Rail Capacity, Freight Rates and Removal of the Maximum Revenue Entitlement Program

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Abstract

In the review of the Canadian Transportation Act submitted to the Minister of Transport in December 2015 it is argued that the Maximum Revenue Entitlement (MRE) program "act as barriers to investment and productivity improvements in the broader rail system". The review anticipates the total removal of the MRE regulation within seven years. This will have profound impacts on the industry stakeholders including grain companies and producers. To a great extent, these impacts will depend on the grain movement levels and service charges in the new environment. This study explores the railways' incentives for moving Western Canadian grain to export positions without the MRE regulation in place. In a spatial-temporal partial equilibrium model we estimate the railways' revenue-maximizing movement levels and the welfare implications for grain producers, shippers, and the railways under several scenarios. Results indicate that removing the MRE may create a perverse incentive for the railways to increase their revenue by increasing freight rates. The grain companies will have to share a great portion of their rents with the railways that control the most scarce resource in the grain handling and transportation system.

Key words: grain handling and transportation, grain transportation, maximum revenue entitlement, rational expectations.

1. Introduction

There has long been debates among economists regarding the necessity and the potential drawbacks of regulating firms with market power. The new classical economic theory makes a case for regulation of monopolies by referring to the inefficiencies (i.e. deadweight loss) created by market power.

In his innovation theory, Schumpeter criticizes the static new classical view of perfect competition and the resulting rationale for government regulation of monopolies. He believes the long-run benefits of innovations performed by a monopolist, which are not incorporated in the new classical theory, are far greater than the short-run inefficiencies (deadweight loss) created by market power. Moreover, in *Business*

Cycles, Schumpeter argues that a monopolist needs the short-run above normal profits during the phase of *prosperity* in order to survive the *depression* (Schumpeter, 1950).

Similarly, contestability theory makes the case that concentrated markets are desirable. Moreover, regulation is unnecessary because *threat of entry* forces monopolies and oligopolies to price competitively (Baumol et al., 1982).

Both Schumpeter's innovation theory and the contestability theory, however, are predicated on the assumption that the monopolist feels the threat of competition, whether it is the threat of *imitation*, entry of other firms due to minimal barriers to entry, or intermarket competition. It is believed, for example, that trucking can have a "disciplining role" for railroads, and therefore laissez-faire is justified (Helwege and Hendricks, 1985).

The Canadian grain handling and transportation system provides an excellent ground for examining the necessity and drawbacks of government regulations. Distanced 1000 to 2200 km to ports on the West Coast and even more to the Gulf of Saint Lawrence and Gulf of Mexico, Western Canadian grain producers are highly dependent on rail transport.

Trucking does not seem to have a "disciplining role" at the rate of $16 per tonne per hundred miles and given the very long distances to export positions. From Edmonton to Port of Metro Vancouver, for example, trucking cost is approximately $115 per tonne compared to less than $40 per tonne rail freight rate (Quorum, 2015).

Competition between the two railways seems to be minimal in many regions where only one of the railways exists. Figure 1 shows the rail network in Western Canada. In many areas such as South West Saskatchewan, Southern Alberta, and Northern Alberta shippers have access to only one of the two major railways – Canadian National (CN) and Canadian pacific (CP).

In the review of the *Canadian Transportation Act* (CTA) submitted to the Minister of Transport in December 2015 it is argued that the Maximum Revenue Entitlement (MRE) program "act as barriers to investment and productivity improvements in the broader rail system". The review recommends the total removal of the MRE regulation within seven years.

The railways do not seem to face significant threat of competition from one another or from trucking as suggested by the contestability or Schumpeter's innovation theory. Given the reliance of the Western Canadian agriculture on the rail transportation, removal of the MRE will have profound impacts on the industry stakeholders including grain companies and producers. To a great extent, these impacts will depend on the grain movement levels and service charges in the new environment.

