FACTORS INFLUENCING AIRLINE PASSENGER FARES IN CANADA

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Introduction

The Canadian passenger airline industry has changed significantly over the last 25 years. This includes a transition to hub-and-spoke networking and the introduction of computer reservation systems, discount fares, reward programs and code-sharing agreements. There has been the emergence of regional and low cost carriers along with mergers, acquisitions and bankruptcies.[2] What has been the impact of these changes on the price of air travel?

To some extent, the Canadian experience has mimicked that of the American airline industry. Anderson, Gong, and Lakshamanan (2005) investigated factors that influenced average passenger airfare in the United States (U.S.). They found that market structure had less influence than did the existence of a lower cost alternative. However, there have been relatively few studies of how such factors have influenced Canadian passenger airline fares (Lazar, 2003).

Following Anderson et al. (2005), Peter and McKeown (2012) used cross-sectional models to assess factors that influenced passenger fares in Canada from 1983 to 2010 and concluded that an alternative specification is needed. This paper uses a panel data approach to explicitly account for year and carrier effects. It begins by providing an historical and economic context. Then, after examining selected industry trends, the paper presents the data, variables and the model, and concludes with a discussion of the findings.

Historical and Economic Context

Historically, Canadian transportation was shaped by federal regulations that supported national carriers as 'natural monopolies'. Air Canada was created in 1937 as a crown corporation. During the post-war period, this national 'incumbent' airline was granted exclusive rights to operate certain routes. Following a flurry of applications for commercial air licenses in the late 1970s, regulation was gradually relaxed. The 1977 Air Canada Act removed the advantages and burdens accruing to the carrier as an instrument of federal policy (Christopher & Dion, 2002; Moneiro & Annan, 2001).

The 1978 Airline Deregulation Act in the U.S. allowed carriers that were "fit, willing and able" to serve any route and charge any fare to compete. Research examined whether the inefficiencies in the American industry would be alleviated through market competition, resulting in an improvement in economic welfare (Bailey, 1981, 1993; Baumol, Panzar & Willig, 1982; Borenstein, 1992). Perfect competition requires a contestable market with low cost entry and no sunk costs so that decisions are inexpensively reversible.[3]

In a contestable market, new entrants induce incumbent firms to price competitively and accrue zero economic profits, maximizing economic welfare irrespective of the number of firms.[4] Earlier work identified the American airline industry as having these conditions (Baumol et al., 1982). However, other studies have found there can be structural (e.g. fixed costs) and strategic (e.g. reward programs) barriers to entry; for example, strategic alliance being used in anticipation of future competition (Goetz & Shapiro, 2012).[5]

After the 1978 regulatory reforms in the U.S., new entrants surged and prices fell. This experience encouraged Canadian reform as passengers turned to U.S. carriers for lower fares and Canadian carriers pushed for reduced regulation to compete on an equal basis (Anderson et al., 2005). The Canadian industry was heavily regulated with larger volume routes cross-subsidizing smaller regional routes and carriers requiring approval to offer service at a given fare on a given route with a given type of aircraft (Statistics Canada, 1993).

A 1984 federal policy statement first liberalized air transport by allowing carriers to compete anywhere domestically (Canadian Transportation Agency, 2004). A Transport Canada (1985) policy paper, which asserted that more freedom of entry would allow market forces to produce a wider range of products and price options, then served as the conceptual framework for the regulatory reforms in the 1987 National Transportation Act.

Anticipating reform, partnerships were formed, and merger and acquisition activity occurred before the 1987 Act was passed.[6] Large airlines moved from fully-connected linear to domestic hub-and-spoke networks to exploit economies of scale and scope while, internationally, partnerships or alliances were formed (Button, 2005; Gillen, 2005).[7] Carriers also took advantage of technology to create automated reservations systems and customer reward programs.

