travelling on tickets paid for by their employers, make the decision as to the quantity, price and choice of carrier, and receive the benefits of the frequent flyer program. The principal, the employer paying for the ticket, pays the cost but is unable to optimize air travel purchases since the decision is being made by the agent.[9] This problem is discussed further in the next section.

It might be argued that the frequent flyers are confined to seats which the airline can predict would otherwise fly empty. If the airline was successful in confining the frequent flyer to otherwise empty seats and if these seats could be filled with no incremental cost to the airline, then perhaps there is some form of social benefit accruing here. Of course, these two assumptions are not likely to be true. Many of us have personal experiences unable to get onto a fully booked flight, only to later learn that many seats were occupied by airline employees or frequent flyer award users. Statistically, it is known that when airline load factors average only 60%, 6% of flights will be fully booked. When the average passenger load factor rises to 70%, this jumps to 21% of flights that are fully booked, and at an 80% load factor the percent of fully booked flights jumps dramatically to 64%.[10] Thus a certain proportion of the time, at the very least, airline frequent flyer award winners are likely to displace paying passengers. This

---

[8] J. Ibbiteson, "Fight for Frequent Flyers", *Vancouver Sun*, 14 November 1988, p.D2.

[9] See M.E. Levine (1986), "Airline Competition in Deregulated Markets: Theory, Firm Strategy and Public Policy", *Yale Journal on Regulation*, p.421ff.

[10] See M.A. Brenner (1982), "The Significance of Airline Passenger Load Factors" in G.W. James, *Airline Economics*, Lexington Books, Lexington, MA.

creates an opportunity cost for the airline in terms of foregone revenues when it accommodates frequent flyer passengers.

D. Principal-Agent Problems: The Employer's Point of View

Frequent flyer programs are not a rebate for quantity purchases. This is because the recipient of the frequent flyer benefit generally is not the same person or entity which made the payment for the original flights. We have already seen that over two-thirds of airline revenues are for business trips where the employer pays for the ticket. A true quantity discount would be one where the employer would receive the frequent flyer benefit.

Economists refer to this type of problem as the principal-agent problem. The principal is the employer who actually purchases the airline services. The agent is the individual travelling on behalf of the employer. It is the agent, the individual business traveller, who makes the decisions generally as to which airline and flight will be taken and which particular fare category will be used. The agent will make his/her decision so as to optimize his/her own utility. Since there is no cost to the agent of paying a higher price than necessary or taking a more circuitous routing, the agent may well make sub-optimal decisions from the principal's point of view.[11]

The magnitude of the overpayment for and overuse of airline services can be quite large. In Canada, it is estimated that 13-20% of business travel is unnecessary.[12] In the United States, it has been estimated that there is $4.2 billion of frequent flyer cost overruns annually.[13] This is almost 10% of the total revenues received by the airline industry. Stephenson and Fox point out that "the U.S. Internal Revenue Service has estimated the value of unnecessary travel accumulated by frequent flyers to be $9.5 billion."[14]

In addition to the dollar cost of this unnecessary air travel, the principal-agent problem in airline frequent flyer programs also cost the employer in terms of squandered work time. When an employee travels Vancouver-Calgary-Toronto rather than Vancouver-

---

[11] See C. French (1989), "Will Frequent Flyers Still Get the Point?", *Globe and Mail*, 4 February, p.11, for a discussion of how business travellers are spending 13-20% more than necessary on airline services in an attempt to maximize their frequent flyer benefits.

[12] Ibid.

[13] See Stephenson and Fox (1987), p.18.

[14] Stephenson and Fox (1987), p.1. The authors cite as a basis for this observation L.K. Jereski (1985), "High Times for Marketers," *Marketing and Media Decisions*, April, p.143.

Toronto in order to earn additional frequent flyer points, the employer is losing a minimum of one hour of work time. In addition, there is a chance that the Calgary-Toronto leg of the flight could be delayed or even cancelled. There is also the possibility that totally unnecessary trips would be taken. Perhaps in the absence of frequent flyer programs an employee would choose not to go to a particular convention, but because he/she is only a few thousand miles short of that coveted trip to someplace warm and sunny, the employee chooses to go to the convention, costing the employer both in terms of travel expenses as well as foregone work time.

Another issue is whether or not airline ticket prices have been inflated in order to cover the cost of frequent flyer programs. Certainly, there are some costs for the airlines to manage these programs. *Business Week* estimated that the startup expenditures to establish a frequent flyer program were between $2 and $12 million in 1984.[15] In addition to the annual program administrative cost, the airlines incur some costs to actually service the awards. As was already discussed, there is a potential opportunity cost for the airlines when frequent flyer passengers fill seats that could have been sold to revenue paying customers. Even when seats would have otherwise been empty, the airline needs to provide an additional meal, expend additional fuel for the roughly 200 lbs of passenger and luggage, and incur additional passenger service cost. The latter are costs involved in handling the passenger's reservation and in processing the passenger at the airport. *Frequent Flyer* estimates that ticket prices are 10-15% higher than they would be without frequent flyer programs.[16]

Overall, frequent flyer programs are undesirable from the employers point of view. Airline ticket prices are inflated, employees may tend to book higher fare tickets than otherwise, they may take unnecessary trips or circuitous routings, and incur additional time costs for the corporation in planning their itineraries and taking the actual airline flight. Ultimately, it is the consumer who is hurt by this, as prices for the services and products produced by these employers ultimately must reflect their higher cost of doing business. Layer and Reid estimate that frequent flyer programs "may be costing American businesses as much as $7 billion a year in added travel costs."[17]

---

[15] "Does the Frequent Flyer Game Payoff for Airlines?", *Business Week*, 27 August 1974, p.75.

[16] "Will the Airlines and Corporations Fight it Out?" (1986), *Frequent Flyer*, November, p.79.

[17] See R. Layer and D.R. Reid (1988), "Have the Frequent Flyer Programs Defeated the Purpose of Deregulation and How Much are they Costing Your Firm?", *Business Travel Review*, June, p.16.

E. Airlines: The Haves and the Have-Nots

Traffic Stimulation. Stephenson and Fox claim that "airline marketing officials have routinely claimed the frequently flyer programs boost their carrier's business by 20-35%".[18] These programs have definitely been successful in building product loyalty in airline consumers. The first airlines to introduce these programs undoubtedly experienced an increase in traffic and revenues. Eventually the other airlines had to offer similar programs in order to stem the losses of traffic to those airlines offering the programs. Now that just about every airline of any importance in North America offers a program, one might ask whether or not there is any residual advantage for the industry as a whole in their maintenance.

Once all firms in any market offer a particular innovation to their product or service, its marketing effect has essentially been neutralized. The question then becomes whether the industry as a whole has been stimulated by frequent flyer programs. In the sections above, statistics have been cited indicating that indeed this is the case. One of the reasons that corporations have higher travel budgets due to frequent flyer programs is due to extra travelling in the form of unnecessary trips and circuitous routings.

Raising Rivals Cost. An important questions is whether or not frequent flyer programs can be used by one airline to harm another. One way this could happen is if the cost of a frequent flyer program is higher for one's competitors. If this is the case, then introducing such a program will raise their cost relative to yours, thereby lowering their profitability and/or increasing your market share.

There are two ways in which frequent flyer programs can be less costly to some airlines than others. One of these is synergies with computer reservation systems. These powerful computer systems can provide airlines with a number of different services. In addition to keeping track of its own seat inventory, it can be connected to travel agents to allow them access to that inventory in selling the airline's product. The powerful CRS can also act as a database for predicting when seats would otherwise be empty, thereby assisting the airline in its pricing decision. Frequent flyer programs are also greatly assisted by the presence of a CRS. The administrative cost of a frequent flyer program may be less if the airline is able to piggyback this onto an existing CRS system. A CRS-based FFP also can be used to differentiate an airline's services from those without CRS systems. For example, some airlines allow agents to key in a customer's frequent flyer number, thereby simplifying the function of making reservations for a flight. This also will make available to the agent the customer's preference with regard to seating, meals etc.

---

[18] See page 19. They cite as evidence for this the previously cited article in *Business Week*.

A second means by which a frequent flyer program could raise the cost of rivals is via the payout ratio. This ratio indicates how many miles a customer must fly in order to achieve a frequent flyer reward of a given value. An airline who awards a transcontinental return ticket upon accumulation of 45,000 miles of travel will have lower costs than one who must award such a ticket after only 14,000 miles of travel. This relationship between cost and the payout ratio is obvious. What is not obvious is whether in equilibrium consumers will require one airline to have a more generous payout ratio than another. In my view, this is likely to be the case. Consider an airline customer located in Toronto. This business traveller makes trips to various destinations in North America during the year. If Airline A flies to most of these destinations, then it will be easy for that customer to accumulate frequent flyer points. Airline B, on the other hand, might only fly to a limited number of the customer's destinations. Even if the customer always chose Airline B for those destinations, it would be very difficult to accumulate a large number of points. Thus, in choosing between Airline A and Airline B for a trip to a destination served by both, the customer is likely to choose Airline A if the payout ratio is the same for both carriers. A marginal trip on A is more likely to bring the customer to a given mileage level necessary for a particular reward. This is especially important given the accelerating nature of rewards as mileages accrued. To counter this disadvantage, Airline B must offer a more generous reward payout. This of course raises Airline B's cost.

Information Database. Another market advantage of frequent flyer programs for an air carrier is in terms of building information on its customers. The frequent flyer program gives the carrier information on the customer's name, address, employer, number of flights flown and destinations, preferences for meals, seating, etc. In the past, airlines had information on the total travel taken by their customers but little, if any, on the patterns of individual customers. As this database accumulates, the airlines will be able to take advantage of it in terms of market research, specialized promotions, differentiating its product by automatically booking the customer's favorite seat, etc. Airlines with this information definitely will have advantages over their rivals.

F. Public Policy

Let's review the evidence presented thus far. Individual airline travellers are likely to view frequent flyer programs favorably as they appear to be something for nothing. At best, only a handful of travellers are likely to recognize that ticket prices are inflated due to the existence of the programs, similar to the higher prices which grocers several decades ago had when they gave out green stamps. Employers are likely to view frequent flyer programs negatively. They cost the corporation in terms of a) higher travel costs due to both unnecessary travel as well as higher ticket prices, and b) foregone productivity of workers who are flying circuitous routings or unnecessary trips. Air carriers will not be uniform in their perception of frequent flyer programs. All

carriers with FFP's will experience advantages in terms of information on their customers. The carriers who first introduce the programs likely experience benefits in the form of increased market share or higher profits. Overall, air travel seems to have been stimulated by the programs. Some carriers, however, are able to offer the programs at a lower incremental cost than others. In particular, carriers offering flights to a large number of destinations are likely to have lower frequent flyer program costs than smaller carriers. What must be done now is to determine whether society as a whole benefits or is harmed from frequent flyer programs.

Excessive Travel. Frequent flyer programs are undesirable from society's point of view to the extent that they produce unnecessary travel. In the economists' parlance, these are trips where the value is less than the cost. Because of the principal-agent problem, employees are likely to take some trips which simply have very little value. The agent makes these trips because he/she incurs no cost for the trip while receiving a very small but positive value. Society's valuation of the trip is the value to the individual traveller, i.e., the agent. Society's cost of the trip is the cost as born by the employer. This can be considerable and often will greatly exceed the agent's value. Thus frequent flyer programs are inducing excessive consumption of airline services. This lowers society's overall welfare.

A blatant example of this problem was manifested during the triple mileage bonus periods of 1988. In Canada, during the first two months of 1988, travellers on one airline would be awarded triple frequent flyer points for a trip made in January or February. Such a trip would also qualify the traveller for triple points on all flights taken during 1988. A number of travellers scheduled trips during January or February which were totally unnecessary. They were made simply to qualify for triple points for travel later in the year. Clearly, society does not gain from this type of decision making.

Raising Rivals' Costs. The previous section described how frequent flyer programs could be used by carriers serving a large number of cities to raise the cost of their smaller rivals. Raising rivals' cost is a very anti-competitive form of behaviour.

Demand Incentives Forcing Consolidation. Because it is easier for customer to accumulate points on carriers serving a large number of points, and because the small carriers must counter this via more generous payout ratios, the net effect is to create forces in the marketplace in favour of large carriers. In the view of the author, these forces played a very important role in the consolidation that occurred in the U.S. airline industry in the mid-1980s. The two largest carriers, United and American, were involved in little or no merger activity. It was the carriers in the next tier who undertook merger activity. Delta, which services cities primarily in the eastern United States, merged with Western whose traffic base was in the west. USAir teamed with Piedmont and PSA in order to offer a continent-wide service capability. One might ask whether this

consolidation would have taken place in the absence of frequent flyer programs. Caves, Christensen and Tretheway (1984) found that airline industry experiences roughly constant returns to scale and that the available economies of traffic density had been achieved by many of the carriers in the United States.[19] Their research suggests that production economies were not the force behind the consolidation movement in the industry, at least in the U.S.[20] The force for consolidation must have come from elsewhere. Frequent flyer programs are a leading candidate for this force.[21] Both PSA and Air California cited membership in frequent flyer programs as reasons for merging into larger carriers.[22]

Barriers to Entry. Putting these strands of thought together, frequent flyer programs constitute a barrier to entry into the airline industry. They raise rivals costs, and give incentives for large scale airlines where cost considerations do not justify operations on such a scale. Cairns and Galbraith view frequent flyer programs as creating artificial compatibilities between totally disjoint airline trips and that these act as a barrier of entry into the airline industry.[23] In Canada, Wardair repeatedly cited its lack of a frequent flyer program as a major barrier to its success in entering the scheduled Canadian airline markets. Its first attempt at a frequent flyer program had to be discontinued as it proved to be far too costly. In its second attempt, it was forced to offer a program so generous that one could earn a free transcontinental return ticket by simply making a single transcontinental flight during the introductory period. It also was

---

[19] D.W. Caves, L.R. Christensen and M.W. Tretheway (1984), "Economies of Density Versus Economies of Scale: Why Trunk and Local Service Airline Cost Differ," *Rand Journal of Economics*, Vol 15, No. 4, p.471-489.

[20] See D.W. Gillen, W.T. Stanbury and M.W. Tretheway (1988), "Duopoly in Canada's Airline Industry: Consequences and Policy Issues," *Canadian Public Policy*, Vol. 14, p.15-31, for a discussion of economies of traffic density as a force behind the merger which created Canadian Airlines International Limited.

[21] Another reason may be the importance of computer reservation systems in distributing an airline product and in potentially raising the cost of rivals.

[22] See C.R. Layer (1988), "Can Business Afford to Continue Feeding its Trojan Horse?" presentation to National Passenger Traffic Association, October 18, Sheraton Boston Tower Hotel. Mr. Layer is president of the Yorktown Group, 300 Albany Street, Suite 7I, New York, NY 10280.

[23] R.D. Cairns and J.W. Galbraith (1988), "Artificial Compatibilities as a Barrier to Entry," Working Paper, McGill University, Montreal.

forced to make its bonuses available at any time of the year, regardless of demand levels.[24]

Taxing Frequent Flyer Benefits. An issue which often arises is whether or not frequent flyer benefits are taxable. When airline tickets are purchased exclusively with aftertax income (by the same individual who receives the frequent flyer benefit), there seems to be little basis for taxation. However, when frequent flyer points are earned on business travel paid for by one's employer, then a case could be made that the benefit accruing to the individual should be taxable. Economists would argue that not taxing the frequent flyer benefit would lead to a misallocation of resources in favour of the non-taxed benefit rather than other forms of employee compensation such as wages.

Thus far, the onus for reporting taxable frequent flyer benefits has rested with the individual receiving the benefit.[25] Frequent flyer programs are generally kept in a computerized database by the airlines. Simply by soliciting members' social insurance numbers, awards earned could be readily reported to the government taxation department. The difficulty lies with separating out when a traveller purchases a ticket with before-tax versus after-tax dollars.[26] It is often alleged that this problem is so difficult that governments will never be able to tax frequent flyer benefits. Such an argument is not very convincing. In many situations, the onus is on the taxpayer to provide appropriate evidence to the government that a benefit is not taxable. This could be done in the case of FFP awards as well. Available evidence indicates that the majority of frequent flyer benefits are purchased with before-tax dollars (i.e., the employer pays). The government could thus declare frequent flyer benefits as taxable, unless the taxpayer can provide evidence, such as receipts for tickets, that points were earned with after-tax dollars. An interesting variation is to require airlines to accrue frequent flyer benefits to the person or entity actually paying for the ticket. This would be highly favoured by business travel managers as frequent flyer benefits would then accrue to the employer paying for the tickets. A complicating factor here is that 70% of airline tickets in Canada

---

[24] Other airlines blackout certain dates and flights when the computer predicts seats would otherwise be sold to revenue paying passengers. This is especially important for Wardair as it typically operated with very high load factors. See our earlier discussion of the non-linear relationship between load factor and the probability of flights actually having empty seats.

[25] See K.D. Howard (1988), "Revenue Canada Faces Bumpy Ride Collecting on Frequent Flyer Credits," *Financial Post*, 19 September, p.17.

[26] Another issue is how to value the award. The value is likely to be less than the going rate, as the travellers are choosing not to make the extra trip at prevailing rates.

are booked via travel agents and thus, the airline does not know who actually paid for a given ticket.

G. Conclusion

The preceding section indicated that frequent flyer programs are undesirable and that they lower society's overall state of well being. While individual travellers receive benefits of free airline tickets, these have been earned in many cases by unnecessary travel at an employer's expense. Consumers ultimately pay for any increase in ticket prices due to frequent flyer programs and any increases in prices of other goods due to higher corporate travel budgets. The frequent flyer programs are anti-competitive in nature, as they favour large air carriers even when there are no economies associated with larger airline operations. The programs are a means to raise rivals' costs and act as a very effective entry barrier to the airline industry. Since frequently flyer programs act as an unnecessary barrier to entry to the airline entry, and since they lead to unnecessary travel, society will be better off if these programs are terminated.

Is it possible to end frequent flyer programs? Certainly an individual carrier cannot unilaterally end the program. Since they are effective in building brand loyalty, its customers would very rapidly switch to other airlines where their loyalty would be rewarded.

Some have suggested that frequent flyer programs are not unlike the green stamp programs in the retail industry several decades ago. This is not true. In the case of green stamps, the person paying for the purchase received the green stamp benefit. In the airline industry there is a principal-agent problem such that the purchaser and the payer are different individuals. The green stamp programs were ended by convincing the individual that they were paying for the benefit through higher prices. In the airline industry, this line of argument will not work since the business traveller is not paying for the ticket.

Ending the frequent flyer programs would require a decision by the industry as a whole. This would be difficult for the industry to initiate without appearing to violate various aspects of anti-competitive legislation. One possibility would be for the government to intervene and either allow the airlines to negotiate an end to the deals or to use its regulatory authority to directly end the programs.

It would be difficult for Canada to end the programs by itself. Indeed, frequent flyer programs were introduced in Canada in order to remain competitive with U.S. carriers serving transborder markets. Thus, a government initiative to end frequent flyer programs will require North American-wide cooperation.

Another avenue to assist in consumer acceptance of the end of these programs is to actively tax them. When faced with going out

of pocket for taxes due on "free" trips for the family to Europe or the Orient, the consumer may well decide to pass.

Finally, it should be pointed out that if programs were to end, the airlines should allow consumers to use previously earned credits without any time deadline. Pan American learned the hard way that by putting a time limit on cashing in benefits, one will lose significant amounts of revenue as frequent flyer award recipients displace revenue paying passengers.[27]

---

[27] See Stephenson and Fox (1987), p.20.

Applying the New Competition Legislation to the Deregulated Airline Industry: the Case of Computer Reservation Systems

By Witold B. Jankowski

Assistant Professor, Department of Economics, Lakehead University, Thunder Bay, Ontario P7B 5E1, Canada, tel. (807) 343-8229.

1. Introduction

Following a wave of mergers, the last of which has been the acquisition of Wardair by CAIL, the Canadian airline industry has become a virtual duopoly. The duopoly leaves public policies in a difficult dilemma. The remaining regulatory authority over prices covers only northern routes and monopoly routes in the south. On all remaining routes, fares are not regulated (see Jankowski(1988). Competition policy, therefore, remains the only policy tool that can be used to promote competition in the industry.

On June 1, 1987, Air Canada and Canadian Airlines International(CAIL) entered a partnership agreement to merge their computer reservation systems (CRSs). The transaction can potentially introduce elements of monopoly in the already highly concentrated industry. Under the terms of the agreement, the management of the newly created system will be the responsibility of the GEMINI Automated Distribution Systems Inc., in which Air Canada and PWA, the owner of CAIL, are to be equal partners.

The proposed merger was challenged by the Director of Investigation and Research of the Department of Consumer and Corporate Affairs on the grounds that it 'prevents or lessens or is likely to prevent or lessen competition substantially in the provision of computer reservation systems services to airlines, travel agents and consumers in Canada within the meaning of section 64 of the Competition Act'. The Director asked the Competition Tribunal to dissolve the merger.[1]

In defence of the merger, Air Canada and CAIL claim that the transaction is necessary in order to achieve the available economies of scale. Other defences used are that of import substitution and that PEGASUS was about to fail.

This paper examines the positive and negative consequnces of the proposed merger. The provisions of the new Competition Act are related to the economics of the computer reservation systems and specific policies are proposed.

2. The Merger Provisions of the New Competition Act

The past Canadian competition legislation was widely considered as being ineffective in dealing with mergers and monopolies. (There has never been a conviction in a contested merger case.) One of the basic weakness of the structure of the 'Combines Investigation Act' was the assessment of complex economic activity in a criminal law setting. Under the new Competition Act of 1986, mergers are to be

examined under a civil law framework where the adjudicator can issue remedial orders that will maintain or restore competition in the market.

The merger provisions of the Competition Act aim at reconciling the reduction in competiton with the potential efficiency gains related to the economies of scale. Although the new legislation states that the potential anticompetitive effects of the merger should not be assessed solely on the basis of market shares (Section 64.2), concentration ratios, nevertheless, remain an important part of the analysis of a merger. Other factors to be included in the evaluation of the merger are as follows: the extent of foreign competition, the availability of substitutes, conditions of entry and the extent to which effective competition remains in a market and the possible impact on innovation (Section 65). The legislation contains provisions allowing for the defence on the grounds of increased efficiency which would outweigh the possible anticompetitive effects. Part of the efficiency defence is the possibility of increased exports or import substitution (Section 68). The legislation also provides the failing business defence which applies when one of the parties to the merger was to about to fail.

3. The Computer Reservation Industry: An Overview

3.1 The Nature of CRS services

A computer reservation system consists of a periodically updated central database. CRSs distribute information on airline schedules, fares, rules and seat availability to subscribers, mainly travel agents. The CRSs allow the travel agents to list the flights, make reservations and issue travel documents to the customers. CRSs also distribute information and allow to book the services of participating hotels, car rentals, tour operators and other travel related businesses. Distribution of information is done electronically through a cathode ray tube terminal which is localted on the subscriber's premises. Travel agents generally lease the necessary computer terminal and ticketing equipement from a vendor.

An airline can be represented in CRS either as a 'hosted' or a 'participating' carrier. The 'hosted' airline stores its complete inventory of seats in the CRS which then acts as the carrier's internal reservation and management systems. For the 'participating' carrier, CRS does not operate as the internal reservation and management system, which means that the information on the availability of seats of the 'participating' carrier is less accurate than on the 'hosted' one.

CRSs receive revenues from the two principal sources: (a) subscription fees paid by travel agents; (b) booking fees, paid by airlines and other travel suppliers whose services are sold by means of CRSs. CRS vendors charge booking fees for each flight segment, which is defined as one takeoff and landing (a journey with several stops will therefore have more than one flight segment).

The importance of CRSs in the distribution of airline services arises from the fact that the vast majority of passenger tickets are sold by travel agents. Approximately 90 percent of all Canadian travel agencies use a CRS to make airline reservation and print tickets. Before CRS were introduced, travel agents had to use published paper guides for information about flights and fares, or had an option to call the carriers directly. CRSs, by providing travel agents with instantaneous information about flights, seat availability, fares, hotels and car rentals, and other relevant information, can substantially reduce the time and the costs of search.

The CRS vendors compete with each other to provide subscribers with the state-of-the-art software and enhancements. However, the most important feature of the system remains the completeness, accuracy and timeliness of information on airlines which the travel agents book. The airlines 'hosted' on a given CRS can provide a complete information on their seats because the CRS plays the role of an airline internal management system. Because of delays in sending messages,

information on participating carriers is less accurate. To provide the travel agents with an additional information about seat availability on participating carriers, several means of improved access to carriers' internal inventory of seats have been developed. One measure, which allows the agents to read information directly from an airline internal system, is called 'direct access'. 'Direct access' requires that different CRS are connected with one another. A comprehensive form of 'direct access', which allows travel agents to directly access data banks of each participating airline or other entity, to obtain schedule, pricing, seat availability and other reference material, is 'parallel hosting' ('Texas Air Spawns a Major Force in Airline Automation', *Air Transport World*, 1/87).

The most complete access, however, is guaranteed by the 'last seat availability' feature, which, in addition to providing up-to-date information, allows agents to withdraw seats from airline inventory and receive confirmation from that airlines internal reservation system. All U.S. systems offer 'direct access' feature to one another. In Canada, RESERVEC and now GEMINI have refused to offer 'direct access' and 'last seat availibility' to other CRSs.