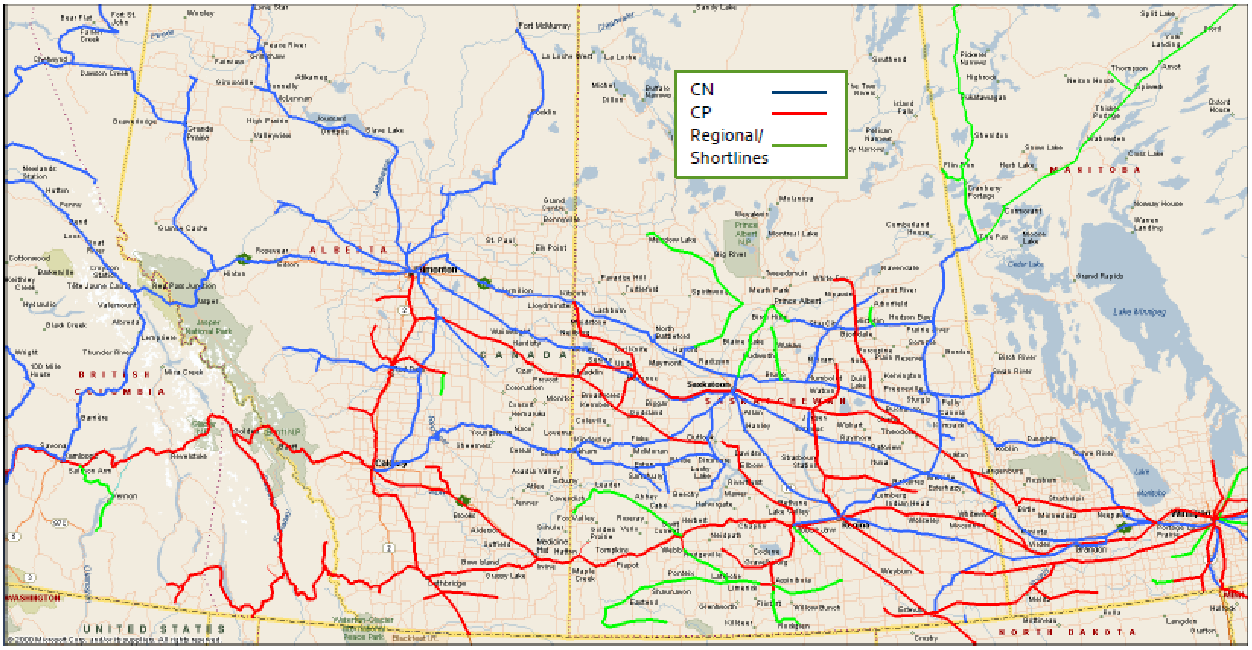

Figure 1. Western Canadian Grain Rail Transportation Network.
Source: Quorum Corporation.

This study explores the railways' incentives for moving Western Canadian grain to export positions without the MRE regulation in place. Results indicate that removing the MRE may create a perverse incentive for the railways to increase their revenue by increasing freight rates.

The remainder of this paper we first present the methodology and results. Then some of the limitation of the study, conclusions and policy solutions are presented.

2. Methodology

In order to find out whether the railways have an incentive to increase their freight rates after the removal of the MRE regulation we find their revenue-maximizing service level and freight rates for future production levels. For this purpose we first forecast future production. Future production is then used in a Mathematical Programming (MP) model that minimizes the cost of storing and/or transporting deliveries of grain from prairie origins to export positions. Expected freight rates are calculated based on the shadow value of the rail constraint at various service levels. Expected railway revenues are the sum-product of expected freight rates and service levels.

The MP model works simply based on the assumption that exportable supplies that cannot be transported will have to be stored. This, however, requires an expected storage cost function imbedded in the MP model so that the model can compare the cost of storage to the cost of transportation at any given level of exportable supplies.