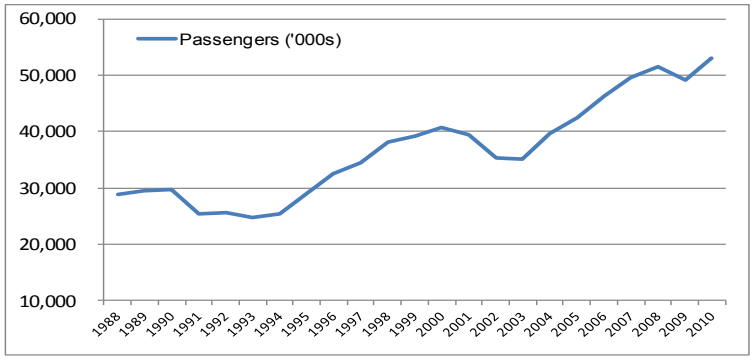
In both countries, the airline industry experienced much turnover with new carriers entering and then exiting the market via acquisition, merger, or bankruptcy. It was not just small carriers that struggled financially, many larger legacy carriers with higher labour costs suffered financial losses (Bornstein, 2011; Button 2005). Indeed, with the 2011 filing for bankruptcy protection by American Airlines, every U.S. legacy carrier has now filed for protection. The Canadian industry experienced similar financial turbulence.[8]

In a study of firm turnover and productivity growth, Baldwin and Lafrance (2011) find that new entrants in the Canadian airline industry were relatively smaller and less productive than incumbents or firms that exited. They found the industry consisted of large firms with scale economies, a structural barrier to entry. After the 1999 merger of two national incumbents, Iacobucci et al. (2007) describe what emerged as a "dominate firm market" in which new entrants were forced to initially offer services on the "competitive fringe".

Trends in Passengers and Fares

The number of passengers carried on Canadian scheduled Level I and II carriers has increased from less than 30 million in 1988, to over 50

million by 2010 (Figure 1).[9] There were downturns along the way corresponding to a recession in the early 1990s and to the combined shocks of 9/11 and SARS in the early 2000s as well as a smaller economic downturn in 2009. While the Canadian population has also increased, the growth in passenger traffic corresponded with a proportional increase in household spending on air travel.[10]

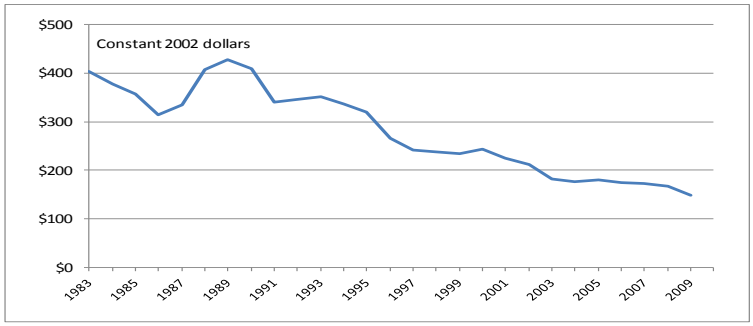


Source: Statistics Canada, Aviation Statistics Centre

Figure 1: Passengers, Level I and II scheduled service, 1988-2010

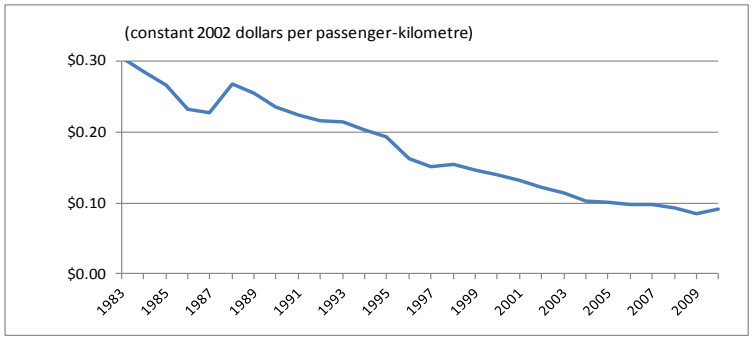
To what extent does this proportional growth reflect a substitution effect based on lower prices? To measure price, we use data from Statistics Canada's Fare Basis Survey (FBS), a quarterly measure of the base fare (net of taxes, fuel surcharges and airport fees) for scheduled flights of Level I carriers. While the average base fare in constant dollars has declined since 1989 (Figure 2), it does not account for distance travelled or level of services (see Ouellet, 1997). Figure 3 standardizes the measure of revenue on a per passenger-kilometre basis in constant dollars.

As mentioned, market structure – concentration and dominance – has also likely changed in response to new carriers, amalgamations and bankruptcies.[11] The industry has also undergone policy changes and technological changes that have spawned, for example, better equipment and reservation systems. The following section examines to what extent these and other factors influenced average airfares.