3.2 The Structure of the CRS industry and its Impact on the Airline Industry

The CRS industry world wide is dominated by a small number of vendors owned by airlines or by consortia of airlines. At present, in addition to the GEMINI system, there are nine CRSs in the world (Table 1).

TABLE 1
COMPUTER RESERVATION INDUSTRY

CRS	OWNERS
Sabre	American Airlines
Apollo	United Airlines, USAir, KLM, British Airways,SwissAir, Alitalia
SystemOne	Continental Airlines, Eastern Airlines
PARS	TWA, Northwest Airlines
DATA II	Delta Airlines
Gemini	Air Canada, CAIL
Amadeus	Lufthansa, Iberia, Air France, Air Inter, SAS, Finnair, Braathens, Islandair, Athia , JAT
Galileo	British Airways, Alitalia, SwissAir, Olympic, KLM, Sabena, TAP, Aer Lingus, Austrian
Abacus	Thai, Cathay Pacific, SIA
Fantasia	Quantas, JAL, All Nippon Airways.

Source: ('Will CRS Revolutionize International World Travel', *Air Transport World*, August 1988).

Since their introduction, computer reservation systems have been criticized for their anticompetitive effects on the distribution side of the travel industry and on the airline industry in general. [2]

On the distribution side, the owners of CRSs may charge travel agents excessive subscription fees. The ability to do that will be a function of industry concentration and the conditions of entry into CRSs market as well as the bargaining position of travel agents.

CRSs can also have a number of anti-competitive effects on the airline industry.

First, the program which runs the system may be designed to favor the host airline's flights, which has been called a 'display bias'.

Second, pricing for CRSs services may be a part of raising rivals' costs strategy. The U.S. Department of Transportation has found the evidence of this strategy in the U.S. The booking fees charged by the owners of the two largest reservation systems were about double the costs that the owner incurred, including the provision for a profit (DOT,1988). Also price discrimation may be used and charges be set depending on the degree of competition that the airline has with the owner of the CRS.

Third, CRSs create the informational advantage for the owner. The data generated by the virtue of operating the system may allow the host carrier to identify changes and shifts in the market, sooner than its competitors.

Fourth, CRS may also affect competition in the airline markets through the impact of code-sharing. Code-sharing is a procedure of listing the flights of more than one airline under the same computer code. It has been applied mainly to flights of small commuter airlines being listed under the code of a major airline. A study by Oster and Pickrel(1989) suggests that code-sharing does not offer benefits to the customers, but instead, in combination with selective withdrawal of joint fares, may eventually reduce competition in the regional airline markets with an accompanying reduction in travel alternatives for travellers to and from small communities. Selective code-sharing also reduces potential competition by making an entry of small commuter carriers more difficult.

In addition, code-sharing can be part of the 'display bias' strategy. For example, flights of commuter carriers owned by Air Canada will be listed as on-line connection and receive priority display compared to flights of independent carriers, even if time elapsed between connections is shorter for the independent carriers. Although consumers generally do prefer on-line over inter-line connections, there is a point where time savings due to shorter times between flights will more than compensate consumers for the disutility of having to switch carriers. Arbitrary priority listing of on-line connections will not reflect consumers preferences and will put the independent carriers at the competitive disadvantage.

Fifth, the airline that owns a CRS is typically able to sell more airline tickets by virtue of its CRS ownership (the so called 'halo' effect).

The U.S. DOT study reveals very high levels of CRSs profitability (DOT, 1988). The owners of the systems invoke the argument that high rates of profits merely reflect high risk involved in developing the systems and are a simple reward for innovation. Such a claim, however, is only partly correct. At a time when the systems were developed, the major airlines in the U.S. and in Canada, were protected from competition by regulation. It was the dominant position of the major carriers that made the only viable founders of the CRS industry. Thus, the profits earned on the systems are at least to some degree post-regulatory rents.

In the U.S., as early as 1984, Civil Aeronautic Board adopted rules aimed at reducing anticompetitive effect of CRSs. Specifically, the rules require the following: (a) all systems must offer displays showing the services of all carriers, and all displays

must be free from bias; (b) CRS owners cannot unjustly discriminate in the setting of fees; (c) CRT owners can retain exclusive use of service enhancements such as automated boarding passess, but they must offer them to all other carriers on non-discriminatory terms once they are offered to one; (c) CRS owners cannot require the purchase of services as a condition of participation; (d) travel agents must be able to use multiple systems and also to switch systems. CRS contracts would be limited to five years; (e) CRS owners must offer any booking and sales data generated by the systems to other carriers. Fees may be charged for such data but they have to be nondiscriminatory (Brenner *et al.*, 1984).

In Canada, the CRSs are not subject to similar regulations, even though there have been complaints about the anticompetitive conduct of the vendors. A commuter carrier City Express, for example, claims that its flights have been subject to a display bias on the RESERVEC system.[3] Air Canada also used the dominant position of RESERVEC as means of increasing CP's costs. (Air Canada refused to pay fees for its bookings done on the PEGASUS system). Finally, RESERVEC and now GEMINI has refused to grant 'direct access' to SABRE and other U.S. vendors in an effort to forestall the growth of these systems in Canada.

3.3. The Technological Developments in the CRS Industry

The CRSs vendors compete extensively with one another in terms of the service features and enhancements. The CRSs offer now features that allow the system software to be used to handle accounting, managerial, and other back offices functions. One of the emerging trends in the industry is the greater reliance on personal computers which are replacing the previously used 'dumb' terminals. The development of future CRS work stations about the personal computers may have important impact on the industry. First, with standarization of the equipment will likely reduce personnel training costs, and thus make cross-entry easier. Second, the PC could be connected to more than one CRS and its computing power could be used to search among CRSs for the services and fares. Both these potential developments can increase competitiveness of the industry.

Other interesting developments involves commercial information networks (CIN). CINs allow subscribers to connect their PCs to mainframe computers and other PCs, which gives the users access to multiple data bases. In the U.S., an electronic version of the Official Airline Guide is now available through a number of CINs. It gives the consumers not only the information on fares and flights, but also allows them to request airport pickup of tickets (DOT, 1988).

The computer technology which made CRS possible is constantly evolving, and the future developments cannot be fully predicted. The CRS industry is thus intrinsically dynamic, and one expects the technological change will continue to have significant impact on industry's conduct and performance.

4. The Economic Evaluation of the Merger

The first step in the assessment of the merger is the identification of the relevant product and the extent of the geographic market. The analysis of market shares, conditions of entry, potential efficiency gains, and other relevant factors may then follow.

4.1 The Definiton of the Product, Geographic Market and Concentration Ratios.

The definition of the product is relatively easy. It includes the computer reservation services, such as providing information about flights, fares, availability of seats, car rentals and hotel reservation and other relevant information. The CRSs can also provide office automation features such as accounting. At present the CRSs have no close product substitutes, the closest alternative being the electronic version of the

published Official Airline Guide.

In their submissions to the Competition Tribunal, the Director and the parties to the merger have not been precise as to what constitutes the relevant geographic market. Thus, Air Canada states : "For many CRS issues, the relevant geographic market is national. However, for some purposes it may be more appropriate to consider smaller regions or urban centres, and for others (e.g. the potential suppliers of CRS services in Canada), the relevant geographic market will be North America." The Director estimates market shares on the basis of the travel agents locations and terminals. This would suggest Canada to be the relevant geographic market. However, the Director also states: "as a result of this merger GEMINI will have nearly 100% market share in non-urban areas and 77% in urban areas". This in turn suggests a narrower definition of the market.

In defining the relevant market one risks two types of errors. If the definition of the market is too narrow, calculated market shares will overestimatie the extent of current market power. On the other hand, if the definition of the market is too broad, potential anticompetitive effects of the merger may be overlooked. Thus, considering that, at present , North America is the relevant geographic, the proposed merger will have only marginal impact on the level of concentraction in the industry. On the other hand, considering regions or even cities as being the relevant markets would overestimate the impact of the merger. The demonstrated ability of SABRE to expand in Canada into new locations suggests that a regional definition of the market is too narrow. [4]

Taking a pragmatic view, we shall assume in this analysis that the relevant geographic market is Canada. Consequently, the scope of actual competition will be defined by the number of CRSs that currently operate in Canada. The extent to which potential competition may constrain firms in the market will then depend on the nature and height of barriers to entry.

The following tables provide information on the approximate market shares when the relevant geographic market is Canada. The shares used to specify the levels of concentration are defined by the numbers of locations and CRS terminals respectively.

TABLE 2
NUMBER OF TRAVEL AGENTS LOCATIONS (JUNE 1987)

SYSTEM	LOCATIONS	MARKET SHARE %	POST MERGER MARKET SHARE
RESERVEC	2926	72	-------
PEGASUS	720	17.7	-------
GEMINI	---	----	89.7
SABRE	390	9.6	9.6
APOLLO	25	0.6	0.6
SODA/SYSTEM ONE	1	0.05	0.05

Source: Submissions to the Competition Tribunal.

TABLE 3
NUMBER OF CRS TERMINALS IN TRAVEL AGENCIES (JUNE 1987)

SYSTEM	LOCATIONS	MARKET SHARE %	POST MERGER MARKET SHARE
RESERVEC	6025	71	-------
PEGASUS	1362	16	-------
GEMINI/ PARS	---	----	87
SABRE	1100	13	13

Source: Submissions to the Competition Tribunal. [5]

The industry, thus, is highly concentrated with the proposed merger significantly increasing the industry concentration.

4.2 Conditions of Entry

Concentration ratios provide the indication of current market power. The conditions of entry then define the ability of firms to sustain market power in the long run. Barriers to entry can be defined as factors or conditions of the market that give the incumbent firms a persistent advantage over the new entrants and consequently allow the incumbents to earn above normal profits (Fisher, 1983). Barriers to entry may be determined by the technology, cost structure and demand characteristics, and may also be created by actions of incumbent firms. The typical examples of the structural entry barriers are economies of scale and scope, and sunk costs. [6]

In general, entry into a given geographic market can originate from two sources - the new start-up firms and the established firms operating in other markets. Typically, entry barriers facing the start-up supplier will be higher than those experienced by the existing firms.

Economies of scale will be a source of entry barriers if entry has to be gradual and cannot take place at the minimum efficient scale of operation. The minimum efficient scale of operation in the provision of CRS services can be inferred from data in Table 4.

TABLE 4
ECONOMIES OF SCALE IN THE PROVISION OF CRS SERVICES

	APPLLO	SABRE	PARS	DATAS II	SYSTEMONE
Average expense per booking(1986)	$1.81	$1.62	$1.74	$2.64	$2.36
Total reservations processed during 1986 (millions)	113.3	144.1	46.6	20.3	36.9

Source: U.S. Department of Transportation(1988).

As indicated in Table 4, costs per booking decline with output. The decline of costs, however, is very small once the size of approximately 50 million bookings is reached, which would indicate that PARS, the third largest vendor in the U.S. operates at the minimum efficient scale. The small start-up entrant therefore is likely to encounter significant cost disadvantages versus the established vendors. Economies of

scale, however, should not constitute an entry barrier for the already established vendor operating at the minimum efficient scale.

In addition to economies of scale defined over the CRS output, the systems operated by the airlines are also characterized by the presence of economies of scope. Economies of scope arise primarily because the computer hardware can be shared between the system used for internal needs of the airline and the system sold to the travel agents. There is also an overlap in the personnel and learning required to operate both systems.

Finally, entry of a new firm into CRS industry involves incurring substantial sunk costs related to the development of software, labour training and promotional expenditures. These unrecoverable costs increase risks and put the new entrants in a strategic disadvantage versus the established suppliers (Table 5).

TABLE 5
ESTIMATED UNAMORTIZED VALUE OF NON-RECOVARABLE INVESTMENT BY CRS VENDORS AT END OF 1986 ($ MILLION)

TYPE OF INVESTMENT	APOLLO	SABRE	DATAS II	SYSTEMONE	PARS
Programming and Product Develpoment Costs	$43.7	$41.7	$38.3	N.A.*	N.A.
Marketing Expenses	59.7	49.1	31.1	24.0	17.8
Subscriber Conversion, Retention, and System Use Incentives	16.4	18.2	19.2	7.1	3.1
Subscriber Training	91.2	89.2	12.6	17.9	N.A.*
Total	$211.0	198.2	101.7	49.0	20.9

Source: U.S. DOT (1988); [* Not Available].

The presence of sunk costs, significant economies of scale and scope suggests that the relevent type of entry that may constrain the existing vendors in Canada is that of the existing vendor operating in the U.S. The existing U.S. vendors are not likely to suffer significant disadvantages related to scale and scope diseconomies. Their systems are already developed and are larger or comparable in size to that of GEMINI. The structural barriers therefore should not impede entry of American vendors. (European and Asian systems are still in their development stage and may become vigorous competitors in the future. Given the unclear status of GATT negotiations on trade in services, however, the ability of non-American vendors to compete in Canada remains unclear.)

The American systems, however, may suffer from barriers created by the conduct of the Canadian vendors.

The first obstacle to entry and growth in Canada is the lack of complete information on seat inventory of the available seats. In Canada, the ability to provide accurate and up-to-date information on Air Canada's and CAIL's flights is crucial for the viability of the system. Refusal to grant direct access or last seat availability on airlines that together account more than 90% of the industry output in Canada reduces

the value of a competing system to the travel agents.

Air Canada and CAIL may also refuse to pay for the bookings done through other systems. This would force the competing vendors to increase travel agent fees and become less competitive or incur losses. The ability of American, the owner of SABRE to retaliate is limited since Canadian CRSs do not operate in the U.S.

The ability of travel agents to switch the systems is also important in assessing the strength of potential competition. Switching costs may arise because of the need to retrain staff. At present, the CRSs rely primarily on personal computers as their terminals (e.g. PEGASUS, SABRE), operation of which is an essential part of travel agents' training in any case, thus training costs may not be substantial. More important than the technological constraints are the conditions of the travel agent - CRS vendor agreement. The U.S. Department of Transportation study (DOT,1988) has found the terms of the contracts travel agents sign to be the most important obstacle to starting a new CRS. For example, SABRE's travel agency contracts usually contain five-year terms with liquidated damage provisions and minimum booking requirements. Such contacts clearly reduce the possibility of early termination and switching the systems. RESERVEC's and PEGASUS's contracts have been less restrictive than those of SABRE, but in the absence of regulation this may change in the future.

The CRSs industry in Canada is thus characterized by the presence of entry barriers for the established U.S. vendors. The merger, by creating a system which has the exclusive and superior information on flights of both Air Canada and CAIL, makes entry of other systems into Canada even less likely. It should be emphasized, however, that barriers facing the U.S. vendors in Canada are primarily created by the practices of Canadian carriers and can potentially be reduced or eliminated by government regulations (e.g. allowing 'direct access' to full inventory of Air Canada and CAIL to other CRSs). In evaluating effective remaining competition after merger, one therefore should include the effects of possible policies aimed at reducing conduct related barriers to entry.

4.3. Efficiency Gains, Failing Business and Import Substitution Defences.

All merger proposals will promise cost savings in overhead expenses, duplication of facilities, etc. , but diseconomies of scale may also be present. Table 6 relates the size of RESERVEC and PEGASUS to the size of the U.S. vendors.

TABLE 6
SIZE OF NORTH AMERICAN CRS VENDORS (1986)

CRS VENDOR	ESTIMATED SEGMENTS BOOKED (MILLIONS)
SABRE	132
APOLLO	98
SYSTMEMONE	31
PARS	30
DATAS II	15
RESERVEC	14
PEGASUS	1

Source: Submissions to the Competition Tribunal.

The combined Gemini system would, therefore, be similar in size to DATAS II, the smallest U.S. vendor. Given that data in Table 3 indicates that the minimum

efficient scale of operation is that of PARS, the economies of scale argument in favor of the merger appears justified.

The efficiency gains have been 'rediscovered' in the recent antitrust literature (see Williamson, 1988). Ideally, improvements in efficiency should lead to a reduction in prices. Even if the prices go up, however, there may be net efficiency gains. In simple terms, the net welfare effect of the merger depends on how much prices will go up as a result of inceased market power compared to the reduction in costs. Increased prices, and consequently, the reduced output lead to the usual loss of the consumer surplus. On the other hand, the economies of scale allow average costs to decline. The net efficiency gain or loss depends on both the shape of the average cost function and demand elasticity (Figure 1 and Table 7).

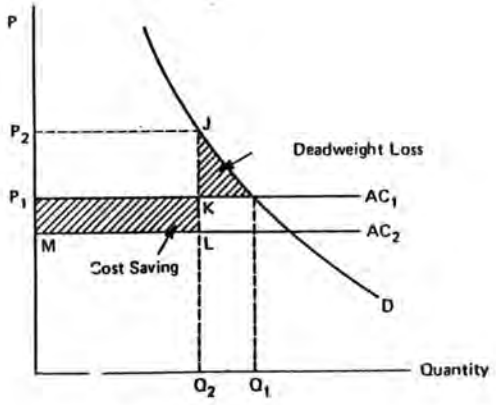


FIGURE 1

TABLE 7
PERCENTAGE COST REDUCTION SUFFICIENT TO OFFSET PERCENTAGE PRICE INCREASES FOR SELECTIVE VALUES OF DEMAND ELASTICITY

	ELASTICITY OF DEMAND			
(ΔP/P)*100	3	2	1	1/2
5	0.44	0.27	0.13	0.06
10	2.00	1.21	0.55	0.26
20	10.38	5.76	2.40	1.10

Source: Williamson(1979).

The data in Table 7 indicates that even relatively small reductions in costs would have to coincide with much greater increases in prices for the efficiency gains to be

negative. The issue of income distribution (consumer always lose when long prices go up), however, remains and may have to be considered in evaluating the merger.

Given that the CRSs do not have close substitutes, it is reasonable to assume that demand for their service is relatively inelastic and, therefore, the potential efficiency gains may be significant, even if the cost savings are relatively small.

In a dynamic sense, a merger may reduce the product rivalry between the firms. This type of rivalry has been very important in the CRS industry. The problem is that both present and future diseconomies related to product innovation are very difficult to estimate. However, should the actual and potential competition from the U.S. vendors be preserved, the effects of the merger on product innovation and dynamic efficiency are likely to be small.

The Competiton Act states that the merger might not lessen competition if one of the parties to the merger was about to fail (Section 65(b)). Both Air Canada and CAIL argue that Pegas was not viable in the long run.

PEGASUS entered the Canadian market in 1984, and between 1984 and 1987 established its systems in approximately 720 travel agencies. However, in the two years prior to the merger with RESERVEC, PEGASUS lost $15 million on gross revenues of approximately $3 million, and similar losses were forecasted in the future. Although, in addition to merging with PEGASUS had other options, namely teaming up with the American, PWA claims that the conditions of the proposed agreeement with SABRE were unsatisfactory. Under the proposed agreement, CAIL was to become a 'prime-host' on SABRE which did not give CAIL an equity position and, consequently, were inferior to that of Air Canada's offer.

The application of the competition policy faces a dilemma as to whether there have been alternative arrangements which could have allowed the economies of scale and preserve competiton at the same time. The Director in his submission speculates that there were other viable options:

"In additon to SABRE option, there are a number of other possible joint ventures that would be less anticompetitive than the current proposal. SYSTEM ONE, for example, has recently concluded a deal with the AMADEUS group in Europe while APOLLO is involved in the GALILEO consortium. CAIL, together with PEGASUS, would be an attractive joint venture partner".

Since those transactions were not considered, there is no information on how attractive such an arrangement might have been. (The 'import substitution' defence clearly indicates that the application of competition policy should help the domestic industry in dealing with foreign competitors, if such dealing do not come at the expense of the consumers. By closing the GEMINI option to PEGASUS, the competition authorities would put CAIL in a weak bargaining position with other vendors .)

The slow growth and low profitability of PEGASUS resulted, at least in part, from the anticompetitive practices of Air Canada (such as denying 'direct access' RESERVEC system and refusing to pay for Air Canada's bookings done on PEGASUS). On the other hand, PEGASUS had superior information on the second largest carrier in Canada, which gave it an advantage over other systems.

Given that it practically impossible to simulate how the industry might have developed if the two systems had granted each other 'direct access', and alternative arrangements between PEGASUS, and other international vendors are subject to speculation on what their conditions might has been, it is probably best to exclude the 'failing' business defence arguments from the analysis.

The preference for the Canadian based CRS , however, can be justified using import substitution defence provisions of the Competition Act: "In considering whether a merger or proposed merger is likely to bring about gains in efficiency described in subsection (1), the Tribunal shall consider whether such gains will result

in (a) a significant increase in the real value of exports; or (b) a significant substitution of domestic product for imported products" (Section 68). It appears that, compared to PEGASUS-SABRE venture, or other similar ventures, the merger, by creating a stronger Canadian CRS, is likely to lead to import substitution in the meaning of Section 68(2).

4.4. The Impact on the Airline Industry and Effective Competition Remaining After the Merger.

One of the potential negative effects of the merger is increased cooperation between Air Canada and CAIL in the airline markets. Imperfect information is a market feature which reduces the likelihood of reaching and preserving cooperation between oligopolists. Information exchange may facilitate collusion by reducing uncertainty about rivals' actions. Some restrictions on traffic related information access, however, can be imposed. For example, carriers may be allowed access only to data on their own traffic. In addition, the notion that cooperation in some aspect of the business leads to collusion and inefficiency is incorrect as a generalization. There are many examples of firms engaging in cooperation in R&D and competing vigorously in other dimensions of the product or service (D'Aspremont and Jacquemin,1988). It is important, however, that the measures to preserve 'arms length' relationship between GEMINI and the carriers are taken. The carriers, as their submissions suggests to the Competition Tribunal, do not seem to object to that and insist that GEMINI will be operated as a separate entity.

The remaining competition in the industry depends on to what degree the U.S. CRS vendors can expand into the Canadian markets. If GEMINI is allowed to continue to refuse to provide 'direct access' to other systems, and other potential abuses (such as refusing to participate in and paying booking fees to other systems) are not eliminated, the merger will lead to a virtual monopoly in reservation systems in Canada and, therefore, should be disallowed under the provisions of the Competition Act. Such a decision, however, has to come with a cost, since the available efficiency gains would not be captured. Given that barriers to entry facing the U.S. vendors are related to the conduct of GEMINI, the question is whether it is possible to design policies that would preserve effective competition in the market and at the same time allow the economies of scale to be exploited.

5. Policy Options

Policy considerations should include the possible effects on both the CRS industry, and on competition in the airline markets.

One of the often suggested options is divestiture. Divestiture of CRS from airlines would eliminate the anticompetitive effects of CRSs on the airline industry. However, because of the presence of economies of scope between the internal airline reservation systems and CRSs divestiture would likely increase the overall cost of reservation. Divestiture option also does not resolve the problem of market power in the CRS industry itself and would have to be supplemented by regulation of booking fees. This system would likely introduce all the usual inefficiencies of price regulation.

It is sometimes suggested that divestiture should lead to the creation of the industry wide system in which all airlines would participate (Gillen *et al.*,1988). This option has the following limitations: First, it may be difficult to agree on the distribution of shares. Second, the benefits of Schumpeterian competition whereby reservation systems compete by providing new features would be lost.

In proposing policies towards CRSs, we shall assume that these policies cannot solve all the problems of the airline industry that originate from duopoly. The policies towards CRSs should ensure, however, that vertical integration in CRSs does not increase market power beyond the level already enjoyed by the airlines. The policies

proposed in this paper are designed to satisfy the following objectives: First, the realization of the potential efficiency gains related to economies of scale. Second, the preservation of the Canadian based and owned high-tech industry. Third, the preservation of effective competition in the CRS industry.

The following policy package, in our view, satisfies these objectives:

1. The merger leading to the creation of the GEMINI system should be approved on the grounds of potential efficiency gains. As a condition of granting approval to the merger, the following constraints on the conduct of CRS in Canada should be imposed:

2. Airline booking fees should be disallowed. This would force the vendors to recover their cost from travel agent's subscription fees which would include a fixed equipment and service charge and a variable component related to the number of bookings. Such a policy would prevent airlines from using booking fees to raise their rivals' costs. It would also ensure that Air Canada and CAIL will not use the strategy of refusing participating in and consequently paying booking fees to SABRE. (This strategy was used by RESERVEC in the past when Air Canada refused paying fees to PEGASUS.) Such conduct is very difficult to deal with under the provisons of the Competition Act which bans refusal to sell, but cannot force an unwilling party to buy a service. In addition, the CRS vendors are not as strong in relation to travel agents as to other airlines. This is because it is easier for the travel agents to switch the vendors than for the airlines not to participate in the major CRS. Furthermore, given that most travel agencies bookings, including those through SABRE, are on Air Canada and CAIL, the two carriers prefer the travel agencies to use GEMINI to other systems. The carriers, therefore, have an incentive to increase the number of agencies using the GEMINI system, which is likely to put a pressure on the level of travel agents' subscription fees; assuming, of course, that SABRE and possibly other U.S. vendors remain viable competitors in Canada.

2. The length of the contracts between CRS vendors and travel agents should be restricted to a maximum of 2 years. In addition, liquidated damage clauses for early termination of the contract should be restricted to the expenditures incurred by the CRS vendor in setting up the system at the travel agent's location (e.g. labour training costs).

3. Travel agents should be allowed to subscribe to more than one system and travel agents' commissions should not be tied to their participation in GEMINI. The minimum-use clauses should be disallowed. In the absence of such a clause, agents can gradually switch to the alternative system, even before their contract with the original vendor expires.