Expected storage cost depends on not only the physical storage cost per year but also the number of years that farmers would *expect* the grain to be stored before they can sell it. That is, expected storage cost in each year depends on the expected production level of future years. In other words, farmers face a *conditional probability* problem-given this year's production and storage level, what is the probability that I can sell my grain next year? The answer of course depends on the likelihood of various production levels occurring in the future.

To resolve this issue, this study generates probability distribution functions (PDFs) for future production levels. The PDFs allow us to find the probability of any future production level given the current production (and storage) levels (*i.e.* a conditional probability). Future production levels, along with their PDFs, are then used in the MP model to calculate future expected freight rates and revenues. The next sections present the methodology corresponding to these steps.

2.1. Future Production

This study uses historical data to forecast future crop production in Western Canada. Production level data from 1976 to 2014 have been obtained from Statistics Canada (2015a). Crops used in this study include spring wheat, winter wheat, durum wheat, barley, canola, soybeans, oats, rye, flaxseed, chick peas, lentils, and dry peas. Production data are presented in Figure 2.

As presented in Figure 2, production levels in the three provinces are highly correlated. Therefore, the aggregate data from Alberta, Saskatchewan, and Manitoba are applied to forecast future production.

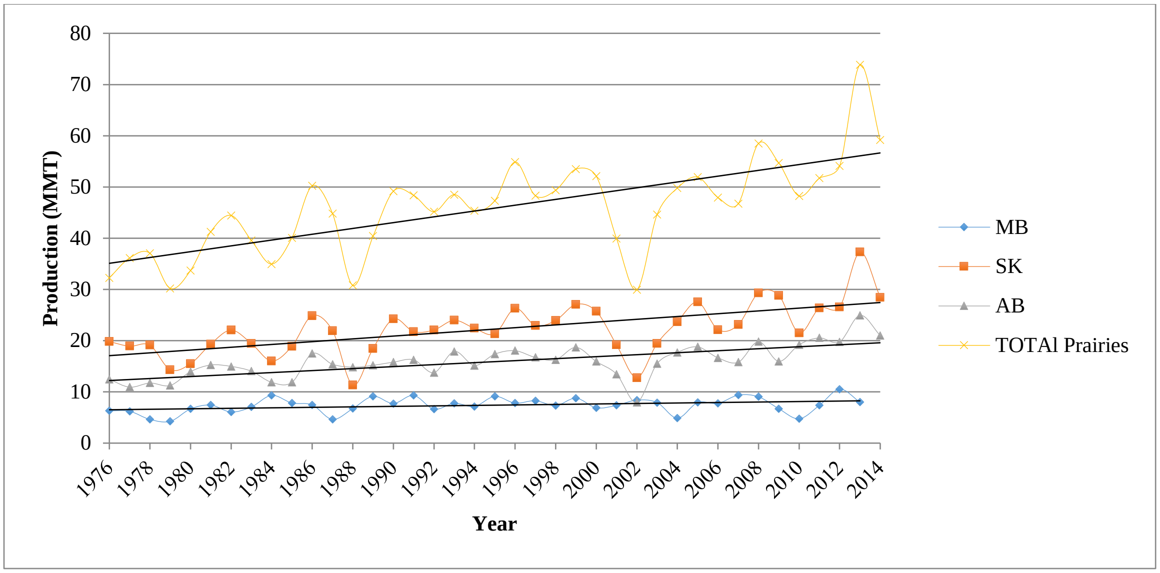

Figure 2. Production of Cereals, Oilseeds, and Pulses in Manitoba (MB), Saskatchewan (SK) and Alberta (AB), 1976-2014.

Source: Statistics Canada (2015a).