Source: Statistics Canada, CANSIM Table 401-0004

Figure 2: Average domestic airfare, Level I carriers, 1983-2009



Source: Statistics Canada, Fare Basis Survey, custom tabulation

Figure 3: Average revenue per output, Level I carriers, 1983-2010

Data and Variables

Since 1983, Statistics Canada's FBS has collected revenue and revenue-passengers by flight coupons (not final O-D), by city-pair, by carrier and by fare type (e.g. business class...). Using a stratified random sample of Level I carriers in Canada, estimates of total revenue and total revenue passengers are obtained. The average base fare is calculated by dividing revenue by revenue passengers:

$$(1) \quad Airfare = \frac{Revenue}{Revenue\ Passengers}$$

For our study, the FBS data were aggregated by city-pair, carrier, and year which yielded 36,973 observations from 1983 to 2010 (see Table 1, where "X" denotes variables such as revenue and distance).

Table 1: FBS Data Structure

Year	Carrier	City-pair	X1	. . .	Xn
1983	1	1	.	. . .	.
1983	1	2	.	. . .	.
.	.	.	.	. . .	.
1983	2	1	.	. . .	.
1983	2	3	.	. . .	.
.	.	.	.	. . .	.
2010	C	IJ	.	. . .	.

We follow Anderson et al. (2005) in terms of variable selection, but not in other respects. The former examine the U.S. domestic airline market while we use all Canadian Level I scheduled flights. Also, the structure of the FBS data allow us to conduct a more rigorous statistical analysis since the panel data methods give stronger and more robust results than is possible with a cross-sectional approach.

The dependent variable is average airfare, AF_{ijct}, for carrier *c* over city-pair *ij* at time *t*, converted into 2002 constant dollars using the CPI air transportation component. The independent variables (Table 2) include distance between the city-pair as well as measures of competition and market structure: market shares, Herfindahl-Hirschman Indices (HHI), hub airports, and contestability.

To begin, it is important to control for $Distance_{ijt}$ since the average fare increases with the length of the flight, reflecting the increase in operating costs. It also captures differences between domestic and international flights. Total revenue passengers (*TRP*) capture the size of airports. It is measured at the departure airport, TRP_{it}, and arrival airport, TRP_{jt}. We anticipate as the number of passengers at an airport increase, the average fixed cost decreases, reducing average fare.

Table 2: Independent Variables

Variable	Description:	Expected Sign:
$Distance_{ijt}$	Distance (km) between the city-pair.	+
TRP_{it} TRP_{jt}	Total revenue passengers at the origin and at the destination of the city-pair.	-
$Share_{ict}$ $Share_{jct}$ $Share_{ijct}$	Market shares measure the market power of the carrier at the origin, destination, and over the city-pair.	+
HHI_{it} HHI_{jt} HHI_{ijt}	The HHI measures the market concentration at the origin, destination, and over the city-pair.	+
$Contestable_{ijt}$	Indicates market contestability.	-
$Regional_{ijct}$	Indicates a regional partner.	-
Hub_{it} Hub_{it}	An indicator of a carrier with a hub at the city-pair origin or destination.	+/-

The market share of a carrier is the proportion of its passengers relative to the total passengers for all carriers. It is calculated for city-pair ($Share_{ijct}$), and at both the departure ($Share_{ict}$) and arrival airports ($Share_{jct}$). An increase in market share, all else being equal, should result in higher average fares. *HHI*, a measure of market concentration, is calculated as the sum of squared market shares and ranges from 1/C (competitive) to 1 (complete concentration or monopoly), where *C* is the number of competitors in the market:

(2) $HHI = \sum_{c=1}^{C} share_c^2 * 10000$, where *C* is total carriers

As with market share, we calculate HHI over the city-pair (HHI_{ijt}) and for the departure (HHI_{it}) and arrival airports (HHI_{jt}). We expect an increase in concentration to translate into an increase in airfare. Similar to Anderson et al. (2005), we construct a variable to capture "hub" effects. If a carrier has greater than 50% market share at an airport, then we consider its total passenger traffic. And, if the airport has 35% share of the carrier's traffic, then it is considered a hub. The variable equals one if the carrier hubs at the departure (or arrival) airport: $Hub_{ict} = 1$ (or $Hub_{jct} = 1$), zero otherwise. The direction of the

"hub" effect is unknown since it may indicate reduced costs (i.e. greater efficiency) or higher prices (e.g. congestion costs).