4. Carriers should not be allowed to exchange information on each other's revenues and other relevant operational statistics. Airlines access to information generated by the CRS should be restricted to data on its own operations.

5. 'Direct access' should be granted by the GEMINI system to other vendors including SABRE. [7] If 'direct access' is allowed, SABRE, given its size in the U.S., could remain as a very effective competitor in Canada. [8]

6. Conclusion

This paper has examined the consequences of the recent merger between PEGASUS and RESERVEC computer reservation systems. On the positive side, the merger may lead to efficiency gains. On the negative side, the merger may raise entry barriers in the reservation industry and lead to the domination of a single reservation system. The proposed merger, therefore, addresses the fundamental dilemma of competition policy in a small country, which is how to reconcile the requirements of economies of scale and vigorous competition in the domestic market. Since, the possible negative effects of the merger are related primarily to the past and possible

future conduct of the Canadian CRS, rather than to the industry structure itself, the appropriate regulation of the conduct of CRSs may reduce or eliminate the negative effects of the transaction.

The trend towards consolidation and greater concentration is not a unique feature of the Canadian markets, but characterizes the trends in the industry world-wide. If one does not want to reintroduce a comprehensive price regulation, freeing trade and increasing the size of the relevant market appears to be the solution. Since trade in CRS services is free under the conditions of the Canada-U.S. Free Trade Agreeement, the elimination of firm created barriers facing the U.S. vendors should make them more effective competitors in Canada. The GEMINI system, rather than being a monopoly in Canada, would become a part of the broader North American market and could seek further expansion in the U.S. While one may still has misgivings about oligopoly, and excessive profits earned by the firms (see DOT study), the effect of the merger on the effective competition in the whole North American market will likely be small. The past growth and performance of SABRE in Canada suggests that with rules regulating the conduct of the CRS systems, the merger, while allowing for economies of scale to be realized, need not lessen competition unduly.

Endnotes

1. The same action was also requested by Wardair, City-Express, American Airlines, and the Consumer Association of Canada (CAA). CAA, however, stated that it would not oppose the merger if some constraints on the future conduct of the GEMINI system were imposed.

2. It is revealing that the airlines did not hide that creating CRSs was strategically motivated(R. Crandal, president of American Airlines has said: 'The preferential display of our flights, and corresponding increase in market share is the competitive *raison d'etre* for having created the system in the first place' ('Reservation Systems likely to be Disciplined' *Air Transport World*, 9,1983).

3. City Express claims that Air Canada refused to permit its RESERVEC management to display City Express flights operating in and out of Toronto Island Airport in the display availability for Toronto. The problem of this alleged bias has not resolved even after City Express became a 'hosted' carrier on RESERVEC (City Express, Submission to the Competition Tribunal, 1989).

4.The lack of precision in identifying the exact boundaries of the market, however, may not be a problem if one considers the reason for defining the relevant markets. The real issue is not whether the firms, or products are *in* the market, but what are the constraints on the ability of firms to increase prices, reduce quality or fail to innovate. Thus, market definition, which organizes the analysis, is a useful tool in assessing effects of mergers, but is not the end in itself Fisher(1983).

5. The above data provide a proxy of market shares. In its submission Air Canada suggested that a proper indicator of market share is the percentage of segment bookings. Unfortunately, such data is not available. Air Canada provided its estimate of the shares: 70% for RESERVEC, 7% for PEGASUS and 22% for SABRE.

6. Economies of scale may not be a barrier if an instanteneous entry at the minimum efficient scale is possible (Baumol *et al.*, 1982). When only small scale, gradual entry is feasible, the new entrant will experience a cost disadvantage versus the established firms.

7. In its submission to the Competition Tribunal, Air Canada states: "'last seat availability' is a resource over which GEMINI has a proprietary right. As such, it has value. Access to 'last seat availability' on Air Canada and CAIL is a matter for commercial negotiations between SABRE and GEMINI. SABRE has never directly approached GEMINI to commercially negotiate 'last seat availability'. The fact that

there has been no commercial negotiation or resolution does not constitute a barrier to entry" (sic). Exactly opposite is true. Barriers to entry are defined as cost that have to be incurred by the entrants but not by the incumbents. If an entrant has to buy 'last seat availability' from GEMINI, it implies cost asymmetry. The denial of timely and accurate information on Air Canada and CAIL's flights to SABRE has forced more of two thirds of its subscribers to instal RESERVEC terminals for the sole purpose of accessing information not available on SABRE (information based on submissions to the Competiton Tribunal). Such duplication is clearly wasteful and its cost will ultimately be paid for by the travelling public. It could be avoided if 'direct' access was granted to SABRE. In the U.S., where because of government regulation conduct determined barriers have been reduced, there is evidence of vigorous competition between the systems. For example, in 1986 1,107 of 8,022 (14%) agencies that renewed their contracts with CRS vendors switched the systems, which indicates that cross-entry may provide a mechanism to reduce at least some of the inefficiencies associated with high concentraction (DOT, 1988).

8. Since its entry into Canada, SABRE has created competitive pressure on RESERVEC both to reduce prices and to improve the features of the system. Thus, in January 1987, in response to competition from SABRE, RESERVEC reduced its booking fees by 30% (information based on the statement of ground and material facts submitted by the Director of Investigation and Research).

References

Baumol, W., J. Panzer and R. Willig (1982) *Contestable Markets and the Theory of Industry Structure* (N.Y.: Harcourt, Brace, Jovanovich).

Brenner, M., J. Leet, and E. Schott(1985) *Airline Deregulation* (Westport: Eno Foundation for Transportation).

Competition Act (1986), Ottawa: Minister of Supply and Services.

D'Aspermont, C., and A. Jacquemin (1988) 'Cooperative and Noncooperative R&D in Duopoly with Spillovers' *American Economic Review*, 78:5:1133-1137.

DOT (1988) 'Study of Airline Computer Reservation Systems' Washington DC, U.S. Department of Transportation.

Fisher, F., J.J. McGowan, and J.E. Greenwood(1983) *Spindled and Mutilated: Economic Analysis and U.S. v. IBM* (Cambridge: MIT Press).

Gillen, D.W., W.T. Stanbury and M. Tretheway (1988) 'Duopoly in Canada's Airline Industry: Consequences and Policy Issues', *Canadian Public Policy*, 14:115-32.

Jankowski, W.B.(1988), ' Market Contestability Theory and the Deregulation of Canadian Air Transport', in *Research in Changing Environment*, Proceedings of the 23rd Annual Meeting of the Canadian Transportation Research Forum, University of Saskatchewan Press.

Oster C. and D.H. Pickrell (1989), 'Code Sharing, Joint Fares and Competition in the Regional Airline Industry',*Transport Research, forthcoming*.

Williamson, O.(1979) 'Economies as an Antitrust Defence Revisited', in Calvani, T. and J. Siegfried, eds., *Economic Analysis and Antitrust Law* (Boston: Little, Brown and Company).

----------(1988) *Antitrust Economics: Mergers, Contracting, and Strategic Behavior* (N.Y.: Basil Blackwell).

A Methodology for Airport Economic Impact Studies

by
T.M. Mazerolle and Prof. B.G.Bisson
UNB Transportation Group

1.0 Introduction

An Airport Economic Impact Study investigates and quantifies the economic activity generated by an airport in a local economy. Traditionally, these studies have been undertaken to evaluate and promote the large capital investment necessary to expand airport infrastructure. Transport Canada has initiated a program which will ultimately examine the economic impact of all federally owned airports in Canada. The UNB Transportation Group has been contracted by Transport Canada to conduct pilot economic impact studies at Fredericton and Saint John. These will facilitate the development of a methodology applicable to federally owned airports in the Atlantic Region.

The primary purpose of an airport economic impact study is to measure the benefits which result from the establishment of the transportation facility; to quantify direct, indirect and induced benefits contributed to local, regional and provincial economies. The terms of reference for this investigation defines three levels of economic impact as follows:

Direct Impacts - are those attributable to businesses and organizations which gain some portion of their activity directly from the airport. They include those providers of services physically located on the airport site. The

economic activities are measured in terms of employment, revenues generated, expenses incurred and capital investment.

Indirect Impacts - are those activities in sectors which support the above direct activity.

Induced Activity - represents the increased household expenditures of those employed in the direct and indirect activity sectors.

2.0 Purpose

The economic impact studies (EIS) enable organizations concerned with the future role of Federally owned airports to:

1) Measure the level of economic activity attributable to each airport, demonstrating the importance of the airport to the local economy as a provider of employment, a generator of revenues, a consumer of goods and as a capital asset.

2) Account for all the benefits which can be expected from investments in airport infrastructure. Once the studies have been completed for all airports in the Atlantic Region, they could form a crucial evaluative tool when examining the merits of competing capital projects.

3) Demonstrate to the proponents of airport devolution the economic value of the airport, highlighting the need to ensure the future viability of smaller federally owned airports which provide valuable services to much of the Atlantic Region.

3.0 Objectives

This study seeks to satisfy several specific objectives, namely:

1) To establish an effective methodology for conducting Airport Economic Impact Studies (EIS) within the Atlantic Region. The approach will quantify direct, indirect and induced activity attributable to an airport's development and operation. The methodology will provide a measure of an airport's economic impact on the municipalities bordering the airport and on a province as a whole.

2) To produce economic impact studies for the federally owned airports at Fredericton and Saint John. The investigations will fulfill the defined purposes of EIS(s). In addition, these studies will serve as prototypes, facilitating the development of an effective general methodology.

3) To investigate the existence of any causal relationships which may exist between aviation activity and economic development within a region. Then, using these relationships, develop a time series model to predict the relative economic impact expected at each airport, given three defined growth scenarios: optimistic, status-quo, and pessimistic.

4) To examine the significance of the variety of socio-economic impacts associated with airport development, specific to the study area. If they are deemed significant, an attempt to quantify these impacts will be undertaken.

5) To consider and describe possible future trends of passenger and freight growth forecasts.

6) To produce a manual designed for use by Transport Canada's Airports Authority Group and local airport authorities to enable them to conduct Economic Impact Studies for all federally owned airports within the Atlantic Region.

4.0 Primary Data Collection

During this phase of the study the data necessary to evaluate the airports' direct economic activity was gathered for Saint John and Fredericton. The data describing the direct economic activity attributable to operations at each airport was assembled through a direct, personal survey of all on site operators. Data describing employment, expenses, revenues, capital investment and predicted future developments was gathered. A list of all on site businesses and organizations was prepared with the cooperation of each Airport Manager. Those contacted included:

- Air Carriers
- General Aviation
- Air Support Services
- Airport Operations and Administration
- Commercial Services
- Ground Transportation

The data collected includes the following:

1) Description of the businesses' activity, including: services provided, area served, reliance on the airport and relations with other businesses on the site. This data is vital for identifying the existence of business interrelationships, necessary to eliminate double counting.

2) Employment statistics describing the number of full and part-time employees including historical data if available.

3) Annual Expenses - Quantifying total annual expenses, identifying the portion spent on wages and salary expenses, and the percent of total expenses attributable to the airport related business activity. Quantification of expenses paid to on site operators, within the local economy, the provincial economy, and within/outside of Canada.

4) Revenue - gross annual revenue and the portion thereof attributable to airport operations. Identification of the source of revenue, ie. activity attributable to passenger traffic and that generated by cargo/general aviation activities. Geographic description of revenue sources: on site, local, provincial, national.

5) Capital Investment - the historical and replacement cost of all fixed assets expressly dedicated to airport related activity. Planned future capital expenditures were also identified, including their magnitude and timing.

6) Future Trends - optimistic, status quo and pessimistic estimates of future growth expectations, identifying critical factors influencing growth projections.

5.0 Evaluation of the Present Airport Activity

The objective of this phase of the investigation was to produce estimates of the economic activity attributable to each airport. The determination of these estimates had

three major thrusts. The first was development of a profile of the direct economic activity generated by the airport, measured in terms of revenue, employment, expenses and capital investigate. Special effort was made to eliminate double counting and to identify leakages (imports from outside the local economy). At the time when this paper was prepared, data collection was on-going and comprehensive results were not available. However some preliminary findings were available for Fredericton Airport and are presented in Table 1.

Table 1
Fredericton Airport Employment Results

Wages	Total Public Sector Private Sector		$4,736,000 $2,210,000 $2,526,000
Employment	Full Time	Part Time	Full Time Equivalent
Total	168	63	189
Private	116	63	131
Public	58	0	58

These very preliminary results show that Fredericton Airport is a very large contributor to the local economy, even if expressed solely in terms of the wages it contributes.

The second phase of quantifying the economic activity applies a model of the regions' economy to the direct activity in an attempt to estimate indirect and induced effects. Indirect activity is that attributable to businesses that support the above direct activity. The household expenditures of those employed in the direct and indirect activity sectors represent the induced activity.

A variety of methodologies exist for estimating the magnitude of these activity sectors, the most common include:

1) Regional Input-Output Models
2) Econometric Models
3) Economic Base Multipliers

6.1 Input-Output Models

Input-output models evaluate the economic transactions that take place within a local economy and offer some understanding as to how impacts in one sector are transmitted throughout the economy. (1:23) The models show how the output of each industry is consumed by other industries and sectors of the economy, while at the same time showing the inputs to each industry from other industries and sectors.

An input output table represents all inputs and outputs of all industries in the study area. A table of coefficients is developed showing the amount of inputs required from each industry to produce one dollar's worth of the output of given industry. These inputs represent indirect impacts as defined for this investigation.

For national input-output models, international trade forms a small portion of total transactions. In regional analysis, there is more specialization and exchange between regions, so that regional imports and exports account for a large proportion of the total transactions. In general, there is a lack of regional data, and especially accurate data on shipments of commodities and money flow from region to region. As a result input-output analysis at the regional level has been forced to rely on established national coefficients. The assumption that these are equal is not accurate as the national input

coefficients differ from the regional due to variations in industry mix and product mix.

To develop an input-output table for a region, precise data is required describing the imports and exports of each industry or sector in the region. An input-output model was developed for the Atlantic provinces in 1965. This constitutes the most recent available input-output data. This model was developed over a period of seven years at a substantial cost. To gather all the data necessary to update this model would be prohibitively expensive and time consuming. Therefore, input-output modeling is not the best method to estimate the indirect and induced economic impacts attributable to Fredericton and Saint John Airports.

6.2 Econometric Models

"An econometric model is an equation or set of equations with numerical values for parameters, describing the behaviour of some specific sectors of the economy or the economy as a whole."(2:357) They forecast aggregate variables such as income, employment and output. This type of model generally employs time series data and regression analysis to estimate relationships among economic variables. They are generally used for largely populated areas, often no smaller than a state (since most literature is from the U.S.).

Sophisticated Econometric models consider both internal and external sources of growth, but sophistication varies. Frederick Bell (1967) in his article "An Econometric Forecasting Model For A Region" uses 16 equations while Norman Glickman (1971) in his article entitled "An Econometric Model For The Philadelphia Region" uses 228. The more sophisticated model are usually for longer run representations of the economy (>5yrs).

On a regional basis the expenditure approach to econometric modeling where GNP=E=C+I+G+X-M, has limitations due to data. Employment statistics are generally available, but limited data is available on output and wages. If output is hard to obtain, then consumption is also, therefore, induced consumption cannot be calculated. The Income Approach (GNP=NI+D+IBT) has limitations due to the lack information on depreciation and/or indirect business taxes at a regional level.

The availability of time series data poses another problem for the development of econometric models. The more sophisticated the model ie. the greater number of variables, the greater number of observations needed to obtain statistical accuracy. More historical data allows more opportunity for the economy to have changed and thus linear and log-linear specifications may lead to biased estimates.

Econometric models are very useful for a large regional or national study area, but when the impact of an airport the size of Fredericton (or Saint John) is observed it is only reasonable that the study area be much smaller. Data constraints remain the major drawback. Given the information available and the size of our study area, the Economic Base Model was recommended over econometric modeling.

6.3 Economic Base Multiplier

The economic base model can be characterized as a highly simplified general equilibrium model of a local economy. It assumes that the economy is initially in equilibrium and describes a new equilibrium position after an exogenous change has been transmitted through the system (1:10).

The general equilibrium model referred to above has been described by Keynes. It develops a relationship

between the national level of aggregate demand and the level of national income. It demonstrates how a change in aggregate demand will cause a change in the level of national income.

A change in the factors that influence autonomous spending will cause a change in the level of aggregate demand spending. If the level of autonomous spending increases there will be a flow of income to the domestic factors of production. The flow of income will raise the national level of income and induce additional rounds of spending. The income earned in each round of spending is subject to leakages from the system due to other demands such as savings and imports. The process of respending continues until the available income for respending has been reduced to zero by the leakages. The national income then exceeds the initial change in autonomous spending or demand because of this multiplier effect (5:5).

The multiplier and the process of respending can be modelled using a geometric progression where:

$K = 1/(1-b)$

b = share of each extra dollar of income spent on domestic output (5:6)

The economic base model applies the theory of the general equilibrium model to a local region. Exports then include the sale of goods and services to the rest of the nation as well as to the rest of the world. The same applies for imports (5:7). The derivation is widely accepted which concludes:

$k = 1/(1-(b-m)(1-t))$.

where k = the marginal propensity to consume locally

b= marginal propensity to consume

m= marginal propensity to import

t= marginal tax rate

Detailed information would be needed to use the economic base multiplier in this form. Since this information is not readily available, it is usually assumed that the marginal propensity to consume is equal to the average propensity to consume and that consumption is proportional to income. The multiplier then becomes

$$k = 1/(1-(\text{local consumption}/\text{total consumption}))$$
$$k = 1/(1-(\text{local income}/\text{total income}))$$

since basic income = total income - local income

$$k = \text{total income}/\text{basic income}.$$

Employment, as a proxy for income, is the most frequently used unit of measurement for the economic base multiplier. The labour force for the economy is divided into basic and non-basic sectors with the unemployed labour force being added to the basic sector. The two sectors are commonly split using employment location quotients. These quotients compare the concentration of industry employment in a particular region with that of the nation. If the location quotient is greater than one, the region is an exporter for that commodity. Location quotients less than one indicate that the region is not satisfying its domestic requirements and must import. The basic sector is composed of exporters and the non-basic of importers.

The advantages of using employment as a measurement of the two sectors are the available data and the fact that employment multipliers are often requested for an impact analysis. The disadvantages of the multipliers are that the ratio of employment to income is neither constant nor stable over time and that total jobs may make underlying changes in wage levels. Economic base

multipliers provide an accurate "snapshot" of activity for our study area. The analysis has not yet been completed to determine the actual multiplier, intuitive speculation by recognized experts suggest a multiplier of magnitude 1.3 - 1.5 for the two counties surrounding each airport. Completion of the multiplier calculation will allow for the quantification of all levels of economic impact: direct, indirect and induced.

7.0 Evaluation of Socio-Economic Impacts

This phase of the investigation involves an examination of the significance of a variety of socio-economic impacts attributable to airport development. A variety of impacts require investigation, including the following:

1) Airport Noise
2) Air Pollution
3) Air Safety
4) Ground Traffic Congestion
5) Land Use Mix
6) Locational Advantages

It appears doubtful that the quantifiable costs of these impacts are significant given the level of airport activity seen in the Atlantic Region. Some effort will be made to investigate each, looking for evidence that the impact may indeed be significant.

8.0 Conclusions

It is evident that assessments of the economic impact of small to medium size airports requires a different approach than methodologies currently available in literature. Much of the work which has been done in this field is oriented towards large airport hubs. The need for the research described in this paper is driven for the most part by Transport Canada's airport devolution initiative.

REFERENCES

1. Pleeter, Saul, Economic Impact Analysis: Methodology and Applications, Martinus Nijhoff Publishing, Boston, Mass., 1980.

2. Dornbush,R., Fischer,S., Sparkes,G., Macroeconomics, 2ed., McGraw-Hill Ryerson Ltd., Toronto, 1985.

3. Bell, F.W., "An Econometric Forecasting Model For A Region", Journal of Regional Science, Vol 7, No 2, 1967.

4. Glickman, N.J., "An Econometric Model for the Philadelphia Region", Journal of Regional Science, Vol 11, No 1, 1971.

5. Schwartz, H., A Guide to Regional Multiplier Estimation, prepared for the Government of Canada, Department of Regional Economic Expansion, Ottawa, ON, 1982.

Employment Trends and Wage Rates in the Trucking Industry

1. Introduction

Canada has become increasingly dependent on its trucking industry for the transportation and distribution of goods, both domestically and through transborder trade. By the beginning of the 1980s, the truck mode accounted for almost 60 percent of Canada's total freight transportation costs (up from 10 percent in 1950); in fact, productivity improvements in the trucking industry suggest that its output has grown at a rate even beyond what is implied by operating cost trends. With the exception of long-haul bulk commodity shipments, where rail and marine modes still command natural competitive advantages, trucking has become the dominant mode in most aspects of freight transportation.

In turn, the Canadian trucking industry is dependent on its labour force to keep goods flowing in a timely and efficient manner. Drivers, accounting for about 60 percent of industry employees (or 65 percent if owner-operators are included), constitute the core of the trucking labour force. Recently, trucking has begun to be affected by a shortage of qualified drivers; in the face of increased demand for trucking services, such a shortage may threaten the future stability and competitiveness of the industry. The alleged shortage occasioned the Atlantic Provinces Trucking Association, the Canada Employment and Immigration Commission and the respective Departments of Labour in the Provinces of New Brunswick, Nova Scotia and Prince Edward Island to jointly commission a study on the supply, demand and future requirements of truck drivers in the Maritime provinces. One of the study's findings was that the short term demand for qualified new truck drivers in the Maritimes is expected to exceed the available supply by approximately 2,000 to 3,000 drivers per year. A second study on driver shortages and related issues, but with a Canada-wide scope, has been commissioned by Employment and Immigration Canada.

The seriousness of the potential impact of a driver shortage on the trucking industry - indeed on the Canadian economy as a whole- warrants an examination of industry employment trends and wage rates, which is the objective of this paper. First, a background section on labour in for-hire trucking will provide a general idea of the magnitude of the labour force and the nature of its components, and will document the growth and productivity of trucking labour over the past twelve years. Next, the discussion will focus on wage rates at the disaggregate level, slicing the industry first by employee category, then by region/province. Cross-industry comparisons follow: trucking industry wages will be measured against those of other industries (both inside and outside the transportation sector)

competing for a common labour force. Finally, possible reasons for the shortage will be put forward, facilitating the generation of potential remedies.

2. Employment Trends

Due to the nature of the trucking industry, it is difficult to isolate exactly how many employees work for the industry and how much is expended by the industry for their compensation. To begin with, the size of the private trucking sector (hence the size of its corresponding labour contingent) is virtually unknown. Although Statistics Canada surveys annually those private operators which run fifteen or more commercial vehicles and which are identified in provincial motor vehicle registration files, a special 1983 survey revealed that, on an operating expense basis, private operators with fleets of five to fourteen vehicles were almost twice as large as the regularly surveyed operators. Moreover, the status of operators having less than five vehicles is entirely unknown.

Statistics Canada's coverage of the for-hire trucking industry is more complete (covering carriers earning revenues of $100,000 or more, and accounting for 97 percent of total employee compensation), but classification problems still arise. For example, brokers (who, by means of owned or leased vehicles, haul freight for carriers) certainly account for a major share of labour in the trucking industry, yet are not included in the survey employee counts. Payments to brokers are itemized, but the labour cost component is not differentiated, and probably represents only about one-quarter to one-third of these payments. (The remainder can be allocated to equipment costs, supplies and fuel.) Also, as of yet, the number of brokers utilized is not documented, although provisions have been made to remedy this omission in future surveys. In addition, a small indirect labour component is associated with purchased services (e.g. piggyback), but is addressed in the survey only through a "purchased transportation expenses" category.

Bearing in mind the statistical limitations associated with the labour component of trucking, much of the present discussion on industry labour centers on data collected by Statistics Canada in its survey on the for-hire trucking industry structure (i.e., Motor Carriers-Freight and Household Goods Movers Survey, Catalogue No. 53-222). Drawing on this source, Exhibit 1 shows the number of employees from 1975 to 1986 in each of four employee categories: equipment maintenance and garage; terminal and platform; sales, tariff, advertising, administrative and general; and drivers (including supervisors and helpers). Total employment increased by about 20 percent (from 81,300 to 97,300) over the twelve year period. A noticeable decline is apparent throughout the recession years (1981 to 1983), with pre-recession levels not being recovered until 1985.

Looking more closely at the individual employee categories, the number of sales and administration employees increased dramatically by 64 percent (from 11,600 to 19,000), the number of drivers

increased by 17 percent (from 48,000 to 56,500), the number of terminal and platform employees increased by only 6 percent (from 13,300 to 14,100), and the number of maintenance and garage employees actually decreased by 8 percent (from 7,600 to 7,000). The rate of increase in administrative/clerical employment more or less kept pace with the rate of revenue growth (in real terms) – a proxy for industry output – despite the advances in office technology over the time period concerned. Driver employment did not keep pace with industry output because brokers gradually replaced some drivers over time, and also because more liberal weights and dimensions regulations coupled with advanced truck size technology allowed for the transport of a greater volumes of goods in a single trip. The influx of owner-operators, who are responsible for maintaining their own vehicles, probably also accounts for the decline in equipment maintenance and garage employees; further, more carriers seem to be contracting out maintenance duties and taking advantage of full-service leasing plans.

Along with labour force size, it is important to have some perspective on the industry's wage bill. Total employee compensation increased from $2.0 billion (in 1986 dollars) in 1975 to $2.7 billion in 1986, an increase of 37 percent against the 20 percent increase in employees cited earlier. Wage and salary expenses are broken down by employee category in Exhibit 2. Despite a decline in their percentage share of total operating expenses, driver expenses increased considerably over time (even in constant dollars) and still constitute by far the largest wage/salary component. Wage and salary expenses related to maintenance and garage operations remained fairly constant in magnitude, but declined in their relative share of operating expenses. Those expenses related to terminal and platform operations increased marginally in magnitude but still declined in share. The largest constant-dollar increase over this period was observed for sales, administrative and other general purpose employment.

The extent of the reversal trend affecting brokers and company drivers is clearly shown in Exhibit 3. Here payments to brokers and driver wages/salaries are plotted as percentages of total operating expenses. While the sum of broker and driver compensation has increased only slightly as a proportion of operating expenses, the driver share has declined from about 25 percent to 17 percent, whereas the broker share has increased from 10 percent to over 20 percent. Carriers have increased their reliance on owner-operators, who provide not only more flexible (and often more cost-effective) operating arrangements but also a source of capital.

There are definite regional differences in the use of brokers. Brokers are used extensively in Atlantic Canada and the west, and less so in Quebec and Ontario. The degree of broker usage depends on regional operating practices which have developed through local traditions or through the examples of leading carriers in the area. In Atlantic Canada, for example, major general freight carriers caught on early to broker utilization and embraced the concept keenly. Broker usage can also be affected somewhat by the type of carriage: certain commodities (e.g. forest products) are less "service sensitive" than are

types of pick-up and delivery operations for which scheduling is a high priority.

In the absence of reliable data on industry output (e.g. tonne-kilometers), average revenue per employee can be used as a proxy for labour productivity. According to this measure, labour productivity appears to have improved significantly: adjusting for broker expenses, revenue per employee rose from about $58,300 (1986 dollars) in 1975 to about $72,500 in 1986, an increase of about 23 percent. Distance driven per driver is another labour productivity measure, this time pertaining specifically to drivers. Average driver distance increased from about 62,000 kilometers in 1976 to almost 66,000 kilometers in 1986, an increase of about 6 percent over the eleven year period.

In Exhibit 4, the percentage change in distance per driver between 1976 and 1986 is broken down by region/province and compared to similar changes in wages per driver and driver cost per kilometer. Some surprisingly dramatic changes are revealed through this exhibit. Average driver distance has improved by 12 percent in Atlantic Canada and as much as 19 per cent in Quebec, as compared with the more modest national average increase of 6 percent. In Ontario, where recently the average distance per driver tended to be the lowest in the country, there has actually been a 2 percent decline. Although the lower average can be attributed to a greater share of local and short-haul traffic in that province, the decline over time may well be sign of productivity erosion.

Taking into account the constant dollar driver wage increase of 10 percent over this period, driver costs per kilometer appear to have increased by 12 percent in Ontario. The same comparison of changes in travel distances and wages reveals increases in driver cost per kilometer of 5 percent and 3 percent in Atlantic Canada (despite significant improvement in distance per driver) and the west, respectively. The 5 percent decrease in Quebec is probably indicative of improved driver utilization, as well as relatively modest wage increases.

3. Wage Trends

Having obtained some conception of the numbers of employees involved in for-hire trucking and the amounts expended by the industry for the compensation of these employees, it is useful to relate these two elements by exploring trends in wage rates. The average wage trends over time in the for-hire trucking industry is shown in Exhibit 5, from which a considerable increase (15 percent in constant dollars) is discernable. The average industry wage in 1975 was $24,400, rising to $28,000 in 1986. While pre-recession wages increased at a rapid rate (leaping almost 17 percent between 1975 and 1981 alone), constant dollar wages predictably dropped during the recession and have yet to recover to peak pre-recession levels.

Relative wage indices for the various employee categories are shown in Exhibit 6. Driver wages stood consistently above the industry

average and peaked during the recession years of 1980 and 1981 when wage rates for other categories declined (at least relative to the average for-hire trucking industry wage) with increasing levels of unemployment. The "sticky" tendency displayed by driver wage rates during economically poor conditions is perhaps due to the higher level of skill and the more stringent training requirements expected of drivers in comparison to employees in the other categories. Long term union contracts could also be a contributing factor.

The highest paid employees in the industry are maintenance and garage employees; the average earnings in this category appear to have been increasing relative to other types of employment in trucking, particularly since the last recession. Wages in terminal and platform operations also experienced a dramatic increase throughout the 1980s; however, as previously mentioned, the percentage share of total operating expenses allocated to the compensation of employees in this category has declined sharply, due to the decline in the percentage of terminal and platform employees in the for-hire trucking work force. For both maintenance and terminal employees, increases in average earnings could be indicative of a "shedding" of employees at the unskilled end of the scale or, alternatively, of true increases in productivity which may have been passed on to employees.

Wages for sales and administration related jobs were above the industry average in the mid-1970s, but fell behind considerably during the recession. They recovered slightly thereafter but, more recently, they represent the lowest job category in the industry. It is interesting to observe that while the largest employment gains were achieved in the sales and administration category, relative wages declined, possibly due to a "deskilling" process, directly opposite to the "shedding" process referred to in the case of maintenance and terminal employees. With respect to clerical labour, "deskilling" may have been facilitated by the widespread use of office automation.

Wage differentials between major job categories in the trucking industry appear to be within 10 percent of the average. As observed in Exhibit 7, however, regional variations are more significant. Wages in Atlantic Canada have been 20 percent to 30 percent below the national average, the difference peaking before the recession and narrowing somewhat since. The highest wages are observed for Ontario and the western provinces, the latter representing the highest wages in the early 1980s despite the severity of the recession in that part of the country. Wages in Quebec appear to have caught up with the national average just prior to the recession but have been lagging behind since by a 5 percent to 8 percent differential.

Industrial aggregate wages for each region are related by trends similar to those observed with respect to trucking, but the regional differentials are far less pronounced for aggregate wages, and have been consistently narrowing over time (e.g., Atlantic Canada was only 8 percent below the national average in 1986, as opposed to 25 percent in the Exhibit 7 scenario). The extreme regional contrasts in the trucking industry are largely due to local labour market

conditions, but could also arise from other factors. For example, the Atlantic provinces rely heavily on owner-operators, the competition from which may exert downward pressure on company driver wages. While western provinces are also heavy users of brokers, their influence could be offset by the protection of strong unions.

4. Cross-sectional Comparisons

Intra-industry wage comparisons are useful for gaining insight into trends at the regional and employee category levels; to obtain a broader perspective on for-hire trucking wage rates, however, these rates should be measured against wages in other industries. In the case of cross-industry comparisons, all wage rates, except those pertaining to the trucking industry, are taken from Statistics Canada's Employment, Earnings and Hours, Preliminary Data (Catalogue No. 72-002). The trucking industry wage rates are again derived from the Motor Carriers – Freight and Household Goods Movers Survey, both to preserve continuity with intra-industry comparisons, and to take advantage of the more accurate results yielded by the trucking survey's broad coverage.

Before presenting the results of the cross-industry wage comparisons, a few discrepancies between the two sources should be brought to attention. First, employee compensation figures in the for-hire trucking industry survey incorporate payments made by employers for the future benefit of the employees (e.g., employee welfare and pension funds, workmen's compensation funds, unemployment insurance). Such payments are excluded from the wages cited from the employment survey, meaning that, in the comparisons that follow, trucking industry wages are slightly overstated. Second, in 1983 the employment survey frame was restructured and expanded from large firms only to firms of all sizes. Any anomalies resulting from this change may affect industry wage statistics, but naturally would not alter the trucking industry statistics derived from another source. Finally, broker wages are probably included in the truck transportation wages presented in the employment publication but, as mentioned earlier, are excluded from the for-hire trucking industry survey wage data (which is the source used in this paper). In fact, the former wage rates decreased by 11 percent (constant dollars), as opposed to the 15 percent increase undergone by the latter; broker wage effects could possibly explain this difference in direction.

In Exhibit 8, industrial aggregate wages are compared on an index basis to truck transportation wages. For-hire trucking wages remained above the industrial aggregate level for the entire twelve years covered by the exhibit. When the trucking industry is segmented by employee category, the wages of even the lowest paid category (terminal and platform) at the lowest point in the time series (1975) exceed the industrial aggregate wage for that year. In general, the gap between trucking industry and industrial aggregate wages widened over time from 6 percent in 1975 to 19 percent in 1986; the recession had only a very minor impact on this trend.

For-hire trucking wages were generally comparable to those of the overall transportation industry, as can be observed from Exhibit 9. Transportation wages in the aggregate exceeded trucking wages by about 8 percent early in the twelve-year period; breaking out of the recession in 1984, trucking gained a 5 percent edge, which has since narrowed to 3 percent. However, when specific transportation industries are isolated - in particular, those industries likely to attract that portion of the labour force from which truck drivers could be recruited - trucking wages emerge at the low end of the scale, especially in the post-recession years. As is apparent from Exhibit 9, trucking wages were strong early in the recession relative to wages in rail transportation, intercity/rural bus transportation and urban transit. Towards the end of the recession, however, trucking industry wages were surpassed. The resilience of rail wages in the face of an economic downturn reflect that rail traffic is less susceptible to business cycle effects than is the trucking industry, and may also be due in part to the protection afforded by economic regulation.

Rail and urban transit wages follow a similar pattern in relation to trucking wages. Both industries had wage levels above the trucking industry level in 1975 (8 percent for rail; 13 percent for urban transit). At the start of the recession, wages dipped to just below or just above the trucking industry level, then surpassed this level by 14 to 15 percent by 1986. Bus industry wages followed a somewhat different pattern. During the middle and late 1970s, bus wages were noticeably low relative to those of trucking (falling as much as 20 percent below the trucking level in 1979); substantial gains were made during the recession, however, and by the mid-1980s, bus and truck wages were virtually on par.

The final exhibit (Exhibit 10) provides some indication of the status of wages in for-hire trucking as measured against wages in non-transportation industries; for example, construction, forestry and mining. Both construction and forestry wages suffered a downward turn relative to trucking wages near the end of the recession. Construction wages dropped drastically, plummeting from 41 percent above the trucking average in 1975 to 3 percent below in 1986; the decrease in the forestry wage was more moderate (from 23 percent above the trucking wage in 1976 to 5 percent above in 1986). Although wages for mining wages dipped slightly relative to trucking during the recession, they were, on average, 27 percent higher than trucking wages over the twelve year period concerned. From 1982 onward, they hovered at a margin of 34 percent or greater over for-hire trucking industry levels.

5. Conclusion

The preceding paragraphs on the comparison of trucking industry wage rates (which are shaped by the high percentage of drivers) to those of other industries competing for a common labour force provide part of the picture in understanding why there might be a truck driver shortage. For a more complete outlook, however, it is

necessary to consider the qualitative conditions affecting the work environment.

One of the least attractive aspects of intercity driving is the long hours of work expected of drivers and, indeed, almost necessary to earn a reasonable living. In the context of most other occupations, the terms of the new "hours of service" regulation (i.e., driving 13 hours in any 15 hour shift, 60 hours maximum in seven days, 70 hours in eight days and 120 hours in a 14 day cycle) would seem excessive; that these terms impose a limitation on far more grueling schedules (e.g. completing the 22-hour Halifax to Toronto run virtually non-stop) attests to the level of stamina demanded by the industry. Hand in hand with long hours of work go side-effects such as physical exhaustion and long absences from the home base. Other factors which should be acknowledged in accounting for the alleged driver shortage include: lack of fringe benefits; lack of advancement opportunities and incentive programs; stress from having to meet stringent time deadlines under adverse conditions; and pressures of coping with increased traffic congestion in urban settings.

One general conclusion which can be drawn from this overview on employment and wage rate trends in the trucking industry is that examining the entire Canadian trucking industry at an aggregate level often masks important details. The disaggregate analyses, both at the employee category level and at the regional/provincial level, reveal trends in various segments of the industry which are not picked up at the national industry level. Another point which emerges from the discussion is that, although wages in the trucking industry are above industrial aggregate levels, they are lower than those in other specific industries sharing a common labour base with trucking. In addition, driver working conditions, particularly the long hours associated with intercity driving, leave much to be desired. These issues, and others covered in the paper, provide a preliminary framework for confronting the potential driver shortage which could have serious impact on the stability of the Canadian trucking industry.

Exhibit 1
Employees by Type
For-Hire Trucking in Canada

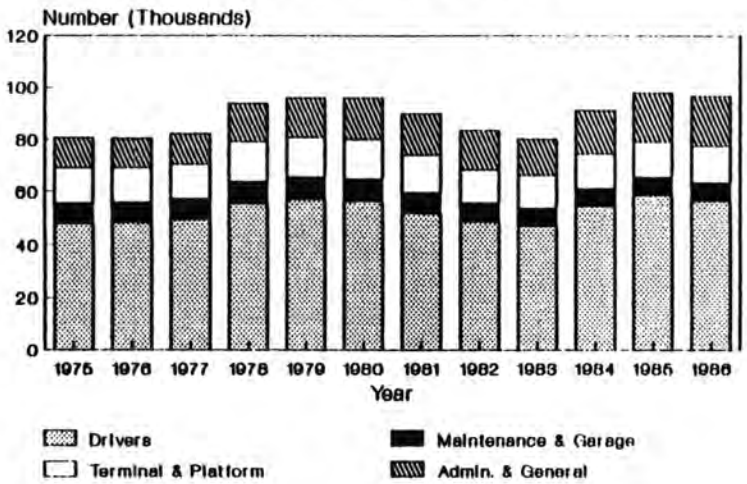


Exhibit 2
Wage and Salary Expenses
For-Hire Trucking in Canada

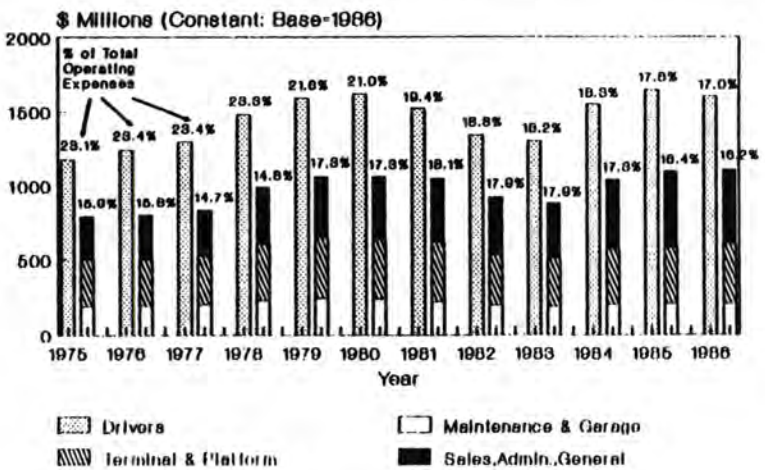


Exhibit 3
Broker and Driver Wage/Salary Expenses
For-Hire Trucking In Canada

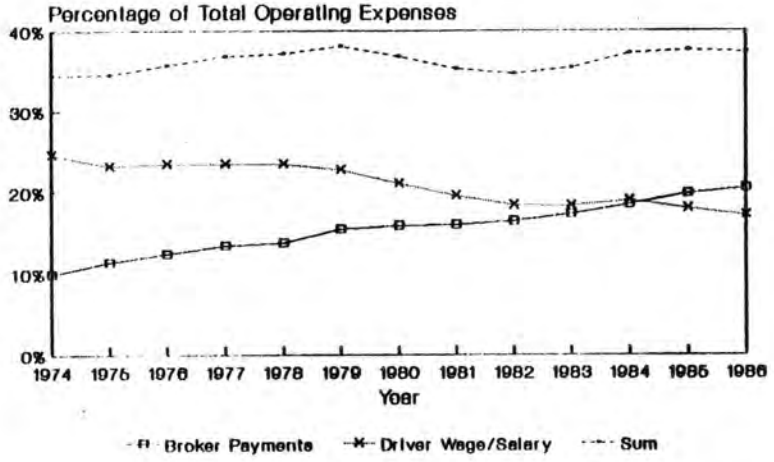


Exhibit 4
Driver Utilization and Cost Comparisons
For-Hire Trucking By Region

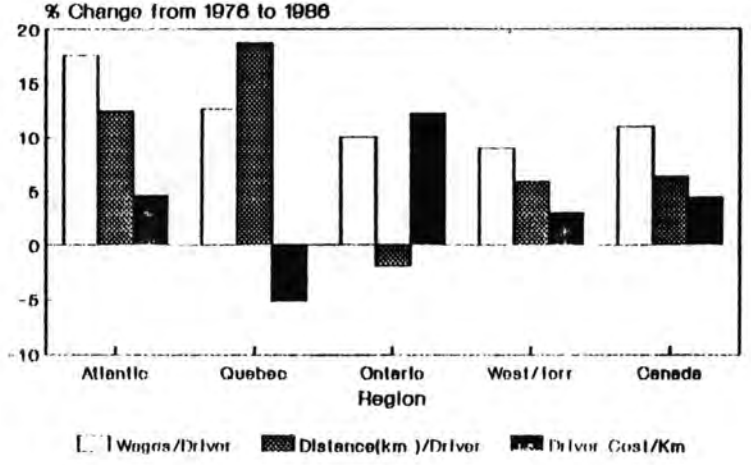


Exhibit 5
Average Wages per Employee
For-Hire Trucking in Canada

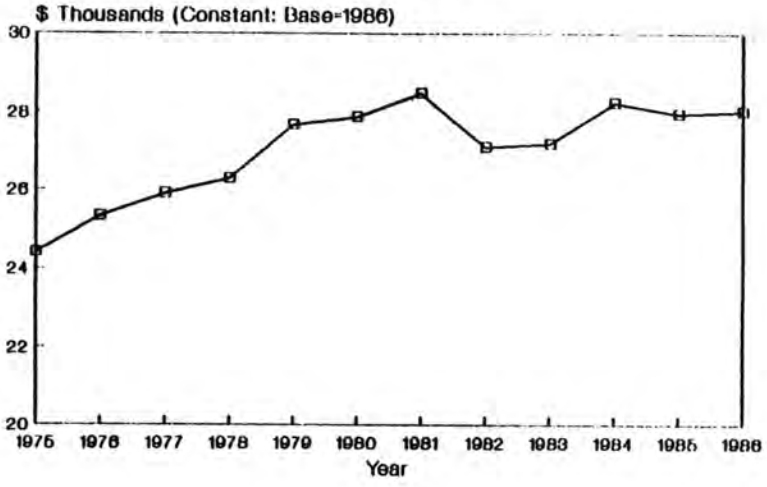


Exhibit 6
Employee Category Wage Variations
For-Hire Trucking in Canada

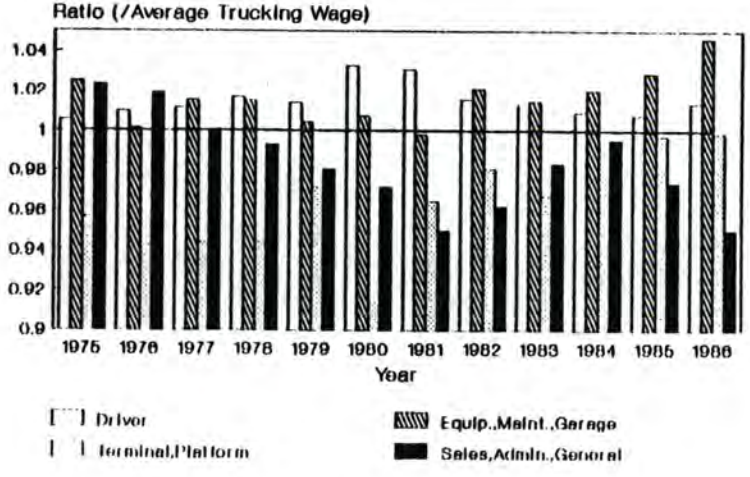


Exhibit 7
Trucking Industry Wage Variations
For-Hire Trucking By Region

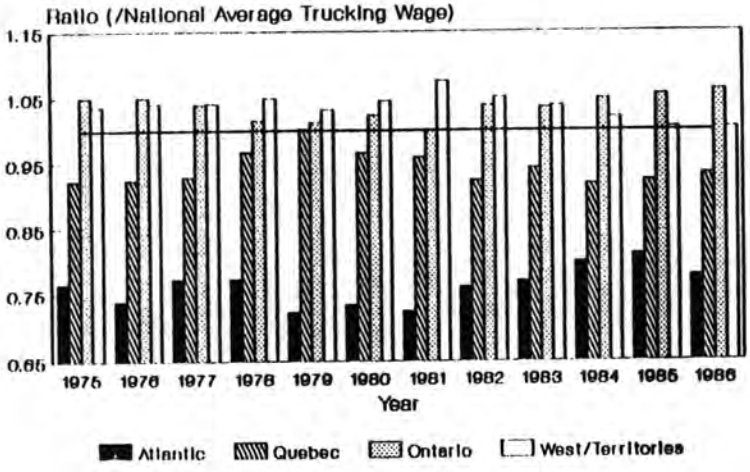


Exhibit 8
Comparison of Industrial Aggregate Wage
to Average Trucking Industry Wage

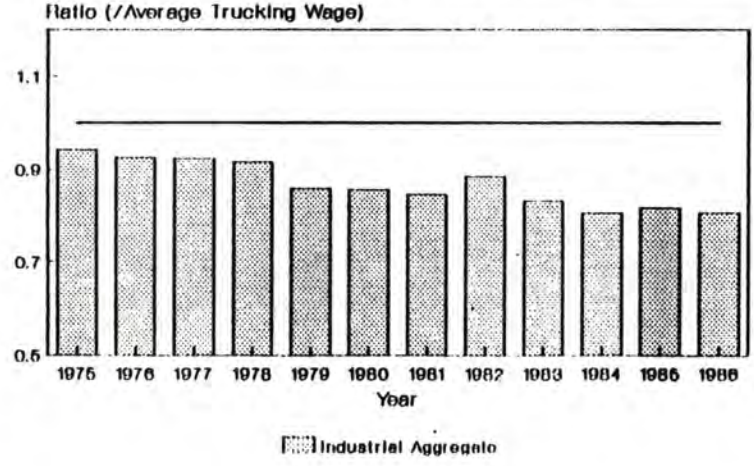


Exhibit 9
Comparison of Transportation Wages
to Average For-Hire Trucking Wage

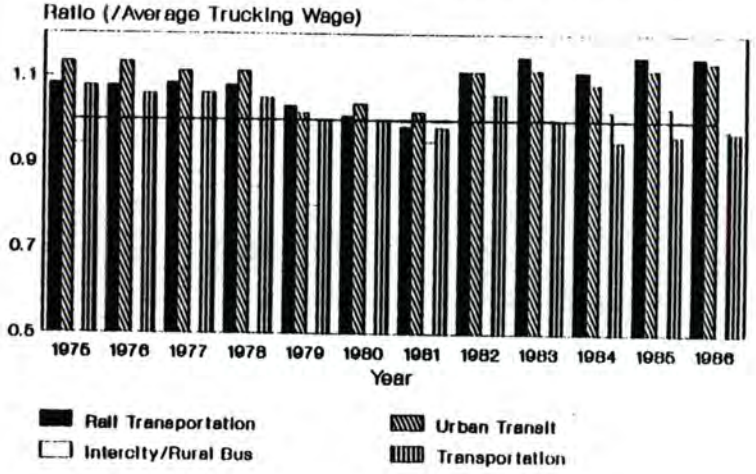
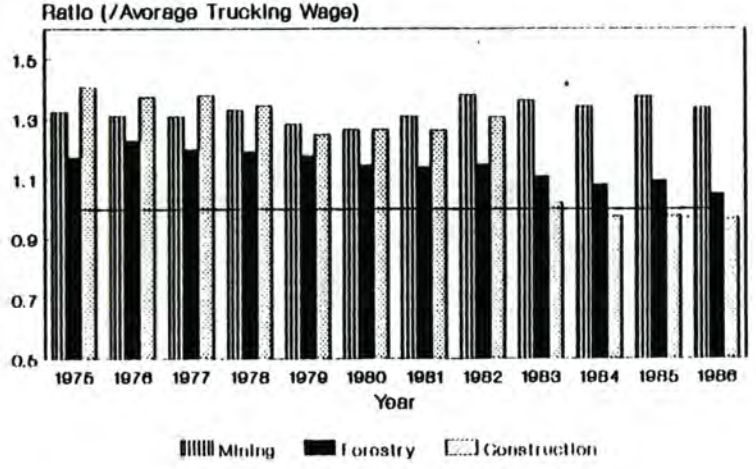


Exhibit 10
Comparison of Wages in Other Industries
to Average For-Hire Trucking Wage



EXECUTIVE M.B.A. PROGRAM FOR TRANSPORTATION MANAGERS

by
William D. Taylor
Concordia University

Introduction:

For many managers interested in transportation, traditional Master of Business Administration programs often do not provide the type of education, or focus related to transportation issues, they desire. In recent years, a new type of M.B.A. program has emerged which allows experienced managers to obtain an M.B.A. degree in two years while still working full time. The purpose of this paper is to explore the concept of an Executive M.B.A. (EMBA) delivery format, and to explore its relevance for those managers working in the transportation area.

What is an EMBA?