The final two variables are specific to the Canadian market. First, $Regional_{ijct}$ indicates if a carrier operates a regional or low-cost service provider over the city-pair. The *HHI* measure may under-estimate market concentration if one carrier *de facto* offers two options. So, if a single carrier, or a carrier or its regional affiliate operates on the city-pair, $Regional_{ijct} = 0$. If a carrier does not operate a regional airline, $\text{Regional}_{ijct} = 1$.

Second, the ability of carriers to compete as whole across markets is considered. If there is only one carrier with greater than 20% market share of total Canadian air passenger traffic, operating on the city-pair, $Constestable_{ijt} = 0$. If there is more than one carrier with greater than 20% market share of total Canadian air passenger traffic, operating on a city-pair, $\text{Contestable}_{ijt} = 1$. It measures a carrier's prominence at a national level. More competition reduces ability to exercise market power, reducing average airfare.

Specification

Our approach makes use of the FBS time dimension to conduct a panel data analysis which, to our knowledge, has not been done for the Canadian airline industry. To conduct our analysis, we use several different model specifications to determine the statistically significant factors correlated with average airfare. We use the logarithmic functional form to conduct our analysis.[12] The initial specification is a pooled OLS log-log regression, with no unobserved effects.

$$\begin{aligned}(3)\qquad \log(AF)_{ijct} = {} & \beta_0 + \beta_1 \log(Distance)_{ijt} + \beta_2 \log(TRP)_{it} + \\ & \beta_3 \log(TRP)_{jt} + \beta_4 \log(share)_{ijct} + \beta_5 \log(share)_{ict} + \\ & \beta_6 \log(share)_{jct} + \beta_7 \log(HHI)_{ijt} + \beta_8 \log(HHI)_{it} + \\ & \beta_9 \log(HHI)_{jt} + \beta_{10} Regional_{ijt} + \beta_{11} Contestable_{ijt} + \\ & \beta_{12} Hub_{ict} + \beta_{13} Hub_{jct} + u_{ijct}\end{aligned}$$

Alternative specifications accounting for unobserved effects are compared to this base model. The pooled OLS model signals if there are omitted variables (time, carrier, and city-pair unobserved effects) or specification issues. There is substantial literature on varying panel data techniques including fixed effects LSDV (least-squares dummy variables), fixed effects (first differencing) and random effects models (Baltagi, 2005; Wooldridge, 2002). For robustness, several specifications using a fixed effects dummy variable (LSDV) were tested (Table 3).[13]

There are three identifying dimensions to the panel in the FBS data: city-pair, carrier, and time. We conduct the analysis for one-, two-, and three-way error models based on theoretically justified reasons. The one-way error model accounts for either time or carrier unobserved effects (Model I and Model II), the two-way error model accounts for differences across time and across carriers (Model III), and the three-way error model accounts for time, carrier, and city-pair unobserved effects (results not reported). In the case of one- and two-way error component models, the unobserved effects that are not being measured are simply included in the composite error term (v).

Time and carrier unobserved effects are likely to have the greatest impact on model results. As mentioned, changes in the airline industry have been substantial and our explanatory variables are not exhaustive. There are yearly changes in the industry (e.g. regulations) that impact average fare, regardless of carrier and route. Carriers have altered business behaviours (e.g. frequent flier programs) that are consistent over time and routes and likely to impact average airfare. Route (city-pair) unobserved effects are likely to be more subdued.

Based on tests for heteroskedasticity, we use robust standard errors in our analysis. Tests for multicollinearity among the explanatory variables were well within acceptable limits. Model specifications that removed variables that are strongly correlated were informally tested for specification error (omitted variables) and model robustness. The least squares dummy variable approach to estimate fixed effects is used rather than a first differencing fixed effects approach. We assume serially uncorrelated errors.[14]

Findings

The results demonstrate the robustness of the models (Table 3). Joint tests of unobserved effects for Carrier and Year indicate statistical significance; specifying the model without these effects causes bias and misspecification. Although the goodness-of-fit and the coefficients of the pooled OLS look good (albeit with some unexpected signs), the model clearly fails to account for information contained in unobserved carrier and year effects. A fixed effects model yields consistency among the estimators; signs and statistical significance remain more consistent across specifications. Except for distance, the impact of each variable on average airfare is relatively small; it is the combination of factors that influence airfares.