An Executive M.B.A. program is an academic program leading to a full M.B.A. degree designed specifically for individuals who have significantly more managerial and professional experience than do students in traditional full time or even part-time M.B.A. programs. Most programs have as their educational goal the development of their students as general managers. EMBA students do not quit their jobs, but rather complete their entire M.B.A. program in two years while working full time. Usually program participants are endorsed by their companies who pay all, or a portion, of their fees during the program. Students attend classes one full day per week with the most typical schedule being alternating Fridays and Saturdays.

The Growth of EMBA Program:

The demand for EMBA programs stems from the fact that there are many managers, and professionals, who did not pick up an MBA degree, or other formal training in management, earlier in their careers and who have now advanced to positions where the knowledge, theory and techniques covered in a graduate management program will enhance their development as general managers. Others feel insecure competing in organizations or business with individuals who do have M.B.A. degrees.

No matter what the impetus to return to formal studies in management, experienced managers can face serious problems in

returning to university to complete an M.B.A.. Traditional delivery formats require managers to either quit their jobs, take a two-year leave of absence, or attend evening classes for periods of up to six or seven years. These options can be very unattractive given the opportunity cost of lost wages, or the uncertainties of entering a long term study program when transfers and moves can disrupt course completion. In addition, many experienced managers can feel uncomfortable in classroom environments where the majority of students have little practical background and have recently completed undergraduate studies.

While Executive masters programs have a long history in the United States, the first program offering weekend classes for managers who were working full time with a two-year completion period was initiated at the University of Chicago in the late 1940's. The number of programs in the United States grew very slowly until the late 1970's; however during the 1980's many new programs have been started. Currently, there are approximately 95 EMBA programs in the U.S..

In Canada, the University of Toronto launched the first EMBA program in 1984 with Concordia University following as the second program in 1985. Although at present these are the only EMBA programs in Canada, several schools are in the process of studying the feasibility of establishing such programs and it is likely that another four or five business schools will be offering EMBA programs within the next three years. Universities are attracted to EMBA programs because of the revenues that can be generated by these programs and also because of the opportunities provided for faculty to work closely with more seasoned executives.

How Does an EMBA Program Differ?

A critical point should be made before any review of the differences between EMBA delivery formats and more traditional programs. Graduates receive the same Master of Business Administration degree that students enrolled in other types of delivery formats do. They cover the same core areas and usually complete the same number of credits as other M.B.A. students.

While the content of EMBA programs is similar to regular MBA programs, there are many differences with respect to participants and the process by which students study and learn. EMBA students are older and have significantly more experience than students who study full time for M.B.A. degrees. In the United States, the average age in traditional MBA programs is around 28 while that of entering EMBA students is 36. These averages correspond to that of Canadian M.B.A. and EMBA programs as well. For example, at Concordia University the average age of the September 1988 entering class was 38.1 years, and over the last four years the average age has ranged from 36 to 39 years. Interestingly, it is not unusual at Concordia to have 2 or 3 students over 50 years of age and to have many students in each class be over 45.

The amount and diversity of the experience and backgrounds found in EMBA classes is also impressive. A typical EMBA class will have a number of engineers, accountants, marketing managers and computer specialists, but will also have company presidents, divisional managers, entrepreneurs, and managers from the not-for-profit sector. Educational backgrounds also show great diversity. Backgrounds range from those who hold Ph.D's and master degrees to a few individuals who do not have formal university training at all.

Admission criteria for most EMBA programs have age and work requirements which are more severe than those of regular programs. Table 1 presents a recent survey of 91 Executive MBA programs (1) which reveals that work experience was the most frequent entrance requirement of EMBA programs.

TABLE 1

EMBA ADMISSION CRITERIA

CRITERION	% OF PROGRAMS
WORK EXPERIENCE	86
LETTERS OF RECOMMENDATION	79
MANAGERIAL EXPERIENCE	72
GMAT (APTITUDE TEST)	66
CORPORATE ENDORSEMENT	65
INTERVIEW	62
UNDERGRADUATE DEGREE	57
POSITION DESCRIPTION/RESPONSIBILITIES	55
WRITTEN ESSAY	55

Source: Annual Survey of EMBA Programs, EMBA Council, October, 1988.

EMBA faculty members are also quite special. The knowledge and experience of EMBA classes puts tremendous pressure on the faculty members who teach in these programs. There are many university business professors who are skilled researchers and well-educated, but lack the practical experience and pragmaticism necessary to gain the respect of seasoned managers. Most successful EMBA programs select faculty who not only have solid academic credentials but who are also able to relate to the needs of managers and professionals who are at about the same age. Somehow successful programs can get around the constraints that the university tenure system presents, and they select faculty who can combine both academic background with real world expertise. Often these faculty members are active in consulting in the areas they teach and have a good understanding of current trends and issues. In short, EMBA students are not intimidated by the mere presence of a professor with a Ph.D. degree, they demand relevance along with academic knowledge.

DIFFERENCES IN THE EMBA LEARNING PROCESS

EMBA learning processes are very different from traditional MBA activities in a number of respects. Time is the critical resource constraint in EMBA programs and this forces those designing curricula to tightly integrate and rationalize topics to be covered. In regular MBA programs, redundancy is not a critical issue. It really doesn't matter a great deal if techniques such as discounted cash flow analysis are taught in more than one course. If anything, there is a certain degree of reinforcement of concepts that takes place. Executive programs do not have that luxury and all material to be presented must be coordinated and integrated into a total framework. Thus, EMBA students follow a tight, locked-step sequence of courses and usually move through the entire program as a unit.

The amount of experience existing in EMBA classes means that students often learn a great deal from each other. No matter what the subject matter, there is usually a student in the class who knows about the area and who can greatly contribute to class discussions. EMBA faculty readily admit that their students usually teach them a great deal as well. Often students will form study groups to help each other prepare for classes and these sessions can be extremely useful to those who participate. The case method of instruction works very well in the EMBA programs.

Not only is classroom time a scarce resource in EMBA programs, but so also is the time these students have to devote to their studies. Given that students hold full time jobs and then must spend between 25 and 30 hours a week on homework and a day in class, it is essential that professors assign work that contributes to learning objectives and that they avoid non-essential, "busy-work" assignments. Successful EMBA programs encourage students to use their own organizations as the subject of assignments both to save time and demonstrate relevance. A recent article in the Wall Street Journal, describes how this can benefit student's firms:

> Going to school while still working means "you have a sand box to play in to see if what you learn in class works in practice," says Michael H. Duran, a project manager at American Telephone and Telegraph Co's Bell Laboratories subsidiary.
>
> For example, Hugh Diamond, a fuel manager at an East Coast utility, drew on his statistics and operations-research training at Wharton to help steer his company away from buying nuclear fuel that would have carried additional costs that weren't evident from sales presentations.(2)

To be able to complete a full M.B.A. program with restricted class hours in two years, EMBA programs demand a great deal from their students. The pace is very fast and there is little time for those who fall behind to catch up. The substantial time commitments required for students to complete EMBA programs means that for two

years they buy a style of life that is extremely difficult. Students and their spouses are under tremendous stress, and there is little time for anything other than work and school.

The Advantages of an EMBA

MANAGERS COMPLETE AN EMBA IN TWO YEARS: The most obvious advantage of the EMBA format is that managers can complete their MBA degree in a specific period of time without leaving their current jobs. Long night school programs can be avoided, and while the two years are rather busy ones, at least they know the exact date they will finish.

EMBA PROGRAMS ARE DESIGNED FOR MORE EXPERIENCED MANAGERS: Experience is the norm in EMBA programs and this allows program designers to build in the type of materials and subject matter managers need in their development. Professors spend little time reviewing basic organizational concepts which are obvious to most managers and can concentrate on critical issues in their areas. All members of the class are in the same situation of having studies plus a full time career, and thus no one is at a disadvantage.

THE COHORT EXPERIENCE IS STRONG: One of the most positive benefits of an EMBA is that students study with a group of talented and experienced managers. Not only do classmates assist in the learning process, but the fact that over two years class members take all their courses together and share a very challenging experience, means that close friendships develop and the bonds that are formed between class members can be very rewarding. Relationships that are built extend beyond the formation of a powerful network of business and professional associates.

THERE IS A STRONG GENERAL MANAGEMENT PERSPECTIVE: All MBA programs, to a degree, concentrate on developing a general management orientation in their program components. Sometimes this is a very difficult task with younger MBA students because they are far away from senior management responsibilities and they are more concerned with developing some functional expertise in finance, marketing or accounting so that they can find employment. EMBA students are well advanced in their careers and can more readily understand and benefit from studies that emphasise the role of the general manager. This allows those teaching in EMBA programs to input materials and subject matter which reinforces this generalist perspective.

EMBA PROGRAMS LEAD TO SIGNIFICANT PERSONAL GROWTH: Almost all EMBA students report that, although they may enter their EMBA studies in search of a degree and the technical knowledge MBA programs provide, they leave with a sense of personal accomplishment and they change and grow as individuals. Frequently they speak of their EMBA program as one of the most significant periods of their lives. Part of this phenomenon may stem from the fact that most

EMBA students are close to mid-life; however, a large part must also be attributed to the challenges of completing an extremely difficult program and to the "living on the edge" factor that EMBA students often talk about. Balancing a busy work life with full time studies is a tremendous personal accomplishment.

EMBA PROGRAMS HAVE DEVELOPED A STRONG REPUTATION: A final advantage EMBA programs offer is that their graduates are beginning to build a strong reputation as managers. Ten years ago there were only 1000 students enrolled in EMBA programs; today there are over 5000 students. Columbia University recently reported that its executive-program alumni receive two or three promotions and have salary increases of 50 to 75% in the first 5-year period following their completion of their EMBA. When one realizes that EMBA graduates have proven themselves in their own corporation to be sponsored, have proven themselves in a classroom of talented managers, and have already significant management experience, this growing reputation is easy to understand.

THE DISADVANTAGES OF AN EMBA

HIGH PERSONAL DEMANDS: There is no doubt that EMBA programs place great demands on the managers who enroll. If a busy job or a tough academic program create excessive stress on certain individuals, then combining both can certainly be extremely difficult for those who enter EMBA programs. The time management problems EMBA students face will force these students to make choices as to how to allocate their critical resource--time. Unless they handle the high level of stress involved, serious health and personal problems can arise. The quality of their family lives can suffer, they can perform at less than their potential at work, and they often feel frustrated in class because they just don't have the time to put into their studies. As one graduate who had always been a star performer throughout his life remarked, "for two years, I was a lousy husband, a lousy manager, and a lousy student." Another EMBA graduate noted that the most difficult thing he had to accept during his EMBA program was to learn that a "B" grade was acceptable--it was a reasonable expectation when all the demands on his time were considered.

HIGH CAREER RISKS: The visibility that EMBA participants have in most organizations can increase the risks of failure these students face. Corporate sponsorship creates very clear expectations for performance, and even failure to be accepted into a program can create problems for applicants. If EMBA students have poor grades or are even asked to withdraw from the program, they can face severe consequences back at the office. Unlike evening MBA programs, an EMBA student cannot "slide quietly out of a program" if all does not go well. Poor performance may result in the student's corporation reassessing the perception that he or she is really a fast-track manager destined for more senior responsibilities. As well, the special treatment that EMBA sponsorship implies can cause other managers in a firm to resent

those managers who have been sponsored. Resentment can also build as co-workers see a manager disappearing every other Friday and perhaps getting other concessions at work because of their studies.

EMBA DEGREES OFFER FEW ELECTIVES: Although it is true that most MBA degrees are generalist degrees, EMBA programs, for the most part, offer even fewer electives and really do not permit the taking of a group of electives in an area of interest or specialization. Normally all courses are prescribed and in those programs that do offer electives, the elective is determined by class vote and all members of the class must take the course. This can be particularly frustrating for students who are interested in a special area, or who wish to go beyond basic courses and concepts. For transportation managers, this can be a real problem as will be outlined later in this paper.

EMBA PROGRAMS HAVE HIGH TUITION FEES: The tuition fees of most EMBA programs are comprehensive in that they cover all courses, other fees, books, and meals and refreshments on class days. Compared to other management development program fees, EMBA fees are probably quite realistic; nevertheless, in an absolute sense EMBA programs are expensive often costing up to $42,000 (US) in the better known programs in the United States. In Canada, where university tuition is generally quite low because of government funding, EMBA programs are relatively expensive with both Canadian schools charging over $20,000 (Can) for the two year program. Currently, the tuition fee at the University of Toronto is $25,500 and at Concordia University it is $21,500. These tuition fees are necessary because Canadian programs do not take government grants for their EMBA programs so that they will have the freedom to offer their programs in a manner appropriate for more experienced managers.

EMBA Programs and the Transportation Manager

A critical issue for transportation industry managers is whether an EMBA program will offer the type of educational program that is appropriate to their needs. Given the general management orientation found in most EMBA programs, it is clear that if they are seeking to improve their general management skills and to broaden their overall perspective an EMBA program can be very useful. For experienced managers, an EMBA can be a rewarding two years which can lead to significant personal and managerial growth. The interaction with other managers from various industries and from various backgrounds can be very beneficial.

On the other hand, discussions with transportation managers who have completed EMBA programs reveal that there is little emphasis in EMBA core curricula on transportation issues, and the lack of electives in EMBA programs makes it very difficult to specialize in the transportation area. A review of EMBA programs that do offer electives indicates only one course that could be regarded as specifically devoted to transportation: a course called Materials

and Logistics Management.

There are ways, however, that a transportation manager can increase the transportation content of an EMBA program. First, when EMBA assignments are given and the student has a choice of industries or firms to use as a subject for a particular task, a transportation perspective can be used. Secondly, this same approach can be used by the selection of a transportation topic if a particular EMBA program has a research paper or research project in its curriculum. For example, at Concordia University this year, 4 of the 34 research projects written dealt with transportation issues. They included:

1) Railway Project Management
2) Strategic Planning at Air Canada
3) Development of a Forecasting Equation to Predict Aluminum Rail Transport Demand
4) The Replacement of Waste Hauling Vehicules

Finally, if an EMBA student joins a study group, the possibility exists that such a group could include other managers from the transportation sector, or others who are interested in transportation issues. Past experience at Concordia University indicates that about 9% of students enrolled in the EMBA program are working in the transportation field.

Conclusion

EMBA programs have become an important element in management development in the United States and the same trend is beginning to appear in Canada as well. While at present in Canada only two universities offer the Friday/Saturday format of delivery traditional to an EMBA program, more universities will be entering this area in the near future, and the option of taking an EMBA program will become more available to transportation managers. An EMBA degree is an excellent program for the development of general management skills and is worthy of the consideration of transportation managers who wish to broaden their managerial perspective. However, it does not offer managers the opportunity to specialize in transportation management.

References

(1) EMBA Council, Annual Survey of EMBA Programs, October, 1988.

(2) The Wall Street Journal, "Executive MBA Getting High Marks", December 20, 1988.

(3) L.J. Philips-Madson and P.R. Sloan, "Managerial Development on the US: a Survey of the Executive MBA", Journal of General Management, Vol. 13 no. 3-Spring 1988.

PETROLEUM PIPELINES: THE DIMENSIONS OF THE U.S. INDUSTRY AND ITS RELATIONSHIP TO CANADA

Leonard L. Coburn
Director, Division of Competition
U.S. Department of Energy

The United States petroleum pipeline industry is an important part of the United States transportation system carrying a significant portion of all intercity freight while distributing crucial energy resources to refiners and consumers. The system is literally invisible since most pipeline systems are buried underground. The system also is invisible in the sense that little is known or written about it. The purpose of this paper is to uncover the system in a figurative sense and expose its dimensions. Moreover, there are several links between the United States and Canada that are important to both countries and they will be discussed. Finally, a deregulation movement exists in the United States and that aspect will be touched upon concluding with the prospects for the future.

I. AN OVERVIEW OF THE U.S. PETROLEUM PIPELINE INDUSTRY

The U.S. petroleum pipeline industry accounts for about 23 percent of all U.S. intercity freight tonnage in 1986. [1] This is about the same percent that the petroleum pipeline industry carried a decade earlier, accounting for about 24 percent of all intercity freight tonnage in 1977. [2] Thus, pipeline growth has kept pace with other modes of transport.

Pipelines are among the least costly method of intercity transportation. In 1986, pipelines transported their commodity at about 2.9 percent of the total intercity freight cost, up from 1.6 percent in 1977. [3] Only water transport modes are comparable in cost with barges about equal and ocean tankers a little more than half the cost. For other overland modes, rail is a little more than three times as costly and truck is about 25 times as costly. In 1986, it cost about 2.0-2.5 cents per gallon to ship gasoline from Houston to New York by pipeline and about 1.5 cents per gallon to transport crude oil from New Orleans to Chicago. This compares to about 1.5-2.0 cents per gallon to ship gasoline from Houston to New York or crude oil from New Orleans to Chicago in 1977. [4]

A. Industry Changes over the 1977-1987 Decade

The U.S. petroleum pipeline system has reacted to the significant changes within the U.S. petroleum industry in general. As crude oil

sources changed, refinery capacity shifted, and product demand altered, pipelines adjusted. These adjustments can be shown from general industry-wide data as well as from individual situations. [5]

Between 1977 and 1987, crude oil production remained rather stable increasing about 0.8 percent. But within this overall total, lower 48 production declined about 18 percent while Alaskan production increased by 322 percent. (See Table 1)

Crude oil and product imports also changed significantly during this ten year period from 1977 to 1987. Overall, total imports declined from 1977 to 1987 by about 26 percent, with crude oil imports declining about 30 percent and product imports declining about 13 percent. But this masks some important trends that occurred in the interim years. Total imports hit their low point in 1983, decreasing about 43 percent from 1977; however, since 1983, total imports increased by about 30 percent, with an acceleration in imports since 1986. Thus, crude oil imports increased by about 39 percent from 1983 and product imports increased by about 11 percent. Thus, while for the decade imports decreased, since 1983 they increased significantly.

The impact of imports from Canada was significant. In 1977, Canadian imports of both crude and products represented about 6 percent of the U.S. total or about 517 thousand barrels per day. In 1987, Canadian imports grew to 837 thousand barrels per day or almost 13 percent of total imports. This represented a change over the decade of about 62 percent and a change of 87 percent from the low point of Canadian imports in 1981. Thus, the U.S. increasingly turned to Canada as a source of crude oil and products, all of which were transported by crude oil and product pipelines.

Refinery capacity and the number of refineries changed over the past decade. The number of refineries went from 282 in 1977 to 219 in 1987, a 22 percent decrease. The number of refineries hit their peak in 1981 with 324 so that the decline to 1987 is really about 32 percent. Capacity went through similar shifts with the decade decrease at about 5 percent, but the decrease from the peak year of 1981 at 16 percent. Similarly, gross inputs to refineries declined about 14 percent over the decade, but this masks a divergent trend of a sharp decline from 1977 through 1983 of about 20 percent and then an increase of about 9 percent since then.

Overall product demand in the United States fell about 10 percent between 1977 and 1987. Gasoline demand, however, is the same today as it was in 1977, although it did decrease by about 9 percent through 1982 and recovered since then. Demand for liquefied petroleum gases (LPGs) grew over the decade increasing by about 14 percent. [6]

These data indicate that there are fewer refineries with less overall capacity and less gross input than in 1977 while refinery utilization has seesawed from about 90 percent in 1977, to 69 percent in 1981, and back up to about 83 percent in 1987. Domestic crude oil production, while relatively stable over the decade, shifted significantly from predominantly lower 48 sources to about 25 percent Alaskan

sources. While overall imports decreased, there is an increasing trend during the last several years with more imports coming from Canada by pipeline. During the last decade, refined product demand decreased, but in 1987 gasoline demand was even with 1977 demand and LPG demand increased. All these petroleum industry changes forced the petroleum pipeline industry to change and adjust its operations to meet different distribution requirements.

B. Pipeline Reaction to Industry Changes

In light of the many petroleum industry changes, the petroleum industry reacted to meet different needs. The changes in the pipeline industry can be viewed in four different ways. [7] These are miles of pipeline, deliveries from the system, trunkline traffic, and financial indicators. [8] (See Table 2) The mileage data provide a measure of how extensive the system is within the United States. The delivery data provide an indication of how much crude or product is transported through the system. The trunkline data, a combination of mileage and deliveries, is measured in barrel-miles, provide a clearer measure of how large the system is since the data take into account mileage, deliveries, and diameters of the pipeline. Thus, transportation through a large diameter pipeline will produce a larger barrel-mile number than transportation over the same distance through a small diameter pipeline. Finally, the financial data provide an indication of the investment and profitability of the system.

1. Mileage

Pipeline mileage usually is broken down into three measures--gathering lines, crude trunklines, and product trunklines. For 1987, gathering lines accounted for 35,055 miles of pipeline, or 20.9 percent of all pipelines. Crude trunklines accounted for 54,886 miles or 32.7 percent of the total. And product trunklines accounted for 77,924 miles or 46.4 percent of the total.

There has been a shift in mileage over the last decade with the total increasing by 8.6 percent. The total, however, masks very different trends among the three categories. Gathering lines remained about the same, increasing only 1 percent. Crude trunklines decreased by about 4,900 miles or 8.1 percent. Product trunklines increased by about 17,800 miles or 29.7 percent.

Two studies done by the National Petroleum Council (NPC) based upon 1977 and 1986 data provide a similar profile. Total mileage decreased from 227,060 to 204,000 or 10.2 percent. Within this total, crude mileage (both gathering and trunk) decreased 25.9 percent, refined product line mileage increased 13 percent and lpg product mileage increased 30.8 percent (combined product mileage increased 16.9 percent). These data indicate a similar shift in the crude and product segments of the industry, although the overall total differs from the data on federally regulated pipelines. [9]

The industry changes explain the change in mileage. With fewer refineries there is less need for crude oil pipelines. Fewer

refineries also mean more product movements as products must be distributed from a more concentrated refining complex.

2. Deliveries

Deliveries from the pipeline system are broken down only by crude and products and are stated in billions of barrels. In 1987, there were about 6.3 billion barrels of crude delivered and about 4.9 billion barrels of product delivered for a total of 11.2 billion barrels. Compared to 1977, the overall total increased 11.7 percent, crude increased a modest 3.1 percent, while product deliveries increased a substantial 25.1 percent.

The delivery data reflect an increasing reliance upon pipeline transportation to deliver both crude and products. The small increase in crude deliveries probably reflects the increased importance of deliveries from Alaska. These deliveries increased substantially during the period and must travel through the Trans-Alaska Pipeline System (TAPS). The large increase from TAPS probably is offset by the conversion of other crude lines from crude service to natural gas service. The large increase in product deliveries definitely reflects greater reliance on pipeline movement of products to replace the supply from closed refineries. Many of the refineries closed were in the mid-continent region of the country so that the crude pipelines serving that region were no longer necessary. For instance, refinery runs in this region declined by about 24 percent over the decade, exceeding the national average of 14 percent by 10 percentage points. [10] That is why some crude pipelines went out of service while crude distribution patterns changed to shift crude deliveries to other regions.

3. Trunkline Traffic

The trunkline traffic data also are broken down only by crude and product and are provided in trillion barrel-miles. In 1987, total trunkline traffic was about 3.5 trillion barrel-miles, with crude traffic providing 55 percent or 1.9 trillion barrel-miles and product traffic providing about 45 percent or 1.6 trillion barrel-miles. Compared to 1977, the total barrel-miles declined by 10.1 percent with crude declining by 14.8 percent and product declining by 3.7 percent.

These data and the delivery data indicate a tendency towards shorter hauls through the system. While the delivery data indicate an increased number of barrels transported, the trunkline traffic data decreased, indicating that these barrels traveled fewer miles. For the crude segments this change is confirmed in the changes in the rest of the industry since crude traveled shorter distances due to the closure of so many refineries in the mid-continent region. Thus, crude that would have traveled from the Gulf Coast north to the mid-continent stayed on the Gulf Coast. Similarly, crude from Texas stayed in Texas rather than being transported northward. The large increases from TAPS clearly were offset by the closure of large diameter systems such as Texoma and Seaway transporting crude from the Gulf Coast to the mid-continent region and from the decrease overall in the crude pipeline mileage.

The product trunkline data are somewhat surprising since it would be more likely that more product is traveling farther in order to accommodate the changes in refinery capacity. It is clear that the delivery data indicate a substantial increase in pipeline movements; however, the trunkline data indicate that these barrels are moving somewhat shorter distances although the change in the data is not that significant. One explanation for the changed product trunkline traffic is the population shift in the U.S. More people now live in the south and southwest, geographic areas that are closer to the major refinery complexes of the Gulf Coast. Thus, while more product must go through the system, it does not have to travel as far due to the shifting nature of the demand. Moreover, given consumption trends of some refined products such as gasoline, an increase would have been expected, but consumption of all products did decrease by 10 percent over the period. The result is a small decrease in the product trunkline traffic.

4. Financial

The financial data focus on investment (carrier property), operating revenues, and net income. It is in this area that the most impressive changes occurred.

Total investment in federally regulated petroleum pipelines in 1987 was about 21.3 billion dollars, an increase of 4.5 billion dollars over 1977, or 27.1 percent. Operating revenues in 1987 were about 7.1 billion dollars, an increase of 4.2 billion dollars over 1977 or 150.4 percent. Finally, net income for the industry in 1987 was 2.5 billion dollars, an increase of 2.4 billion dollars over 1977 or 508 percent.

The increase in investment reflects investment in large expensive systems such as TAPS or large additions to existing pipelines such as the looping of Colonial Pipeline Company. The increase in operating revenues and net income reflects the operation of these large, expensive systems. The increase in operating revenues and net income also reflects inflation as well as increasing profitability of the entire petroleum pipeline system.

The increasing profitability is reflected in two indicators, income as a percent of property and income as a percent of revenues. Income as a percent of property in 1987 was 11.6 percent, the second highest percentage during the entire decade. Income as a percent of operating revenue in 1987 was 35.1 percent, the highest for the decade and more than double the figure for 1977.

5. Top Ten Companies

The largest petroleum pipeline companies remained relatively stable over the 10-year period. This reflects the dominance of the largest pipelines--TAPS, Colonial, Capline, Southern Pacific (now Santa Fe Pacific), Williams, Plantation, and the combined systems of the large integrated companies. Most of the top ten companies were subsidiaries of the large integrated companies. A few independently

owned systems, Williams, Southern Pacific, and Buckeye managed to make it into the top companies of the industry. The stability of the industry participants reflects the stability of the petroleum industry participants in general, with some shifting of position usually due to mergers and acquisitions.

II. THE INTERRELATIONSHIP OF THE U.S. AND CANADIAN PIPELINE SYSTEMS

Pipelines transport virtually all crude and products between the United States and Canada. This section will explore the pipeline links in more detail. [11]

A. Crude Oil Pipelines

There are two pipeline systems capable of exporting crude oil from the U.S. to Canada. Portland Pipeline Company operates 186 thousand barrels per day of capacity between Portland, Maine, and Montreal, Canada. This pipeline transports imported crude oil (that is, crude oil originating outside the U.S.) to Canada. It also is capable of transporting crude oil from offshore Canada in the Hibernia field once production commences. The Lakehead Pipeline Company operates between 562 and 540 thousand barrels per day of capacity to Sarnia, Canada. Lakehead is the U.S. component of the Canadian Interprovincial Pipeline that originates in Edmonton, Alberta, and delivers crude oil to Minnesota and then splits into two segments delivering crude directly to Marysville, Michigan, through the northern leg while the southern leg delivers crude via Chicago and then to Michigan, ultimately linking up with the northern leg at Marysville. Lakehead therefore delivers both U.S. and Canadian crude back to the Interprovincial Pipeline at Sarnia.

There are six pipeline systems delivering crude oil from Canada to the U.S. They are Lakehead, Westspur, Conoco, Texaco, Cenex, and Transmountain for a total capacity of between 1710 and 1747 thousand barrels per day. Lakehead is the principal pipeline operating from 1314 to 1346 thousand barrels per day of capacity from Edmonton to Clearbrook, Minnesota. At Clearbrook, there are pipelines that carry the crude south to refineries in Minnesota. Lakehead continues to Superior, Wisconsin, where it divides into two segments, the northern leg going across the upper peninsula of Michigan and then to Marysville. The southern leg goes to Chicago, then to Detroit, and finally linking back up with the northern leg at Marysville. There is another segment of Lakehead with between 101 and 106 thousand barrels per day of capacity that delivers crude oil off of Interprovincial at Westover, Canada, to Buffalo, New York, to local refineries and to other pipelines.

The Westspur Pipeline delivers crude oil from Steelman, Canada, to Lignite, North Dakota, where the crude is delivered to other pipelines for use in North Dakota or for export out of the state. The capacity of this system is unknown.

There are three pipeline systems delivering crude oil from Canada to Montana. The Conoco Pipeline with a capacity of 79 thousand

barrels per day delivers crude oil from Oldman, Canada, to Aurora, Montana. The Texaco Pipeline with a capacity of 36 thousand barrels per day delivers crude oil from Regina, Canada, to Poplar, Montana. The Cenex Pipeline with a capacity of 20 thousand barrels per day delivers crude oil from Sweetgross, Canada, to Cutbank, Montana. All the deliveries either are delivered to Montana refineries or are delivered to refineries in adjacent states.

The last pipeline system between the two countries is Transmountain Pipeline with 160 thousand barrels per day of capacity operating from Edmonton to Ferndale, Washington, to the three refineries operating in that area.

Since the last National Petroleum Council study was published in 1979, there have been some changes in the cross-border pipelines. For instance, there used to be three pipelines exporting crude to Canada--Portland, Lakehead, and Wascana (now Texaco)--with the latter delivering crude from Montana to Canada, with a total export capacity of 792 thousand barrels per day. Thus, one pipeline no longer delivers crude to Canada; it only imports crude, while overall export capacity has decreased by about 44 thousand barrels per day or about 5.5 percent.

With respect to imports from Canada, there are now six pipelines importing crude where there used to be four. In addition to Lakehead, Conoco (formerly Rangeland), Texaco (formerly Wascana), and Transmountain, there are now Westpur and Cenex. Although there are more pipelines, overall import capacity has decreased from 2015 thousand barrels per day to between 1747 and 1710 (averaging 1729) a decline of 287 thousand barrels per day or 14.2 percent. This decline in capacity occurred despite the increasing trend towards more imports from Canada; however, capacity appears adequate given the present level of pipeline capacity and average crude oil imports.

B. LPG Product Pipelines

Liquefied petroleum gas (lpg) and natural gas liquids (ngl) pipelines are the primary product pipelines operating between the two countries. [12] Presently, there are five pipelines that carry these products from Canada into the U.S.

The largest pipeline system is Lakehead operating 228 thousand barrels per day of lpg and ngl capacity from Edmonton to Superior, Wisconsin, where the line splits into two legs for deliveries to different locations (see supra). This pipeline has increased its capacity from 135 to 228 thousand barrels per day over the past decade or by about 69 percent.

Cochin Pipeline is the next largest operating 55 thousand barrels per day of capacity from Edmonton to Toledo, Ohio. Its capacity has decreased from 75 thousand barrels a day a decade ago or 27 percent.

Sun Pipeline operates a combined product, lpg/ngl pipeline between Sarnia, Canada, and Toledo, Ohio, with 20 thousand barrels per day of capacity, down from 30 thousand barrels per day or 33 percent.

This pipeline is the only pipeline capable of importing refined products into the U.S.

Amoco-Dome operates two pipelines into the U.S. from Sarnia, one to Marysville, Michigan, and the other to St. Claire, Michigan. Both have a capacity of 28 thousand barrels per day down from 35 thousand barrels per day or 20 percent.

Overall, there is 359 thousand barrels per day of import capacity of lpg/ngl product pipelines into the U.S. This compares with 310 thousand barrels per day a decade ago operated by the same pipelines. Thus, there has been an increase of 15.8 percent in the import capacity of these pipelines--all of it attributable to Lakehead.

III. THE POTENTIAL FOR DEREGULATION IN THE U.S. AND IMPACT UPON TRANSBORDER MOVEMENTS

Today, most U.S. petroleum pipelines are economically regulated. Economic regulation extends to both rates and service. As a result, all initial rates and all increases and decreases in rates must be approved before they can be implemented. Furthermore, economic regulation extends to the rate base and the rate of return permitted each pipeline. There is no entry or exit regulation, however. Service regulation requires that all federally regulated pipelines operate as common carriers, accepting all shipments upon reasonable conditions. Service as well as price discrimination is prohibited. Rebates also are prohibited.

Economic regulation for federally regulated petroleum pipelines has existed since 1906. Under this system, pipelines must post their tariffs--the conditions of service as well as the price of the service--so that it is relatively easy to find out what it costs to ship over any federally regulated pipeline. Furthermore, since price discrimination is prohibited there are few incentive rates or deviations from the posted tariff.

Rates have been fairly stable over a long period of time. In the past, rates were based upon a valuation rate base (made up of original cost and replacement cost elements in addition to other factors) so that rates were adjusted primarily to reflect inflation and additional investment in the pipeline.

The regulatory system is undergoing significant changes. With the transfer of regulatory jurisdiction from the Interstate Commerce Commission to the Federal Energy Regulatory Commission (FERC) in 1977 and because of several recent court decisions, pipelines are undergoing a transition to a different form of regulation. This revised regulation requires the use of a different rate base (based exclusively on original cost) with rates of return set for each individual pipeline, whereas in the past rates of return were established for the industry as a whole (8 percent for crude pipelines and 10 percent for product pipelines).

The effect of this change in regulation upon rates is uncertain. For some pipelines, rates could decrease significantly if the rate base has been substantially depreciated, while for other pipelines rates could be stable or increase depending upon how the rate base is calculated. The FERC also is experimenting with the introduction of a "lighthanded" form of regulation; however, this experiment is in the very early stages of implementation. At the very least, the industry is experiencing relatively large regulatory costs as the FERC determines its new regulatory philosophy on a case-by-case basis. This change in regulation has led to great uncertainty in the industry. Pipelines are reluctant to change their rates since the filing of new rates invariably leads to an extended rate proceeding. While some pipelines have been willing to go through these proceedings, most are not. Thus, rates have been relatively frozen. Pipelines also have been reluctant to make significant new investments fearing that new rate filings to cover the investments will lead to extended rate proceedings.

This regulatory atmosphere is a primary reason for the effort to deregulate petroleum pipelines. The petroleum pipeline industry introduced deregulation legislation in 1981 and in every session of Congress since then. This legislation would deregulate the rates of all pipelines but leave all other forms of regulation in place. The federal government responded with its proposal for deregulation. The government's proposal would eliminate all regulation in competitive markets and retain all regulation in noncompetitive markets. A special procedure would be established to sort out the competitive pipelines from the noncompetitive pipelines. The regulation that would remain would be the present form of economic regulation.

These proposals were objectionable to the two main proponents of deregulation. The industry disliked the government's approach because residual regulation relied upon the present form of regulation that the industry stated was the cause of the present uncertainty. The government disliked the industry's approach because it did not differentiate between competitive and noncompetitive pipelines. The government had issued a study by the Department of Justice indicating that while most of the industry was competitive there were pockets of market power that should remain regulated. Thus, the government wanted a deregulation proposal that addressed this competitive concern.

In 1988, the industry and the government held extensive negotiations and arrived at a consensus approach to deregulation. In this proposal, the industry conceded that the competitive concerns were relevant and decided to accommodate the government's desire to maintain some form of regulation over some markets. The government conceded that the industry's concerns over present regulation were relevant and proposed an alternative form rate regulation that proved acceptable.

Under the consensus approach, rates of pipelines in competitive markets would be deregulated while rates of pipelines in noncompetitive markets would be capped. This means that for some pipelines, some markets could be deregulated while other markets could be

regulated. The present form of cost-of-service regulation would be abandoned for the new form of price cap regulation. Rates would be free to fluctuate under the price cap. Service regulation would remain. Other important features of the consensus approach include freeing new pipelines and new capacity from rate regulation, permitting pipelines to offer contracts for rates and service, and indexing the rate cap to rates in the competitive portion of the industry.

The implications of this new regulatory approach, if enacted, are significant. In all likelihood, most pipelines would be deregulated. Based upon the Department of Justice study, Justice concluded that all crude oil pipelines (except TAPS) should be deregulated. For product pipelines, Justice concluded that five pipelines should remain regulated, while another six were close calls. Justice did not make any findings on the lpg/ngl pipelines.

Thus, for the crude pipelines now transporting crude to or from Canada, under the deregulation proposal, their rates would be deregulated. Given that there is sufficient competition in crude oil transportation to prevent market power, it is difficult to conclude that deregulation would create any significant rate impact upon the pipelines transporting Canadian crude oil. The major impact would be that the rules of the game would change. Pipelines would no longer post their rates if they were deregulated. They also would be free to charge shippers different rates, except with respect to affiliate shipments. In that instance, they would be required to offer similar rates to other shippers. They also would be free to conclude contracts for shipments. Thus, shippers could obtain some measure of certainty for their shipments through contract rates.

Similar conclusions are likely for the product pipelines operating between the countries. Since most of the product capacity is lpg/ngl capacity and given that Justice has not made any competitive determinations with respect to these systems, it is impossible to conclude with any assurance at this time that the rates of these systems would be deregulated. If they were deregulated, then the conclusions regarding crude oil pipelines would apply here as well. Further study is required before any definitive conclusions can be made with respect to the lpg/ngl pipeline system.

IV. CONCLUSION

The petroleum pipeline system in the United States is an extensive system that is fully capable of meeting the distribution needs of the country. The pipeline industry has reacted to the changes in the petroleum industry in general. Crude distribution patterns changed as production shifted to include more crude oil from Alaska. Crude distribution also changed as the level and source of imports shifted. Most importantly, many refineries closed down due to poor economics leaving refining more geographically concentrated.

In order to accommodate these overall industry changes, the pipeline industry grew in mileage, in deliveries, and financially. As would be expected, product mileage and deliveries increased

significantly to meet the distribution needs of a more geographically concentrated refining industry. Both crude mileage and deliveries decreased in light of the shift in crude distribution patterns. Crude trunkline traffic decreased reflecting the shorter distances traveled for most crude shipments, while product trunkline traffic decreased only slightly most likely to accommodate changing population and product demand. Whatever the ultimate reason for the shorter hauls reflected in the trunkline data, it is clear that the pipeline industry altered its operations to meet the changing distribution needs of the petroleum industry. The pipeline industry changed expeditiously and profitably in reaction to the overall changes of the petroleum industry.

The biggest uncertainties today are not operational, but regulatory. The FERC is changing its method of regulation imposing a relatively strict regulatory philosophy on the industry. It must be pointed out, however, that the FERC is struggling to find an acceptable way to permit a more lighthanded regulatory methodology. But this solution appears years away. As a result, a deregulation movement has taken root in the U.S.

The most prominent deregulation proposal has the agreement of the petroleum pipeline industry and the federal government. It would deregulate most pipelines but require regulation only in markets where a pipeline had market power. Rate regulation would take the form of maximum rate caps with the freedom to rate discriminate anywhere under the rate cap. Service regulation would not change significantly. Thus, the rules of the game could change in the near future permitting pipelines to be more innovative in their rate and service philosophy. With significant transborder movements between the U.S. and Canada, the implications of petroleum pipeline deregulation could ripple through the Canadian pipeline industry.

At the present time, it is difficult to assess the likelihood of deregulation being implemented. There is a consensus approach between the industry and government, a very important ingredient for success. There has not been much opposition to the consensus approach; however, full Congressional hearings have not been held yet. While the industry and government remain optimistic, everyone is taking a wait and see attitude toward the future.

Table 1

U. S. Petroleum Industry Indicators
1977-1987

	1987	1977	Percent Change
Crude Production (Million BPD)			
Lower 48	6.349	7.781	-18.4
Alaska	1.961	.464	+322.6
Total	8.311	8.245	+0.8
Imports (Million BPD)			
Crude	4.64	6.61	-29.8
Products	1.90	2.19	-13.2
Total	6.54	8.81	-25.8
Canadian	.837	.517	+61.9
Percent of Total	12.8	5.9	
Refinery Capacity			
Number	219	282	-22.3
Capacity (Million BPD)	15.57	16.40	-5.1
Gross Input (Million BPD)	12.96	14.98	-13.5
Products Supplied (Million BPD)			
Gasoline	7.18	7.18	0.0
LPG	1.62	1.42	+14.1
Total	16.56	18.43	-10.1

Source: EIA Annual Energy Review 1987.

Table 2

Federally Regulated U.S. Petroleum Pipelines
Operating and Financial Indicators
1977-1987

	1987	1977	Percent Change
Miles			
Gathering	35,055	34,703	1.0
Crude Trunk	54,886	59,739	-8.1
Product Trunk	77,924	60,099	29.7
Total	167,865	154,541	8.6
Deliveries (000 BBL)			
Crude	6,277,670	6,089,031	3.1
Products	4,916,665	3,929,863	25.1
Total	11,194,335	10,018,894	11.7
Trunkline (Million BBL-Miles)			
Crude	1,931,768	2,267,207	-14.8
Products	1,568,133	1,627,994	-3.7
Total	3,499,901	3,895,201	-10.1
Financial (000 $)			
Property	21,272,953	16,736,017	27.1
Operating Revenue	7,057,235	2,817,951	150.4
Net Income	2,475,046	477,777	508.0
Income as a Percent of Property	11.6	2.9	
Income as a Percent of Operating Revenue	35.1	17.0	

Source: Oil and Gas Journal.

ENDNOTES

1 National Petroleum Council, Petroleum Liquids Transportation, Draft Report, Volume V, (Washington, D.C.: .National Petroleum Council, 1988), p. 2-2 (hereinafter NPC 1988).

2 National Petroleum Council, Petroleum Storage and Transportation Capacities, Volume III, "Petroleum Pipeline," (Washington, D.C.: National Petroleum Council, 1979), p. 25 (hereinafter NPC 1979).

3 NPC 1988 and NPC 1979.

4 Ibid.

5 U.S. Department of Energy, Energy Information Administration, Annual Energy Review 1987, (Washington, D.C.: Department of Energy, 1988). Data in this section taken from various tables in this publication unless otherwise indicated.

6 Liquefied petroleum gases (lpgs) are butane, propane, and ethane that are separated from natural and refinery gases and are transported in liquid form.

7 Federally regulated pipelines transport crude and products in interstate commerce usually across state lines. There are many pipelines that transport only within a single state and are not federally regulated. The inclusion of these intrastate pipelines increases the mileage and other data found in the NPC studies.

8 Oil and Gas Journal, various issues from 1978 through 1988. Data in this section taken from this source unless otherwise indicated.

9 The NPC includes nonfederally regulated pipelines.

10 NPC 1988.

11 NPC 1988 and NPC 1979.

12 Natural gas liquids (ngls) are high vapor pressure hydrocarbon liquids separated from wet natural gas and moved by pipeline to a fractionation facility where the components are separated into ethanes, propanes, butanes, and natural gasoline.

SCHEDULED AIR SERVICES BETWEEN THE UNITED STATES AND CANADA

Ira Gesser and David B. Vellenga

Department of Purchasing, Transportation, Operations
Arizona State University
Tempe, AZ 85287-4706

Introduction

This paper provides a survey of scheduled air services between the United States and Canada. While these services have many of the features of domestic air transportation, they do cross an international boundary, albeit a rather unique one.

First, the key features of transborder routes and passenger movements will be discussed. This will be followed by a discussion of the various bilateral agreements that govern scheduled air services between the two countries, and an impression of the prospects for future bilateral agreements. Finally, the impact of customs and immigration preclearance on transborder air services will be examined.

Transborder routes and traffic

Canada's population of 25 million is primarily concentrated along a strip extending about 100 miles from the U.S. border. About 16 million Canadians live in the provinces of Ontario and Quebec, close to New York State and the Great Lakes area of the U.S. In contrast, the U.S. population is much more dispersed, with considerable population in the Western and Southern U.S.(Haanappel, 1980).

These demographic differences translate into a much larger number of domestic U.S. routes than Canadian routes, and the imbalance in population between the two nations (roughly 1:10) has a major impact on the extent and type of transborder air services. Over 80 percent of transborder journeys by air start or end in four Canadian cities (Toronto, Montreal, Vancouver and Calgary), while only 40 percent start or end in the top four U.S. cities (New York, Los Angeles, San Francisco and Boston). To reach the 80 percent mark for U.S. cities, 21 points must be included (Western Transportation Advisory Council, 1986).

Tables 1 and 2 show the difference in concentration of transborder traffic at Canadian and U.S. airports. The ten Canadian cities with the largest share of transborder traffic accounted for 48.11 percent of total traffic (volume) in both directions in 1986. In contrast, the ten corresponding U.S. cities only accounted for 32.08 percent of total traffic. The substantial increase in traffic at Vancouver from 1985 to 1986 can probably be attributed to Expo '86.

The difference in population size and distribution between the two nations also implies that Canadian carriers would depend on transborder routes for a larger percentage of passengers carried than U.S. airlines, who have a much larger domestic network to serve.

However, the existence of such a U.S. network, combined with the dispersal of U.S. origins and destinations for transborder services, makes U.S. carriers even better equipped to provide transborder services, which effectively become minor extensions of the domestic network.

Each U.S. airline, with only a small number of transborder flights from a given Canadian city, can provide service through its hubs to a wide variety of American destinations, while Canadian carriers must rely on traffic wishing to travel only to the specific destination permitted by the bilateral agreement. With the change to a hub-and-spoke system in the United States domestic network and the acquisition of many regional carriers by trunk airlines, Canadian airlines are also no longer able to conclude attractive joint fare arrangements with American carriers, who would rather serve the final destinations themselves. An example of this situation was Air Canada's withdrawal from the Texas market in 1986, even though it remains authorized to serve the route. The joint fare arrangement that had been made with Delta at Dallas/Fort Worth was no longer competitive with what Delta or other U.S. carriers could offer by themselves from Toronto (Canada, 1987a and 1987b).

The presence of U.S. inspection agencies at Canadian airports simplifies serving a wide variety of U.S. destinations from Canada, including cities that do not have inspection facilities at their airports. As well, neither nation allows the other to serve its domestic market, which further benefits the U.S. carriers. While Canadian residents account for roughly 60 percent of transborder passengers (Dresner, Hadrovic and Tretheway, 1988), about 68 percent of transborder passengers in 1985 were carried on U.S. airlines, up from 59% in 1975 (Statistics Canada, 1988).

Table 3 shows the ten most important city pairs for transborder traffic. In each case, the cities shown are final destinations rather than connecting points (hubs). As in Table 2, Los Angeles, San Francisco/Oakland and Miami stand out as important destinations for Canadians; these points are located quite far south of the international boundary. This explains the importance to Canadian carriers of "deep penetration" routes serving these U.S. cities.

Toronto's dominant position in transborder air transportation parallels its importance on the domestic scene. As Canada's only major hub, Toronto is included in seven of the top ten city-pairs for Canadian domestic flights ranked by the number of passengers carried, and five of the top ten transborder routes (Statistics Canada, 1988). Table 1 shows that Toronto accounted for 20.80 percent of transborder traffic in 1986, with Montreal second at 11.22 percent and Vancouver third at 7.09 percent.

American Airlines, which at present serves a number of U.S. and Carribean points from Toronto through its Chicago and San Juan hubs, is spending $40 million (U.S.) on four gates in the Toronto airport's new Terminal III, where Canadian Airlines will be leasing about 50 percent of the space. American also intends to link Toronto with its hubs at Nashville, Tennessee and Raleigh/Durham, North Carolina. Canadian Airlines intends to expand its transborder services significantly, as it now serves only domestic and overseas points from Toronto (Ausnit, 1988).

A partnership agreement has been concluded between Canadian Airlines and American Airlines at Toronto, where each airline will be feeding each other's traffic. It has been suggested that such an arrangement, if successful, would encourage liberalization of the transborder air service agreement between the two countries during future negotiations (Dresner, Hadrovic and Tretheway, 1988). The principal features of this agreement will be described next.

The Canada-U.S. Air Transport Services Agreement

Canada's relatively sparse population base, and the concentration of that population along the U.S. border, have led to a weak bargaining position for the Canadian government in negotiating transborder air services. The central document covering transborder air services is the Air Transport Services Agreement of 1966, which has been amended several times. A consolidated listing of the transborder air routes mentioned in the agreement is included in Table 4.

A review of the agreement (U.S. Department of State, 1966) reveals a number of significant features. First is the restriction on cabotage privileges. No Canadian carrier is allowed to pick up passengers in the U.S. for carriage to other U.S. cities. The same is true in reverse for U.S. carriers operating in Canada. However, many U.S. carriers continue service to other cities with the same aircraft once the original segment of the flight has landed at the first U.S. airport on a southbound trip.

Sixth freedom privileges, according to the nomenclature adopted in international aviation (Dempsey, 1987) would involve, for example, a Canadian carrier picking up passengers in the U.S. for carriage to a third country via Canada. While the agreement does not prohibit this practice, use of the terms "single carrier" or "through service" in advertising is prohibited.

However, the agreement provides two routes where fifth freedom privileges (picking up passengers in a foreign country for carriage to another foreign country) are specifically permitted: Canada-Honolulu-Australasia (assigned to Canada) and United States-Gander (Newfoundland)-Europe (assigned to a U.S.carrier). The introduction of long range jet aircraft has rendered the latter routing redundant.

The original agreement also provided that the transborder route network should bear "a close relationship to the requirements of the public for such services". In line with such expectations, considerable changes were made to the Route Schedule to the agreement in 1974. While all routes assigned to Canadian carriers were being operated at the time, such was not the case with routes assigned to U.S. airlines (Haanappel, 1980). The 1974 agreement provided for a large number of new routes; as well, some existing routes were now assigned to one or two carriers from each nation. Additionally, a U.S. carrier was allowed to serve the Honolulu-Vancouver route. The 1966 agreement had provided few such "double track" routes. Table 4 indicates the year in which each currently authorized route came into effect.

Of considerable significance to Canadian carriers in the 1974 amendments was the addition of several "deep penetration" routes into the U.S. for Canadian carriers. These included Toronto-Texas, Alberta-California, Montreal/Toronto-San Francisco and Vancouver-Los Angeles. As a counterweight to improved Canadian carrier access to desirable American destinations, the U.S. customs and immigration preclearance system in effect at several Canadian airports was entrenched in the agreement. The impact of preclearance will be discussed further on. Since 1974, only minor adjustments have been made to the agreement's Route Schedule, as indicated in Table 4.