While the correct specification for the fixed effects model is debatable, Model III is our preference since it includes our full set of observable explanatory variables as well as time and carrier fixed effects. Including city-pair fixed effects over-specifies the model, while excluding market share or concentration variables under-specifies the model. The estimated signs are generally consistent with our expectations. An increase in distance is associated with an increase in airfare; on average, a 10% increase in distance increases the average fare by 4.6% (Model III). The influence of distance is consistent across all model specifications.

Total revenue passengers effect is always negative, reflecting the scale effect; more passenger traffic at an airport results in lower airfares, all else being equal. While Anderson et al. (2005) report a hub affect that increases the average airfare in the U.S., the impact in Canada is less clear. The hub coefficient switches signs and significance across specifications. This volatility may reflect our uncertainty of whether cost effects or market power effects dominate. Also, other explanatory variables may be capturing some of these effects. Irrespective, it appears that carrier hubs have less influence on average airfares in Canada than in the U.S.

Table 3: Regression Results

Logrithmic regression (with robust errors)								
Dependent Variable: $log(AF)_{ijct}$								
	Pooled OLS		Fixed Effects Dummy Variables					
			Model I		Model II		Model III	
$log(Distance)_{ijt}$	0.405	*	0.419	*	0.431	*	0.460	*
$log(TRP)_{it}$	-0.038	*	-0.006	*	-0.019	*	-0.008	*
$log(TRP)_{jt}$	-0.036	*	-0.003		-0.016	*	-0.005	*
$log(Share)_{ijct}$	-0.020	*	0.012	*	0.017	*	0.015	*
$log(Share)_{ict}$	0.022	*	-0.009	*	0.008	**	0.006	
$log(Share)_{jct}$	0.024	*	0.001		0.014	*	0.015	*
$log(HHI)_{ijt}$	-0.017		0.045	*	0.097	*	0.080	*
$log(HHI)_{it}$	0.187	*	0.106	*	0.075	*	0.042	*
$log(HHI)_{jt}$	0.198	*	0.116	*	0.087	*	0.054	*
$Regional_{ijct}$	-0.134	*	-0.121	*	0.064	*	0.008	
$Contestable_{ijt}$	0.008		-0.055	*	-0.038	*	-0.031	*
Hub_{ict}	-0.020	***	0.004		-0.041	*	0.016	***
Hub_{jct}	-0.025	**	-0.010		-0.051	*	0.003	
Constant	0.473	*	0.932	*	0.648	*	1.331	*
Year Effects	No		Yes		No		Yes	
Carrier Effects	No		No		Yes		Yes	
Citypair Effects	No		No		No		No	
obs	36973		36973		36973		36973	
	R-squared		R-squared		R-squared		R-squared	
	0.5163		0.7156		0.675		0.7554	
*, **,*** - statistically significant at the 1%, 5%, and 10% level								

Market shares and HHI have the expected signs and are statistically significant. For instance, a 10% increase in market share over the city-pair increases average fare by 0.15%, plus the impact shares has on HHI (Model III).[15] The contestability of the market reduces average airfare, albeit by a small amount. If a market is being contested, average airfare decreases by 3.1%.

In general, the stability and reliability of the panel methodology have both improved over Peter and McKeown's (2012) initial cross-sectional specification. The robustness of the coefficients is reflected by their improved stability across model specifications.

Summary

There have been many changes in the Canadian passenger airline industry over the last 25 years and, of particular interest, is how they have influenced average airfares. To provide some insight, we use a panel data approach to estimate the influence of selected factors on average airfare in the Canadian industry. Such an approach solves the problems of the unstable direction and significance of coefficients across cross-sections found in Peter and McKeown (2012). Including fixed effects for unobserved time and carrier effects has a substantial impact on the reliability of the model specification. The results are robust to changes in the specification of fixed effects in the model.

Our preferred specification (Model III) accounts for year and carrier fixed effects and includes the full set of observable variables. Controlling for distance, market structure (i.e. concentration and share) has a significant impact on average airfare. It is the combination thereof, rather than any one specific measure, that impacts fares. These measures are related but not enough to raise concerns about endogeneity. A decrease in market concentration, *HHI*, or market share, at the city-pair, departure, or arrival airport, is associated with a decrease in average fare. The impact of hub airports does not appear important. Finally, the effect of regional carriers is not significant while contestability of the market matters: If a city-pair is contestable, average fares decrease.

In concluding, we note three limitations of our approach. First, while our methods make use of unobserved effects modeling, observed variables would be better; for example, fuel prices likely have an impact on base fares and passenger load factors can indicate how fixed costs impact average fares. Second, the use of coupon (FBS) rather than final O-D data may better reflect yesterday's direct flight networks than today's hub and spoke networks. And thirdly, we would rather use final than base fares, particularly with the recent proliferation of airport-related fees and surcharges.[16] Nevertheless, our model identifies factors that collectively accounted for roughly three-quarters of the variation in average Canadian passenger airline base fares over the period from 1983 to 2010.

Bibliography

Anderson, W., Gong. G. and Lakshamanan T. (2005). Competition in a Deregulated Market for Air Travel: The U.S. Domestic Experience, *Research in Transportation Economics*, **13** (3-25). Elsevier Ltd.

Bailey, E. (1981). Contestability and the design of regulatory and antitrust policy. *American Economic Review*, **71** (2).

Bailey, E. (1993). Airline deregulation - Confronting the paradoxes. *Regulation*, *13* (Summer). Cato Institute.

Baldwin, J. and Lafrance, A. (2011). Firm Turnover and Productivity Growth in Selected Canadian Services Industries, 2000 to 2007. *Economic Research Paper Series*, **72**. Statistics Canada: 11F0027.

Baumol, W., Panzar, J., and Willig, R. (1982). Contestable Markets and the Theory of Market Structure. NY: Harcourt Brace Jovanovich.

Baltagi, B. (2005). Econometric Analysis of Panel Data (3rd Edition). England: Wiley & Sons Ltd.

Borenstein, S. (2011). On the Persistent Financial Losses of U.S. Airlines: A Preliminary Exploration. *NBER Working Paper No. 16744*. Washington: National Bureau of Economic Research.

Borenstein, S. (1992). The Evolution of U.S. Airline Competition. *Journal of Economic Perspectives*, **6** (2) p. 45-73.

Button, K. (2005). How stable are scheduled air transport markets? *Research in Transportation Economics*, **13** (27-48). Elsevier.

Canadian Transportation Agency (2004). 100 Years at the Heart of Transportation. Ottawa: A Centennial Historical Perspective of the Canadian Transportation Agency and Its Predecessors.

Christopher, J. and Dion, J. (2002). The Canadian Airline Industry. Ottawa: Public Works and Government Services Canada, 89-2.

Ciliberto, F. And Schenone, C. (2012). Bankruptcy and product-market competition: Evidence from the airline industry. *International Journal of Industrial Organization* **30**, 564-577.

de Mestral, Armand (2005). Canadian-EU Bilateral Air Service Agreements. Institute for European Studies Working Paper 5. Montréal: Université de Montréal – McGill University.

Dixit, A. (1980). The Role of Investment in Entry Deterrence. *Economic Journal*, **90**, 95-106.

Gill, V. (2012). Driven Away: Why More Canadians are Choosing Cross Border Airports. Ottawa: The Conference Board of Canada.

Gillen, D. (2005). The Evolution of Networks with Changes in Industry Structure and Strategy: Connectivity, Hub-and-Spoke and Alliances. *Research in Transportation Economics* **13**, 49-73.

Goetz, C. and Shapiro A. (2012). Strategic alliance as a response to the threat of entry: Evidence from airline codesharing. *International Journal of Industrial Organization* **30**, 735-747.

Iacobucci, E., Trebilcock, M., and Winter, R. (2006). The Political Economy of Deregulation in Canada. Creating Competitive Markets: The Politics of Regulatory Reform, eds. M. Landy, M. Levin, and M. Shapiro. Brookings Institution Press: Washington, D.C., 290-315.

Lazar, F. (2003). Turbulence in the skies, *Commentary 181*. Toronto: C.D. Howe Institute.