A major concern for Canadian carriers in recent years has been increasing congestion at U.S. airports. This factor is said to make it more difficult for Canadian carriers to gain entry to U.S. airports or maintain attractive schedules (Western Transportation Advisory Council, 1986). Of particular importance are the four U.S. airports at which regulations have been imposed by the U.S. Department of Transportation limiting the maximum number of flights that may arrive and depart during peak hours (Fawcett and Fawcett, 1988). These airports, which are LaGuardia and John F.Kennedy International in the New York area, Chicago's O'Hare and Washington, D.C.'s National, account for a significant proportion of transborder traffic, as can be seen from total passenger volume into and out of these cities (Table 2).

In order to address Canadian concerns regarding access to LaGuardia airport, the two nations agreed in 1985 that any such rules would not result "in a limitation on the number of operations for their respective airlines that is inconsistent with obligations arising under the [Canada-U.S. Air Transport] Agreement". Additionally, no U.S. carrier would be allowed to increase transborder service to LaGuardia so that the total number of U.S. operations (i.e. arrivals and departures) was greater than the number scheduled on December 31, 1984, unless Canadian carriers (in this case only Air Canada) were given an opportunity to establish a comparable increase in service.

It would seem apparent that route allocation issues will continue to dominate air transport negotiations between the two countries. A consensus seems to have evolved, however, that the strength of the U.S. domestic network, which includes an ability to create additional segments to serve the transborder market, must be balanced against the corresponding need for Canadian carriers for maximum "deep penetration" routes to those U.S. points that are worth serving directly from Canada.

Experimental transborder services

Montreal's second airport, Mirabel, opened in 1975. It was originally intended to completely replace the existing facility at Dorval. However, only overseas flights have been transferred to Mirabel and domestic and transborder services continue to operate from Dorval. Unlike Dorval, Mirabel does not have U.S. customs and immigration preclearance facilities, due to the lack of transborder traffic from the newer airport. Flights to American destinations from Mirabel would therefore be restricted to airports with facilities for international arrivals.

In order to increase use of Mirabel, Canada proposed a trial program where any combination of carriers from both countries could fly from Mirabel to a U.S. point. As well, a key concession was made in the area of pricing; rather than require that both countries' regulatory authorities approve fares prior to them coming into effect, as required by the Air Transport Services Agreement of 1966, the fare would come into effect on the proposed date of introduction unless both countries filed an objection.

In order to preserve the integrity of the existing transborder routes operating out of Dorval, a provision was inserted into the agreement prohibiting direct service (i.e., without change of aircraft) between Mirabel and Boston, New York (JFK), Chicago (O'Hare), Los Angeles, San Francisco, Miami or Seattle. The restriction on a Mirabel-Seattle route may have been intended to protect Montreal-Vancouver service by Air Canada and CP Air (now Canadian). The agreement came into effect on August 21, 1984, and lasted for three years (U.S. Department of State, 1986).

The only airline to take advantage of the experimental agreement was People Express, which operated a Mirabel-Newark service from July 1985 until September 1986, shortly before People Express was acquired by Texas Air Corporation (Statistics Canada, 1986). San Jose, California was chosen as the U.S. counterpart in the agreement, but nothing came of it before the program expired. In a similar manner to restrictions on destinations to be served from Mirabel, the agreement prohibited serving the important transborder destinations of Los Angeles or Honolulu behind San Jose without changing aircraft.

Future bilateral agreements

The most recent indication available of the Canadian government position towards transborder service is that it favors a fully integrated North American system, allowing Canadian carriers to serve domestic U.S. routes at will. This would compensate for the strength of the American carriers' hub-and-spoke networks. In constrast, the U.S. government position appears to be more restrictive, allowing unlimited transborder service by all carriers but only limited rights for Canadian aircraft to carry passengers between American cities. (Dresner, Hadrovic and Tretheway, 1988). Air Canada Chairman Claude Taylor has also stated that a single North American aviation market should be established, with equal opportunities for carriers on both sides of the border (Sturken, 1988, Canada, 1987a and 1987b).

The agreements on local and experimental air services represent one of the few indications of the influence of international bilateral negotiations on transborder services. In 1979, the U.S. Congress passed the International Air Transportation Competition Act, which was intended to develop international negotiating positions for the U.S. Government that would increase the degree of competition on international routes (Toh and Shubat,

1985). As well, Congress granted the Administration greater retaliatory powers in order to improve the position of U.S. airlines in the international market.

The 1966 Air Transport Agreement and its amendments to date are based on the more restrictive "Bermuda I" philosophy, and so is less competition-oriented than more recent U.S. bilateral agreements (Haanappel, 1980). The vulnerability of Canadian airlines due to the greater size of U.S. carriers, the American hub-and-spoke system, higher operating costs of Canadian carriers and the use of preclearance make significant transborder liberalization a doubtful prospect (Western Transportation Advisory Council, 1986). As well, consumer interests have played a secondary role in Canadian bilateral negotiations (Dresner and Tretheway, 1987).

At the "Shamrock Summit" held on March 18, 1985, Canadian Prime Minister Brian Mulroney and U.S. President Ronald Reagan announced that the two countries would negotiate a new trading arrangement. This would include an overhaul of the 1966 Air Transport Services Agreement (Dresner, Hadrovic and Tretheway, 1988). The U.S.-Canada "free trade" agreement signed in January 1988 excluded transborder air transport, and there is little prospect of an agreement covering this area in the near future.

Preclearance - background

Preclearance is defined as the inspection of passengers and their luggage prior to departure from foreign airports rather than on arrival at their destination in another country (U.S. Department of Justice, 1985). Inspection prior to departure places the delay at the beginning of the trip rather than at the end. Since the passenger usually has more free time at the originating airport that at the final destination, it is often more convenient. Passengers also arrive at the originating airport a few at a time, as compared to arriving at their final destination all at once. Additionally, since flights are often timed to arrive at an airport during certain time windows each day (to facilitate connnections), preclearance minimizes congestion and delays for inspection at the first foreign airport.

As well, preclearance is administratively simpler for the inspecting nation. By placing customs, immigration and related personnel at a foreign airport, it becomes possible to reject prospective passengers without detaining them and possibly deporting them back to where they came from. In many cases, the costs of deportation will include accomodation, local transportation and the return air fare to the country of origin. Finally, requirements for inspection areas and personnel in the country of arrival will be reduced.

The passenger who arrives in the new country will be immediately integrated into that nation's domestic airline network, as the flight will arrive at a "normal" domestic gate. Airports in the U.S. that receive flights from locations where preclearance has not taken place, and all Canadian international airports, have flights arrive in an international arrivals area, which must be completely "sterile", i.e. separated from the world outside, until the passengers and their baggage have been cleared. Because of the cost of such facilities, it is simpler to combine them in one location at an airport, which can be quite distant from departure gates for connecting domestic flights.

The preclearance agreement served as a counterweight for U.S. carriers to the expanded "deep penetration" routes provided to Canadian airlines in the revisions to the 1966 agreement that were also agreed upon in 1974. The implicit understanding was that in return for such access, preclearance would be institutionalized in a bilateral agreement. The entrenchment of preclearance occured more than twenty years after the U.S. first began the practice, at Toronto in 1952 (Haanappel, 1980). In return for additional traffic rights into the U.S. granted Canadian carriers, U.S. airlines would be able to maintain their direct, post-inspection access to their domestic airports and networks, particularly hubs. Preclearance is therefore tied directly to maintaining the division of traffic between U.S. and Canadian carriers. The manner in which each nation has applied the preclearance agreement will be discussed below.

U.S. preclearance in Canada

The U.S. Government performs preclearance at airports in Montreal (Dorval), Toronto, Winnipeg, Edmonton (International), Calgary and Vancouver. The preclearance agreement also allows the U.S. to establish preclearance in Halifax, London, Ottawa, Quebec City and Victoria at some point in the future. It should be noted that the costs of preclearance facilities must be paid by the inspecting nation, with the exception of costs attributable to carriers. An air carrier has the technical right to opt for post-clearance where preclearance facilities exist, although competitive considerations make such an action implausible.

While the U.S. Immigration and Naturalization Service "strongly supports" opening additional preclearance locations (U.S. Department of Justice, 1985), its own budgetary limitations as well as those of its sister agencies (Customs and Agriculture) may have limited the number of preclearance locations in Canada. As well, there must be a sufficient number of U.S.-bound passengers passing through the airport to make preclearance worthwhile.

Canadian preclearance in the U.S.

The preclearance agreement provides for Canadian inspection facilities at thirteen airports in the United States (U.S. Department of State, 1974), which include the most important U.S. cities for transborder air traffic: Boston, New York, Miami, Chicago and Los Angeles. As travellers between the two countries know, Canadian preclearance has never been established at U.S. airports, and a review of the literature for this paper turned up no comments on this issue. Interestingly enough, Canada Customs does carry out preclearance inspection at one location: the Canadian Forces Base at Lahr, Federal Republic of Germany. This is to simplify the movements of defence personnel and their effects when returning to a variety of points in Canada. The number of passengers involved is a small fraction of Canada-U.S. transborder air traffic.

As discussed earlier, a significant proportion of northbound travellers will end their trips at the first Canadian airport; there is little onward connecting traffic to other Canadian cities. Therefore, the argument that pre-clearance simplifies making connections upon arrival holds less weight than for southbound traffic. Additionally, Canadian airports are, all other things being equal, smaller, and so the small proportion of travellers from the U.S. who do connect are not inconvenienced to the same extent. Only the Toronto airport has more than one terminal.

Perhaps the main reason for lack of Canadian preclearance in the U.S. lies with the size and organization of U.S. airports and the importance of connections within the hub-and-spoke networks that have evolved in recent years. Each airline leases a section of a U.S. airport, which may involve several concourses. Arrivals and departures are organized so that connections are made quickly and, hopefully, with as little walking as possible. Gate assignments within each airline's area are changed frequently. A Canadian preclearance facility, which would include inspection lines, office space and separate sterile waiting areas for precleared passengers, would have to be established for each airline with transborder flights.

It is doubtful that either the airlines or the Canadian government would want to share in their respective costs for the type of facilities that would be necessary, particularly given the value of floor space at major U.S. airports. Alternatively, a centralized Canadian inspection and holding area at each airport in question could be established, but this would have a major impact on traveller convenience and seriously reduce the present degree of integration of transborder services into the domestic U.S. network.

As discussed previously, the entrenchment by bilateral agreement of U.S. preclearance in Canada was intended in part to compensate American carriers for the increased routes granted Canadian carriers into the U.S. in 1974. Perhaps the provision in the bilateral agreement providing for Canadian preclearance in the U.S. was intended to make the deal

appear more equitable from the Canadian perspective, rather than there being any real intent to establish such facilities.

In the text of the preclearance agreement, requirements for each country's inspection areas are spelled out in separate annexes. U.S. requirements for preclearance facilities at Canadian airports run to five pages, including specific requirements for Montreal's Dorval airport, which U.S. officials found deficient in several respects. In contrast, Canadian requirements for hypothetical facilities at U.S. airports fill barely half a page and are sketchy at best. One is left to wonder whether Canadian authorities ever really intended to establish preclearance at U.S. airports.

Accordingly, it could be said that the existing preclearance policies of both countries reflect the realities of passenger movements between Canada and the U.S. While we can look forward with some justification to additional U.S. preclearance locations in Canada, there would seem to be little need or prospect for Canadian inspection sites in the United States.

Conclusion

This paper began by describing the distinctive nature of transborder air services as a logical outcome of the geography of Canada and the United States and the flow of people between the two countries. The evolution of the main agreement which governs transborder air service was discussed, along with the principal features of that agreement. Finally, the impact of preclearance on the share of traffic between the two nations' carriers was examined.

From a Canadian perspective, it would appear that the dominant feature of the negotiating positions that have characterized transborder agreements is one of protecting Canadian carriers against the massive size of their U.S. counterparts. Concessions to the American side have been made where necessary to preserve or enhance the Canadian position. Concerns such as the accessibility of services to consumers or fostering competition have played a secondary role. Transborder services, while more challenging for Canadian carriers to provide in a profitable manner, are relatively much more important to those same carriers. In contrast, U.S. carriers would tend to see transborder routes as a minor part of their domestic networks.

Hypothetically, a completely level playing field in North American air transport could see Canadian carriers swallowed up into American hub-and-spoke networks with barely a hiccup. Protecting the viability of Air Canada, Canadian Airlines, and local carriers remains a key concern of the Canadian government, with or without any advocacy of free trade between the two countries. In both nations, strong home-based carriers play a vital role in the economy.

References

Ausnit, Suzanne, "$365M Expansion Plans Almost Set at Toronto Airport", Business Travel News, April 11, 1988, 48-51.

Canada, House of Commons, Minutes of Proceedings and Evidence of the Standing Committee on Transport, Issues No. 13, 2nd Session of the 33rd Parliament, 1986-87, March 3, 1987a, and 14, March 24, 1987b.

Dempsey, Paul Stephen, "Turbulence in the 'Open Skies': The Deregulation of International Air Transport", Transportation Law Journal, 15, 1987, 305-388.

Dresner, Martin, Carolyn Hadrovic and Michael W. Tretheway, The Canada-U.S. Air Transport Bilateral: Will It Be Freed?, Faculty of Commerce and Business Administration, University of British Columbia, 23 February 1988.

Dresner, Martin, and Michael W. Tretheway, Policy choices for Canada in International Air Transport, Faculty of Commerce and Business Administration, University of British Columbia, January 1987 (Working Paper 1220).

Fawcett, Stanley E., and Stanley A. Fawcett, "Congestion at Capacity-Constrained Airports: A Question of Economics and Realism", Transportation Journal, 27(4), Summer 1988, 42-54.

Haanappel, P.P.C., "Bilateral air transport agreements between Canada and the U.S.A.", Annals of Air and Space Law, 5, 1980, 133-153.

Statistics Canada, Air passenger origin and destination: Canada-United States report, Catalogue 51-205, years 1982 - 1986.

Statistics Canada, "Passenger Traffic on Commercial Air Services", Canadian Social Trends, Catalogue 11-008E, Spring 1988, 28-34.

Stevenson, Garth, The Politics of Canada's Airlines: from Diefenbaker to Mulroney. Toronto: University of Toronto Press, 1987 (The State and Economic Life Series, No 9).

Sturken, Barbara, "Air Canada Chief Urges Unified Market for North American Lines", Travel Weekly, April 7, 1988, 47.

Toh, Rex S., and Nathan S. Shubat, "The Impact and Effectiveness of the International Air Transportation Competition Act of 1979", Transportation Journal, 25 (2), Winter 1985, 46-54.

U.S. Department of Justice, Immigration and Naturalization Service, Preclearance: The Logical Choice, Form M-260 (07/01/85).

U.S. Department of State, Air transport agreement between the government of the United States of America and the Government of Canada, entered into force January 17, 1966, with exchange of notes, as amended to May 24, 1984 (TIAS 5972).

U.S. Department of State, Agreement between the government of the United States of America and the Government of Canada on air transport preclearance, entered into force May 8, 1974, with annexes and related agreement, August 23 and October 15, 1979 (TIAS 7825, TIAS 9677).

U.S Department of State, Memorandum of understanding concerning access of airlines of the United States and Canada to LaGuardia Airport for transborder services, entered into force March 25, 1985.

U.S. Department of State, Agreement concerning an experimental transborder air service program, exchange of notes entered into force March 13, 1986 [superceded agreement of August 21, 1984].

Western Transportation Advisory Council, WESTAC Newsletter, 12(4), November 1986.

TABLE 1
TRANSBORDER AIR TRAFFIC VOLUMES
TOTAL OUTBOUND AND INBOUND PASSENGERS
TEN BUSIEST CANADIAN AIRPORTS

City	Volume 1985 of ('000s)	Cumulative percentage volume	Volume 1986 ('000s)	Cumulative percentage of volume
Toronto	2841.4	20.77	3220.0	20.80
Montreal	1567.7	32.23	1736.7	32.02
Vancouver	784.1	37.96	1097.2	39.11
Calgary	445.2	41.21	472.0	42.16
Edmonton	238.6	42.94	244.5	43.74
Winnipeg	215.8	44.52	230.2	45.23
Ottawa	246.3	46.32	225.3	46.69
Halifax	113.0	47.15	124.3	47.49
Quebec City	59.0	47.58	57.4	47.86
St. John's	36.3	47.85	38.5	48.11
Total transborder volume	13677.9	100.00	15480.1	100.00

Source: Statistics Canada (1986).

TABLE 2
TRANSBORDER AIR TRAFFIC VOLUMES
TOTAL OUTBOUND AND INBOUND PASSENGERS
TEN BUSIEST U.S. AIRPORTS

City	Volume 1985 ('000s)	Cumulative percentage of volume	Volume 1986 ('000s)	Cumulative percentage of volume
New York	1234.0	9.03	1426.7	9.22
Los Angeles	626.8	13.61	761.3	14.14
San Francisco/Oakland	404.8	16.57	510.7	17.44
Boston	413.5	19.59	489.7	20.60
Chicago	426.0	22.70	487.9	23.75
Miami	390.7	25.56	429.1	26.52
Tampa/St. Petersburg	277.6	27.5	288.9	28.39
Washington/Baltimore	214.0	29.15	249.6	30.00
Philadelphia	144.3	30.21	164.0	31.06
Dallas/Ft. Worth	162.6	31.40	158.2	32.08
Total transborder volume	13677.9	100.00	15480.1	100.00

Source: Statistics Canada (1986).

TABLE 3
TRANSBORDER AIR TRAFFIC VOLUMES
TOTAL OUTBOUND AND INBOUND PASSENGERS
RANKED BY CITY PAIR

City Pair	Volume 1985 ('000s)	Cumulative percentage of volume	Volume 1986 ('000s)	Cumulative percentage of volume
New York-Toronto	637.2	9.32	747.3	9.66
Montreal-New York	410.4	15.32	461.0	15.62
Chicago-Toronto	228.4	18.66	260.3	18.98
Los Angeles-Vancouver	183.9	21.35	253.4	22.25
San Francisco/ Oakland-Vancouver	133.1	23.30	210.7	24.97
Boston-Toronto	171.2	25.80	200.4	27.56
Los Angeles-Toronto	162.1	28.17	197.9	30.12
Miami-Montreal	165.6	30.59	172.1	32.34
Boston-Montreal	129.2	32.48	160.9	34.42
Miami-Toronto	133.5	34.43	155.0	36.42
Total transborder volume	13677.9	100.00	15480.1	100.00

Source: Statistics Canada (1986).

TABLE 4
SCHEDULED TRANSBORDER ROUTES UNDER THE AIR TRANSPORT SERVICES AGREEMENT JANUARY 17, 1966 - DECEMBER 31, 1987

Route (in order of Canadian point)	Year assigned	Carrier (U.S./Cdn.)
Calgary-Chicago	1974	Cdn.
Calgary/Edmonton -Denver/Great Falls	1966	U.S.
Calgary/Edmonton-Las Vegas	1974	U.S.
Calgary/Edmonton-Los Angeles	1974	U.S./Cdn.
(Houston/Dallas)-Calgary/ Edmonton-Anchorage/Fairbanks	1974	U.S.
Calgary/Edmonton-San Francisco	1974	Cdn.
Calgary/Edmonton-Spokane	1966	U.S.
Halifax-Bangor(/Portland-Mtl)	1974	Cdn.
Halifax-Boston/New York	1966	Cdn.
Hamilton-Pittsburgh	1974	Cdn.
Inuvik-Fairbanks	1974	U.S.
Montreal-Boston	1966	U.S.
Montreal-Buffalo/Rochester	1974	U.S./Cdn.
Montreal-Burlington/Albany	1974	U.S.
Montreal-Chicago	1974	U.S.
Montreal-Cleveland	1974	U.S./Cdn.
Montreal-Detroit	1974	U.S.
Montreal-Philadelphia	1974	U.S.
Montreal-Portland(/Bangor-Hfx)	1974	Cdn.
Montreal-Tampa/Miami	1966	U.S./Cdn.
Montreal-New York	1966	U.S./Cdn.
Ottawa-New York	1981	U.S.
Ottawa-Washington	1966	U.S.
Prince Rupert-Ketchikan	1966	U.S./Cdn.
Quebec City-New York	1974	Cdn.
Sydney-Boston	1974	Cdn.
Thunder Bay-Duluth/Superior	1966	U.S.
Toronto-Boston	1966	U.S./Cdn.
Toronto-Buffalo	1966	U.S.
Toronto-Chicago	1966	U.S./Cdn
Toronto-Cleveland	1966	U.S./Cdn.
Toronto-Dallas-Houston	1974	Cdn.
Toronto-Detroit/Milwaukee	1966	U.S.
Toronto-Erie	1966	U.S.

Route (in order of Canadian point)	Year assigned	Carrier (U.S./Cdn.)
Toronto-Los Angeles	1966	U.S./Cdn.
Toronto-New York	1966	U.S./Cdn.
Toronto-Philadelphia	1974	U.S.
Toronto-Pittsburgh	1974	U.S./Cdn.
Toronto-Rochester	1974	U.S.
Toronto-San Francisco	1974	U.S./Cdn.
(Montreal)-Toronto-San Juan	1984	U.S./Cdn.
Toronto-Tampa/Miami	1966	U.S./Cdn.
Vancouver-Chicago	1974	U.S.
Vancouver-Honolulu	1974	U.S.
Vancouver-Los Angeles	1966	U.S./Cdn.
Vancouver-San Francisco	1966	Cdn.
Vancouver-Seattle	1966	U.S./Cdn.
Vancouver-Spokane	1974	U.S.
Victoria-Seattle	1966	Cdn.
Whitehorse-Fairbanks	1966	U.S./Cdn.
Whitehorse-Juneau	1966	U.S./Cdn.
Winnipeg-Bismarck/Minot	1974	U.S.
(Regina)-Winnipeg-Chicago	1974	Cdn.
Winnipeg-Duluth/Superior/ Milwaukee	1974	U.S.
Winnipeg-Minneapolis	1966	U.S.
(Chicago/Minneapolis)-Winnipeg/ Edmonton-Anchorage	1966	U.S.
(Calgary)-Winnipeg-New York	1974	Cdn.
U.S.-Gander-Europe and beyond	1966	U.S.
Canada-Honolulu-Australasia and beyond	1966	Cdn.

Source: U.S. Department of State (1966 [as amended], 1986).

Note

Numerous restrictions and conditions apply to service over many routes. The agreements themselves should be consulted for details.

TRANSPORTATION RATES AND SEAWAY COMPETITIVINESS FOR EXPORTING U.S. GRAIN

by
Ilazem Ghonima*
TAF Consultants

INTRODUCTION

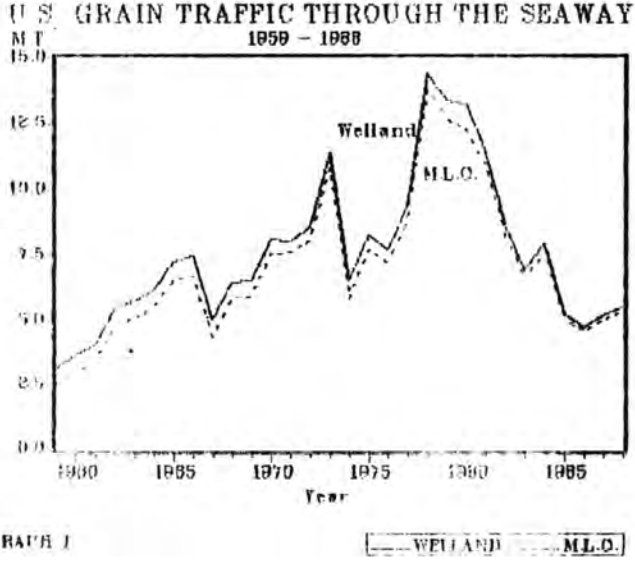
U.S. grain(1) for exports is moved to overseas destinations from four major U.S. coastal areas: the Great Lakes, the Atlantic, the Gulf and the Pacific. These outlets are linked to U.S. grain-producing areas by 5 major transportation arteries composed of various modes and routes. U.S grain exported through the Seaway system originates at the U.S. Great Lakes terminals and is destined for Europe, North Africa & the Middle East, Latin America and the Soviet Union. An important portion of this traffic is carried by Seaway-size lakers to lower St. Lawrence ports for trans-shipments to ocean vessels. Beside the laker movements, a considerable amount of U.S grain is shipped directly from the Great Lakes to overseas destinations in ocean vessels.

When the Seaway opened in 1959, U.S grain traffic, on the Welland canal, amounted to 3.1 million tonnes. This movement reached the record level of 14.5 million tonnes in 1978 . During this period, two major cycles occurred in which the traffic fluctuated sharply. A third major cycle appears to have started after 1979 and seems to have reached a bottom line in 1986 when U.S. grain traffic through the Welland canal dropped to 4.8 million tonnes. A slight upward trend appears to have started in 1987 bringing this traffic to about 5.6 million tonnes in 1988 (see Graph 1).