Moneiro, J. And Annan, R. (2001). The Evolution of Airlines in Canada with Emphasis on the Competition Bureau's Role in the Restructuring of the Airline Industry. *Canadian Transportation Research Forum*: 36th Annual Meeting, 136-155.

Ouellet, R. (1997). Mesure de Prix et de Production dans l'Industrie du Transport Aérien au Canada. *Canadian Transportation Research Forum*: 32nd Annual Meeting, 165-179.

Peter, J. and McKeown, L. (2012). Trends in the Canadian airline industry: A statistical review. 59th *North American Regional Science Association International Meetings*. Ottawa, November.

Statistics Canada (1986, 1993). Aviation in Canada. Statistics Canada: 51-501-E.

Transport Canada (1985). Freedom to Move: A Framework for Transportation Reform. Ottawa: Supply and Services Canada.

Wooldridge, J. (2002). Econometric Analysis of Cross Section and Panel Data. Boston: Massachusetts Institute of Technology.

Endnotes

[1] The views expressed by the authors are not necessary those of Statistics Canada. The authors acknowledge the comments provided by Mark Brown and Bradley Snider.

[2] See Iacobucci, Trebilcock and Winter (2006) and Peter and McKeown (2012) for more detailed discussions of the rationale for and implications of these changes.

[3] Price is only one consumer side indicator of a change in welfare; others are quality and frequency of service. Often overlooked in assessing welfare are producer side indicators of efficiency and costs to the air carrier.
[4] Economic profits are accounting profits minus opportunity costs. Under perfect competition, economic profits are zero and accounting profits are positive.
[5] They estimate that if an incumbent carrier's segment is threatened by a low-cost competitor, it is about 25% more likely to code-share. In theory, strategic investment can be used by an incumbent to dictate market outcome and deter entry (Dixit, 1980).
[6] Incumbent carriers had acquired regional and feeder airlines to expand service. And the 1988 Air Canada Public Participation Act privatized Air Canada, allowing it access to equity markets for fleet renewal and acquisitions.
[7] In 1995, Canada and the U.S. signed an "Open Skies" agreement expanding bilateral services and increasing the travel options for Canadians. However, national carriers were restricted from operating point to point services in the other country (i.e. cabotage, Icobucci et. al., 2007). The 1996 Canada Transportation Act provided the regulatory framework for international aviation (i.e. de Mestral, 2005)
[8] Wardair and Nordair were well known airlines that exited the market, while WestJet and Porter are more recent examples of new entrants. We also note the financial difficulties experienced by Canada 3000, CanJet, Nationair, and Odessey International.
[9] A Level I Canadian air carrier, in the calendar year before the year in which information is provided, transported at least 2,000,000 revenue passengers or to be part of a code-sharing agreement with a major carrier. A Level II carrier transported at least 100,000 but fewer than 2,000,000 revenue passengers. These thresholds have changed over time to identify the main passenger airlines in Canada.
[10] Average household spending on air travel as a proportion of total spending increased from about 0.55% in 1997 to 0.75% by 2009 (CANSIM Table 203-0007).
[11] Although we note that a recent study for the United States did not find evidence of significant changes by a bankrupt airline's competitors in route structure, frequency or capacity (Ciliberto & Schenone, 2012).
[12] An alternative method to standardize the coefficients is to use beta (standardized) coefficients in a linear specification.
[13] The statistical method takes into account an unbalanced panel due to attrition .The results for random effects model specification are not reported for two reasons. First, the estimates only make sense when we believe them to be random. The FBS data encompasses a large population and it makes sense to consider unobservable effects as parameters to estimate (fixed effects). Second, there is no reason to believe that individual effects are uncorrelated with the independent variables.
[14] The Stata panel data test for serial correlation (xtserial) was unavailable to verify our assumption of serially uncorrelated errors; if invalid, this makes the LSDV fixed effects model less efficient than first differencing (see Wooldridge (2002) for a discussion of fixed effect dummy variable versus first differencing).
[15] Market shares interact with HHI in a non-linear way. The marginal effect of an increase in market shares is not straight forward to interpreted, as an increase in market shares also increases HHI.
[16] Gill (2012) estimates that "Other" factors, airport and navigation fees, contribute to more than one half of Canadian and U.S. carrier cost differentials in their study.