This paper analyses the various components of transportation charges for moving U.S. grain from producing centers to overseas markets through alternative routes and modes. Its purpose is to determine the extend to which transportation charges for exporting U.S grain via the Great Lakes - St. Lawrence Seaway system contributed to the decline of this traffic since 1979. The flows of U.S grain through the major alternative routes and

* Il Ghonima was Senior Economist with the St. Lawrence Seaway Authority until the end of January 1989. He is presently a Traffic Analysis & Forecasting consultant.
(1) Include wheat, corn, rye, oats, barley, soybeans, flaxseed and sunflower seeds

modes, including the Great Lakes-St. Lawrence Seaway system, the rail route via the U.S. Atlantic outlet, the barge and rail routes via the Mississippi Gulf outlet, and the rail mode via the U.S. Pacific outlet, were depicted. Overseas markets for U.S grain were then determined and the historical share of the alternative outlets for shipping U.S. grain to these markets identified. Domestic transportation rates for moving grain to the major U.S. outlets were estimated and combined with the ocean rates to various overseas grain markets. A matrix of the total transportation charges for moving U.S. grain from producing area to overseas port destinations through alternative routes and modes was then developed. Finally, the findings regarding the influence of various factors, including transportation charges, on the competitiveness of the Seaway for exporting U.S. grain are presented.



GRAPH 1

U.S. GRAIN MARKETING SYSTEM

The grain marketing system in the U.S. is somewhat different than that in Canada. Whereas the Canadian Wheat Board (CWB) is the sole marketing agency for grain produced in western Canada, with extensive marketing power, no similar organization exists in the U.S.; in the American context, this role is assumed by several independent organizations. This makes a study of the U.S. grain transportation and marketing system much more complex than its counterpart in Canada. Therefore, the techniques used in this study to gather data about transportation rates for moving U.S. grain domestically were different than those which were used in the Canadian grain transportation rates study[1].

Since published data on transportation rates are not available on a regular basis from public U.S. organizations, extensive phone interviews with shippers and carriers of U.S. grain were undertaken in order to obtain transportation rates for the various modes along several routes. For example, in order to estimate barge rates, the official "Basis Trading Benchmarks" guide was obtained from the St. Louis Merchant Exchange, the agency where barge freight services are traded. This guide lists the benchmark rates for numerous points along the Mississippi system. Moreover, the American Commercial Barge Line provided us with historical annual average traded percentages which, when used with the benchmarks, allowed us to estimate some historical barge rates.

A more difficult task was to obtain historical data for truck rates as U.S. agencies for this mode are not required to file their tariffs; the trucking industry, as far as hauling grain is concerned, is not monitored in terms of tonnage or rates charged. Most grain is hauled by "exempt" or "private" carriers whose activities include transporting commodities which are not subject to the jurisdiction of the Interstate Commerce Commission (ICC).

Similarly, U.S. rail rates are not monitored by U.S. government agencies, particularly since the Staggers Act of 1980 which allowed for deregulation and confidential contracts. This has complicated matters further in that, in many cases, published rail rates have become "paper rates" i.e. they may or may not represent the actual rates at which grain is moved. To

[1] Hazem Ghonima, Transportation Rates and Seaway Competitiveness for Moving Canadian Grain, CTRF, Minaki, May 1988

obtain the rates for the rail and truck modes, quotations were provided by U.S. carriers and boards of trade dealing with these modes.
A comprehensive survey of other existing studies dealing with the costs of transporting U.S. grain was conducted to verify the accuracy of the information gathered as well as to substantiate the statistical findings of this study. Finally, it is relevant to note that the transportation rates matrix which is presented in this paper should be used with caution and for comparison purposes only since it represents estimated rates for transporting U.S. grain rather than true transportation costs.

U.S. GRAIN EXPORTS AND THE SEAWAY

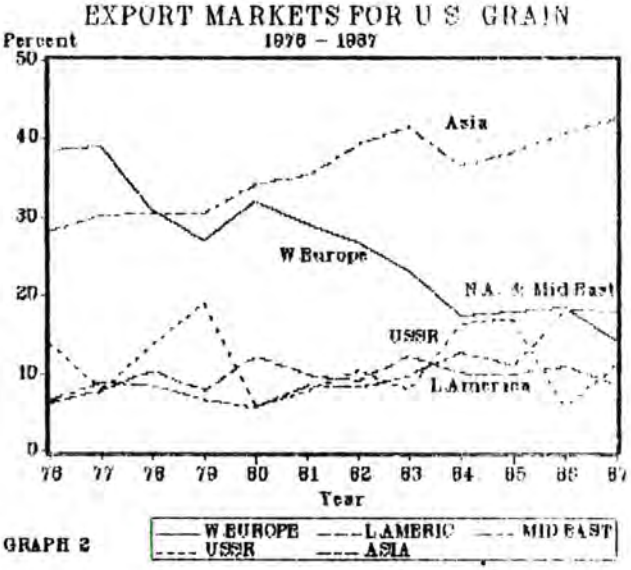
For a better understanding of the behavior of U.S. grain traffic via the seaway in recent years, the following observations should be considered. In 1980*, when world grain trade level reached 230 million tonnes, U.S. grain exports recorded 133 million tonnes, representing 58% of the world grain trade. Six years later, in 1986, when world grain trade declined to an estimated 206 million tonnes, U.S. grain exports dropped to about 95 million tonnes, 29 % lower than the record level of 1980, and accounting for only 46% of the world grain trade.

In 1976, Western Europe was the biggest market for U.S. grain, representing 38% of total U.S. grain exports. The Asian market was second in importance, accounting for 28% of total U.S. grain exports, followed by the Soviet Union (14 %), North Africa & the Middle East (6.6%), and Latin America (6.3%). By 1986, the market for U.S. grain exports had changed radically; Asia became the most important with a market share of almost 41% of total U.S. grain exports, followed by Western Europe, which drastically diminished in importance to only 18%. In contrast, North Africa - Middle East and Latin America increased their shares to about 18% and 11% respectively. Meanwhile, the Soviet Union which tend to fluctuate sharply from year to year, accounted for only 6% in 1986 (see Graph 2).

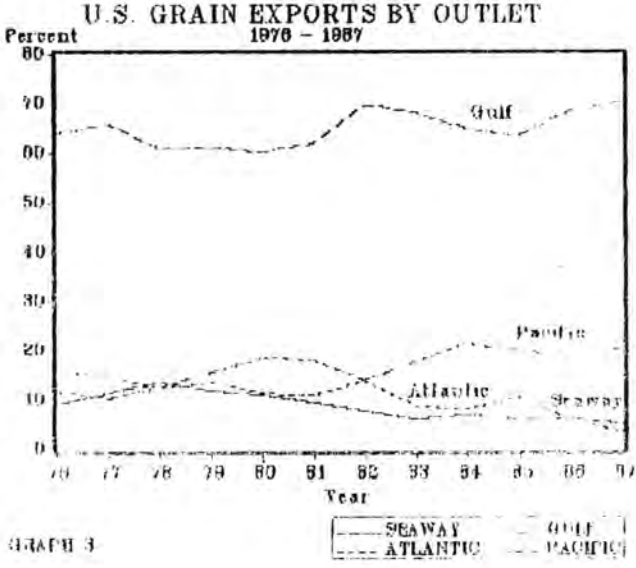
The Seaway share of total U.S. grain exports in 1986 was 6.1%. In the same year, the waterway moved 13.7% of all U.S. grain exported to Western Europe, 12.9% to North Africa & the Middle East, 2.4% to the Soviet Union and 2.7% to Latin America. Meanwhile, the U.S. Atlantic, the U.S. Gulf and the U.S. Pacific outlets moved 6%, 68.8%, and 19.1% of total U.S. grain exports respectively (see Graph 3).

---

*Crop year



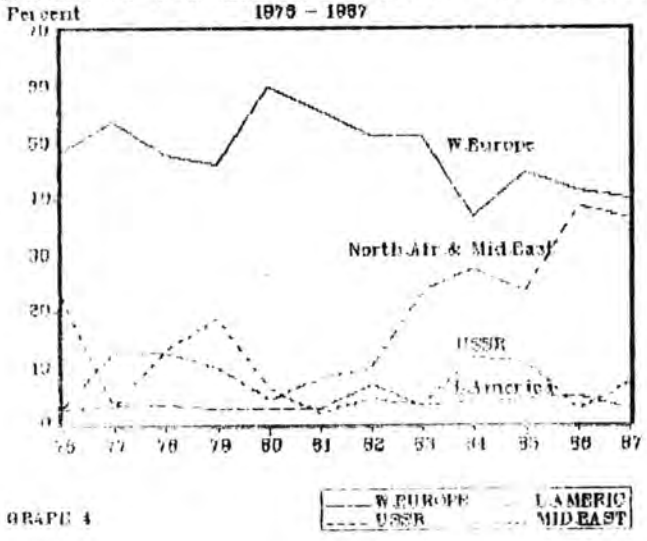
GRAPH 2



GRAPH 3

Western Europe continues to be the major recipient of U.S grain exported through the Seaway. In 1986, it accounted for 41.6% of this traffic, far below the 60% recorded in 1980. North Africa & the Middle East came a close second in importance, representing about 38.7% of all U.S grain moving via the Seaway, compared to 4% six years earlier. Meanwhile, the Soviet Union, accounted for 2.3% compared to 6.2% in 1980.
Algeria, which is included in the North Africa & Middle East region, obtained 42% of its U.S. grain imports via the Seaway in 1986. This amounted to 0.88 million tonnes, representing 18.3% of all U.S. grain traffic moving through the Welland (see Graph 4)..

MARKET OF U.S. GRAIN EXPORTED VIA SEAWAY



GRAPH 4

FINDINGS

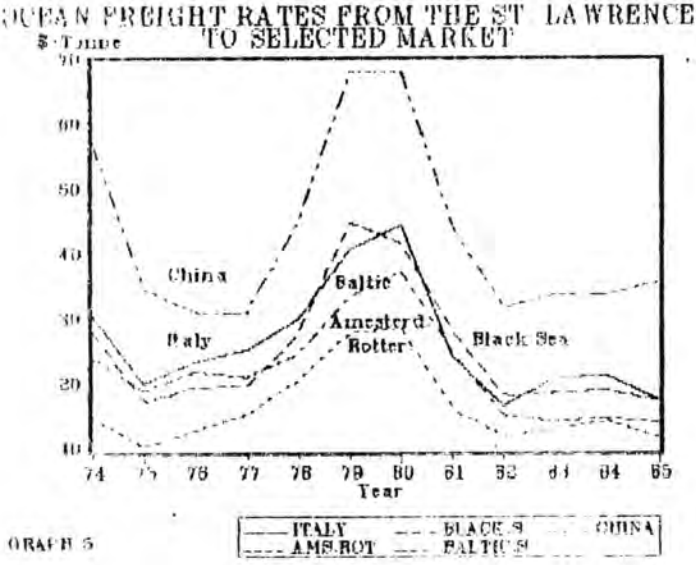
The amount of U.S. grain moving through the Seaway develops as a result of the influence of several factors including; the world and domestic grain supply/demand conditions, the agricultural policies of major grain producers as well as traditional Seaway market countries, the Soviet-North American grain trade situation, the capacity of the grain transportation system in both Canada and the U.S., U.S. agricultural and foreign aid policy, the development and modernization of Great Lakes-Seaway port and grain-handling facilities, and finally, Seaway laker fleet efficiency and the comparative costs of transportation, the latter being the subject of this report.

U.S. grain traffic through the Seaway was found to depend mainly upon the demand from traditional Seaway markets as well as on the component capacities of the U.S. grain transportation system. These, in turn, were affected by the prevailing world and domestic economic situation. In years when world grain demand was high and the U.S. economic situation was robust, the flow of various commodities through the U.S. transportation system flourished; the U.S. transportation system tended to experience capacity limitations and hence, U.S. grain exports through the Seaway grew. But with the softening of world seaborne trade in the last few years, ocean rates declined (see Graph 5) and their share of the total transportation cost relatively diminished. Meanwhile, commodity movements through the U.S. transportation system declined, hence, the available capacity of this system artificially increased, transportation rates (particularly the Mississippi barge rates) relatively fell and consequently U.S. grain via the Seaway declined.

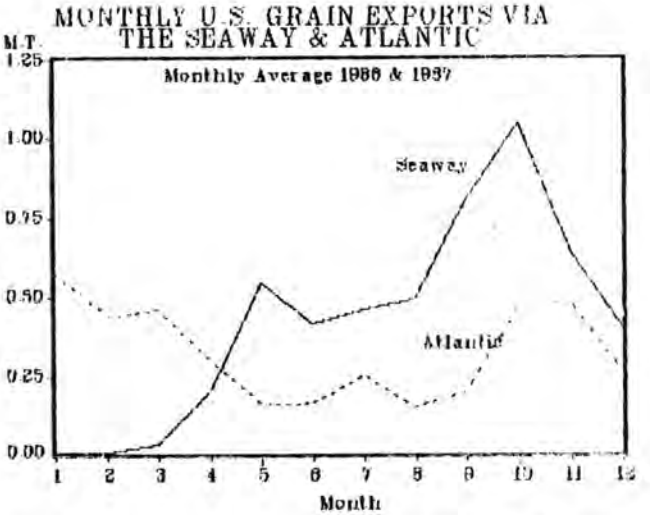
U.S. grain traffic on the Seaway was also found to be highly sensitive to the grain demand from Western Europe and, to a lesser degree, from North Africa and the Middle East. The decline in demand from the European market in the last few years has had a drastic impact on the amount of U.S. grain exported via the Seaway. Moreover, In 1986, when the world grain trade had diminished and total U.S. grain exports shrunk, U.S. grain through the Welland declined to the 4.8 million tonnes. This was a reflection of the dramatic decline of U.S. grain exports to Western Europe which had plummeted to the 13.6 million tonne level.

Although the U.S. Staggers Act of 1980 may have contributed to reducing the cost of moving U.S. grain by rail, it was not the main factor which contributed to the decline of U.S. grain moving via the Seaway vis a vis the U.S. Atlantic outlet. In fact, grain exported through the Atlantic has been

higher in absolute terms and in percentage share than U.S. grain shipped through the Seaway since 1974, six years before the Staggers Act. Moreover, in 1986, the Seaway share of total U.S. grain exports surpassed that of the Atlantic outlet. An important factor regarding the higher grain exports via this eastern terminal is the timing of grain shipments. When shipments are strong during the first three months of the calendar year, the U.S. Atlantic seems to gain the upper hand in cumulative grain exports for the year. But in a year when U.S. grain exports are soft during the first three months, the cumulative traffic advantage tends to shift to the Seaway since the waterway usually moves more U.S. grain exports than the U.S. Atlantic outlet during the remainder of the season (see Graph 6).



GRAPH 5



GRAPH 8

Transportation rates for moving U.S. grain through the Seaway are not the principal factors responsible for the downward trend of this traffic in the last few years. In a deregulated environment, they tend to fluctuate proportionately with the equilibrium developed as a result of the interplay between the forces of supply and demand. Hence, they should not be considered as the sole indicators of the competitive position of the Seaway; rather, they should be analyzed in the wider scope of world market conditions.

In general, transportation rates for moving U.S. grain from a point located within a 160 km (100-mile) radius of the Great Lakes via the Seaway to final overseas destinations were found to be relatively more competitive than most U.S. alternative routes, particularly those using rail to move U.S. grain. For example, to move U.S. grain from within a 160 km (100-mile) radius of Toledo, Ohio by truck to the Seaway and then by laker to Montreal, followed by ocean vessel to Amsterdam/Rotterdam, was estimated to cost approximately $35.38/tonne. This, compared to $47.53/tonne if we considered a movement from within a 160 km (100-mile) radius of Columbus, Ohio by truck to Baltimore and then by rail to the

U.S. Atlantic for ocean shipment to Amsterdam/Rotterdam. Similarly, a movement from within a 160 km (100-mile) radius of Chicago by truck to the Seaway, then by laker to Montreal and on by ocean vessel to Amsterdam/Rotterdam, would cost $36.28/tonne. This is slightly lower than the $37.27/tonne for moving grain from within a 160 km (100 mile) radius of Chicago by truck and then by barge to New Orleans via the Mississippi and on to Amsterdam/Rotterdam.

Nevertheless, it was also found that the further the distance the grain shipments originate from ports on the Great Lakes, the more the rate advantage tends to shift towards alternative routes, particularly the Mississippi Gulf route. For example, shipment by truck from within a 160 km (100 mile) radius of Cairo, Illinois, which is located 586 km (364 miles) from Chicago, and then from Cairo to New Orleans by barge and on by ocean vessel to Amsterdam/Rotterdam would cost $32.77/tonne versus the $36.28/tonne rate from Chicago via the Seaway to Amsterdam/Rotterdam.

Tables 1 to 3 illustrate the U.S. grain transportation rates framework which was developed for this paper. These tables show comparative rates for selected routes and modes within the U.S. grain transportation system to overseas destinations.

CONCLUSION

Overall, it has been demonstrated that transportation rates for moving U.S. grain through the Seaway are not the principal factors responsible for the downward trend of this traffic in the last few years. U.S. grain traffic was found to depend mainly upon the demand from traditional Seaway markets as well as on the component capacities of the U.S. grain transportation system. These, in turn, are affected by the prevailing world grain trade as well as by the economic situation of other commodity flows.

The study also found that the Seaway has not lost U.S. grain traffic to the U.S. Atlantic outlet as a result of the deregulated environment created by the U.S. Staggers Rail Act of 1980. In general, transportation rates for moving U.S. grain from a point located within a 160 km (100-mile) radius of the Great Lakes via the Seaway to final overseas export destinations were found to be relatively more competitive than rates for most U.S. alternative routes, particularly those using rail to move U.S. grain. However, the further the distance the grain shipments originate from ports on the Great Lakes, the more the rate advantage tends to shift towards alternative routes, particularly the Mississippi Gulf route.

TABLE I OCEAN RATES FOR MOVING US GRAIN OVERSEAS FROM ALTERNATIVE OUTLETS

(Cdn $ / tonne)

OUTLET	OCEAN RATES (1)							
	Amster/ Rotter.	Italy (West)	Black Sea	Baltic Sea	Siberia	China	Japan	Egypt
SEAWAY	14.84	21.72	19.64	13.40	-	34.68	-	-
US ATLANTIC	20.28	25.51	22.97	15.69	26.35			29.56
US GULF	17.48	25.88	27.55	16.38	26.35	30.80	36.17	32.53
US PACIFIC	-	24.47	-	-	22.76	24.79	26.92	

Note:
(1) Schedule "A" ocean rates
(-) Not available

TABLE 2 DOMESTIC TRANSPORTATION RATES (1) FOR MOVING US GRAIN BY ALTERNATIVE ROUTES & MODES

(Can $ / tonne.)

Route	Mode				Total Domestic Rate
	Truck	Rail	Water		
			Barge	Seaway(2)	
Seaway					
100-mile radius to Toledo(truck)-Toledo to Montreal(Seaway)	3.39	-	-	2.14	20.54
100-mile radius to Chicago(truck)-Chicago to Montreal(Seaway)	9.30	-	-	2.14	21.44
Allendorf,Iowa to Chicago(rail)-Chicago to Montreal(Seaway)	-	19.30	-	12.14	31.44
N Dakota to Duluth(truck)-Duluth to Montreal(Seaway)	30.64	-	-	2.14	42.78
Minot,N Dakota to Duluth(rail)-Duluth to Montreal(Seaway)	-	33.08	-	12.14	45.23
U.S. Atlantic					
100-mile radius to Columbus(truck)-Columbus to Baltimore(rail)	10.39	16.85	-		27.25
US Gulf					
Barge via Mississippi					
N Dakota to Minneapolis(truck)-Minneapolis to New Orleans(barge)	27.58	-	12.13		39.71
100-mile radius to Chicago(truck)-Chicago to New Orleans(barge)	9.30	-	10.49		19.79
100-mile radius to Cincinnati(truck)-Cincinnati to New Orleans(barge)	10.39	-	7.74		18.13
100-mile radius to Cairo, Ill(truck)-Cairo to New Orleans(barge)	9.30	-	5.99		15.29
Rail					
Aberdeen, S Dakota to Texas Gulf(rail)	-	50.97	-		50.97
St James, Minnesota to New Orleans(rail)	-	41.37	-		41.37
Cedar Rapids, Iowa to New Orleans(rail)	-	37.07	-		37.07
U.S. Pacific					
Hastings, Nebraska to Pacific Northwest(rail)	-	43.20	-		43.20

Note:

(1) Fobbing charges are excluded as they are assumed to be similar for all alternative outlets

(2) The Seaway rate represents the CWB's estimation of lake freight, excluding pilotage, tolls, etc to the lower St. Lawrence for transshipment

TABLE 3 TOTAL TRANSPORTATION RATES (1) FOR MOVING US GRAIN OVERSEAS BY ALTERNATIVE ROUTES & MODES

(Can $ / tonne)

ROUTE	DOMESTIC RATES	DESTINATION OCEAN RATES (2)							
		Amster/ Rotter	Italy (West)	Black Sea	Baltic Sea	Siberia	China	Japan	Egypt
SEAWAY									
200-mile radius to Toledo (T) - Toledo to Montreal (S)	20.54	14.84	21.72	19.64	13.40	-	34.68	-	-
Total (Domestic + Ocean)	————	**35.38**	**42.26**	**40.18**	**33.94**	-	**55.22**	-	-
200-mile radius to Chicago (T) - Chicago to Montreal (S)	21.44	14.84	21.72	19.64	13.40	-	34.68	-	-
Total (Domestic + Ocean)	————	**36.28**	**43.16**	**41.08**	**34.84**	-	**56.12**	-	-
Hollandorf, Iowa to Chicago (R) - Chicago to Montreal (S)	31.44	14.84	21.72	19.64	13.40	-	34.68	-	-
Total (Domestic + Ocean)	————	**46.28**	**53.16**	**51.08**	**44.84**	-	**66.12**	-	-
N. Dakota to Duluth (T) - Duluth to Montreal (S)	42.78	14.84	21.72	19.64	13.40	-	34.68	-	-
Total (Domestic + Ocean)	————	**57.62**	**64.50**	**62.42**	**56.18**	-	**77.46**	-	-
Minot, N. Dakota to Duluth (R) - Duluth to Montreal (S)	45.23	14.84	21.72	19.64	13.40	-	34.68	-	-
Total (Domestic + Ocean)	————	**60.07**	**66.95**	**64.87**	**58.63**	-	**79.91**	-	-
US ATLANTIC									
200-mile radius to Columbus(T)-Columbus to Baltimore(R)	27.25	20.28	25.51	22.97	16.69	26.35	-	-	29.56
Total (Domestic + Ocean)	————	**47.53**	**52.76**	**50.22**	**42.94**	**53.60**	-	-	**56.81**
US GULF									
Barge via Mississippi									
N Dakota to Minneapolis(T)-Minneapolis to New Orleans(B)	39.71	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	————	**57.19**	**65.59**	**67.26**	**56.09**	**66.06**	**78.59**	**75.88**	**72.04**
200-mile radius to Chicago(T) - Chicago to New Orleans(B)	19.79	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	————	**37.27**	**45.67**	**47.34**	**36.17**	**46.14**	**58.67**	**55.96**	**52.12**
200-mile radius to Cincinnati(T)-Cincinnati to N Orleans(B)	18.13	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	————	**35.61**	**44.01**	**45.68**	**34.51**	**44.48**	**57.01**	**54.30**	**50.46**

TABLE 3 CONT

US GULF - Barge vis Mississippi continued

ROUTE	DOMESTIC RATES	DESTINATION OCEAN RATES (2) Amster/ Rotter	Italy (West)	Black Sea	Baltic Sea	Siberia	China	Japan	Egypt
50-mile radius to Cairo, Illinois - Cairo to New Orleans (B)	15.29	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	———	32.77	41.17	42.84	31.67	41.64	54.17	51.46	47.62
Rail									
Aberdeen, S. Dakota to Texas Gulf (R)	60.97	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	———	78.45	86.85	88.52	77.35	87.32	99.85	97.14	93.30
St. James, Minnesota to New Orleans (R)	41.37	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	———	58.85	67.25	68.92	57.75	67.72	80.25	77.54	73.70
Cedar Rapids, Iowa to New Orleans (R)	37.07	17.48	25.88	27.55	16.38	26.35	38.88	36.17	32.33
Total (Domestic + Ocean)	———	54.55	62.95	64.62	53.45	63.42	75.95	73.24	69.40
US PACIFIC									
Hastings, Nebraska to Pacific Northwest (R)	43.20	-	24.47	-	-	22.76	24.79	26.92	-
Total (Domestic + Ocean)	———	-	67.67	-	-	65.96	67.99	70.12	-

Note

(1) Fobbing charges are excluded as they are assumed to be similar for all alternative outlets.

(2) Schedule 'A' ocean freight rates

(-) Not available

Legend: T = Truck R = Rail
S = Seaway B = Barge

SELECTED REFERENCES

American Commercial Barge Line
DRI/ACRES, Seaway Commodity Flow forecast 1980 to 2000, Feb. 1982
Gemmell, A.W., The Mississippi River Waterway: An Alternative Route for Canadian Grain Export, CTC Working Paper, 1987
Ghonima, H., The Future of the Seaway Traffic, The University of Manitoba Transportation Institute Conference on the Future of the Great Lakes- St. Lawrence Seaway System, Winnipeg, February 1986
Rand McNally, Handy Railroad Atlas of the U.S.
International Wheat Council (IWC), World Wheat Statistics
The St. Lawrence Seaway Authority, Economics Section
The St. Lawrence Seaway Authority, Traffic Report
The St. Louis Merchant Exchange, Basic Trading Benchmarks
U.S.D.A., Federal Grain Inspection Service
U.S.D.A., Weekly Grain & Feed Market News
U.S.D.A., World Grain Situation & Outlook
U.S.D.A., World Oilseed Situation & Market Highlights

ACKNOWLEDGEMENTS

The Author gratefully acknowledges the valuable assistance and contribution provided by E. Riach