An auto-regressive (AR) model has been applied to estimate the magnitude and length of autocorrelation, and the importance of a time trend in a crop production time series (Greene, 2002; Chapter 19). The AR model takes the following functional form:

(1) $$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_3 T + \beta_4 D_{1988} + \beta_5 D_{2002} + \beta_6 D_{2013} + \epsilon_t$$

where Y_t, Y_{t-1}, and Y_{t-2} are the current, first lag, and second lag of production levels, respectively; T represents time trend; D_{1988}, D_{2002}, and D_{2013} are dummy variables for years with significantly lower or higher than average production levels; and ϵ_t represents the error term.

2.2. Probability Distribution Functions (PDFs)

A simulation model has been used to produce probability distributions for current and future production of cereals, oilseeds, and pulses. These probability distributions (Billingsley, 1979) take into account the autocorrelation and the time trend estimated in Equation 1.

2.3. Expected Storage Cost with Rational Expectations

The objective of this section is to describe how average excess freight rate levels are calculated based on expected storage costs given the total export capacity, rail movement levels, and rational expectations. Next section describes how expected storage costs are used in the MP model to find the storage levels and the resulting average excess freight rates.

It is assumed that total export capacity is constrained by rail capacity. Therefore, exportable supply levels that are higher than export capacity result in storage. The existence of storage cost, which is incurred by farmers, creates an opportunity for the railways to increase freight rates when they are not regulated by the MRE. The higher freight rate that is reflected in a higher basis level. The increased freight rate will increase the export basis and reduce farmers received prices.

Assuming *EC* is export constraint, *DU* is domestic consumption, and subscript *t* represents time, expected basis can be calculated as described in Table 1.

Table 1. Expected Basis Calculations.

Production Level in year *t* (Y_t)	**Expected Basis Level in year *t* ($E[B_t]$)**
Zero to (EC_t+DU_t)	Normal Basis ($\bar{B}$)
Over (EC_t+DU_t)	Normal Basis ($\bar{B}$) + Expected Storage Cost ($E[\sum_{i=1}^{2}\tau_i^s]$)

Basis is determined by the most "desperate to sell" farmers. Therefore, if there is positive storage, regardless of the amount, basis will increase by the expected storage cost. Even if the probability of having to store grain for more than one year is zero, expected storage cost will still be equal to storage cost for one year. That is, expected basis will be equal to normal basis plus the storage cost for one year. However, as the amount of storage increases, the probability of having to store for more than one year increases. This increases the expected storage cost. Therefore, expected storage cost can be formulated as follows:

(1) $$E\left[\sum_{i=1}^{2} SC_i\right] = \tau_1^s + P.\tau_2^s$$

where τ_1^s and τ_2^s are storage costs in year 1 and 2, respectively, and *P* is the probability of having to store grain for more than one year (i.e. probability of having to store grain in year 2). It is worth noting that because of the spatial *law of one price,* the expected storage cost, or the increase in basis level, will not be confined to the area in which storage occurs. Instead, it will apply to the entire market.

The probability of having to store grain for more than one year (i.e. the probability of having to store grain in year 2 or more generally year *t+1*) is calculated as follows:

(2) $$\mathrm{P}(Y_{t+1} > EC_{t+1} + DU_{t+1} - S_t) = 1 - F_{Y_{t+1}}(EC_{t+1} + DU_{t+1} - S_t)$$

$$= 1 - \int_{-\infty}^{EC_{t+1}+DU_{t+1}-S_t} f_{Y_{t+1}} dY_{t+1}$$

where is Y_{t+1}, EC_{t+1}, and DU_{t+1} are production level, export constraint, and domestic use in year $t+1$, and S_t is storage level in year *t*. F and f represent PDF and cumulative distribution function (CDF), respectively. The PDF has a Normal distribution as follows:

(3) $f_{Y_{t+1}} \sim N(\mu_{t+1}, \sigma^2)$

where μ_{t+1} and σ^2 are expected production level and variance in year *t+1*. In order to calculate the probability in equation 2, we need the expected value and the variance of the PDF for production levels in year *t+1*. The expected value is the "expected production" level for year *t+1*. However, as mentioned previously, good crop years are usually followed by another relatively good crop year. Usually, basis becomes an issue when there are significant carry-over stocks from one good year to another relatively good year. Farmers are aware of this fact and take into account of it when forming their expectation of future production. This is reflected in the AR model through the first lag. If the production level in year *t* is above the mean, then β_1 (percent) of the difference from the mean is added to the expected production in year *t+1*. To incorporate this in the calculation of farmers' expectations, expected production in year *t+1* is calculated as follows:

(4) $\mu_{t+1} = \bar{Y}_{t+1} + \beta_1(Y_t - \bar{Y}_t)$

where $\bar{Y}_t$ and $\bar{Y}_{t+1}$ are estimates of average production in years *t* and *t+1*, respectively. Y_t is the production level in year *t*, and β_1 is the autocorrelation coefficient obtained from the AR model.

Notice that as the railways reduce their movement level the export constraint (*EC*) will be set at a lower level. This result is a higher probability of having to store grain. This, in turn, causes expected storage cost to increase. As a result, expected basis increases. The increase in the expected basis above the normal level is obtained by those who possess the most scarce resource, the railways.

2.4. The Mathematical Programing Model

The objective of this section is to quantify the average excess freight rate and railway revenues without the MRE regulation in place. For this purpose, a MP model is designed. In the MP model it is assumed that cereals, oilseeds, and pulses are transported from Alberta (AB), Western Saskatchewan (West

SK), Eastern Saskatchewan (East SK), and Manitoba (MB) to the export markets through the West, East, and South ports. Origins and destinations are presented in Table 2.

Table 2. Origins and Destinations of Crops in the MP model.

Origins	Destinations
Alberta	West-Vancouver and Prince Rupert
West Saskatchewan	East- Thunder Bay
East Saskatchewan	South-Minneapolis
Manitoba	South- Pacific Northwest (through Minneapolis)

The MP model minimizes the cost of transporting deliveries of cereals, oilseeds, and pulses from Western Canada origins to the West, East, and South ports. However, if export capacity is limited, whether by rail movements or port capacity, then grain must be stored for at least one year. The MP model that incorporates both transportation and storage can be formulated as follows:

(5) $$Min\ TC = \sum_i \sum_j \left[\tau_{ij} X_{ij}\right] + \sum_i \left[\tau^s S_i\right]$$

Subject to:

(5-a) Production Constraint: $\sum_j \left[X_{ij}\right] + S_i = \bar{X}_i \quad ; \forall\ i$

(5-b) Port Constraint: $\sum_i \left[X_{ij}\right] \leq \bar{X}_j \quad ; \forall\ j$

(5-c) Rail Constraint: $\sum_i \left[X_{ik}\right] \leq \bar{R} \quad ; \forall\ k$

(5-d) Non-negativity Constraint: $X_{ij}, S_i \geq 0$

Where *i* represents origins and includes AB, West SK, East SK, and MB; *j* represents destination ports and includes West, East, PNW, and Minneapolis; *k* represents destination ports that require rail transportation (i.e. West and East); X_{ij} represents the amount of grain transported from origin *i* to destination *j*; X_{ik} represents the amount of grain transported from origin *i* to destination *k* by rail; τ_{ij} represents the cost of transporting grain from origin *i* to destination *j*; S_i represents the amount of grain stored at origin *i*; τ^s represents the cost of storing grain and is identical for all four origins; $\bar{X}_i$ represents the amount of grain produced at origin *i*; $\bar{X}_j$ represents the capacity of port *j*; $\bar{R}$ represents the rail capacity. While generally in such models rail capacity is set at the current capacity level, in this study we will set this at various levels to find the revenue-maximizing level of rail movements. The corresponding Lagrangian can be formed as follows:

(6) $Z = \sum_i \sum_j [\tau_{ij} X_{ij}] + \sum_i [\tau^s S_i] + \lambda_i [\bar{X}_i - \sum_j [X_{ij}] - S_i] + \lambda_j [\bar{X}_j - \sum_i [X_{ij}]] + \lambda_k [\bar{R} - \sum_i [X_{ik}]]$

Rail capacity constraint is set at various levels to find the revenue-maximizing level of grain movement for the railways. Shadow value of the rail constraint at any given movement level represents the railways per tonne above normal revenue or excess freight rate for that movement level and without the MRE regulation in place. These Shadow values are calculated for various production levels within the PDFs. Estimated shadow values along with the corresponding probabilities are used to calculate the railways expected above normal revenue from various movement levels.

3. Data and Assumptions

Exportable supplies are calculated as total production minus total domestic use in Western and Eastern Saskatchewan, Alberta, and Manitoba. Exportable supplies for each of the four regions have been calculated based on their historical share in total production. Port capacities are assumed to be the record high 2013-14 movement levels (see Table 3).

Table 3. Export, Rail and Domestic Use Capacity for the 3 Provinces.

	Capacity (MMT)
Export-West Coast- Vancouver and Prince Rupert	27
Export-East Coast	11.25 (non-constraint)
Export-South-Minneapolis	1
Export- South-PNW (through Minneapolis)	3.75
Rail Capacity	40
Domestic Use (MMT)	20

Source: CGC (2015), AAFC (2016), Quorum Corporation (2015), Statistics Canada (2015b), Authors' Calculations.

Cost of storage is assumed to be 15 percent of the value of the crop. This can be attributed to physical storage cost, interest rate on farmers' debt, potential degradation of stored crops, etc. Given the average value of crops at approximately $400 per tonne, the storage cost is assumed to be $60 per tonne per year (see Table 4). This value reflects the behavior observed in the 2013-14 and 2014-15 crop years when producers could either sell their grain at the current elevated export basis or contract for delivery in the next crop year at a normal export basis.[1]

[1] For more on this issue see Gray (2015).

Current rail freight rates for west and east movements, seaway shipping cost for east movements and storage cost are presented in Table 4. Freight rates for South movements to Minneapolis have been obtained from Gray (1995) and inflated by 1 percent per year. Freight rates to PNW includes a $16/MMT for 100 miles trucking from Canadian origins to Minneapolis, and a $55/MMT rail freight for Minneapolis to PNW ports.

Table 4. Freight Rates and Storage Cost Data

Region	Freight Rates ($)						One-Year Storage Cost ($)
	West Coast (Vancouver)	East Coast (Thunder Bay)	Seaway Shipping Cost	Total East Coast	South (Minneapolis)	South (PNW)	
AB	34	46	30	76	84	71	60
West SK	40	41	30	71	54	71	60
East SK	48	31	30	61	55	71	60
MB	51	25	30	55	41	71	60

Source: Authors' Calculations, Quorum Corporation (2015), Gray (1995), US Wheat Associates (2014).

4. Results

4.1. Future Production

Table 5 presents the results of the AR model. The Schwarz Criterion has been used to verify the optimal lag length (Greene, 2002; page 565). The estimated coefficients for the time trend variable shows that, on average, production level in the three provinces have increased by 449267 tonnes a year. The estimated coefficients for the lagged dependent variables and the time trend variable are used in the calculations for probability distributions.

Table 5. AR Regression Results Prairie Grain Production, 1977- 2014

Provinces:	Alberta,	Saskatchewan,
Dependent Variable:	Aggregate Production	
Estimation Method:	AR	
Independent Variables	Coefficient	Standard Error
Constant (β_0)	-8.50E+08	2.0E+08***
Aggregate Production (Lag 1) (β_1)	0.3015	0.12**
Aggregate Production (Lag 2) (β_2)	-0.2985	0.14**
Time Trend (β_3)	449267	171809***
Dummy for 1988 (β_4)	-10434793	4435866***
Dummy for 2002 (β_5)	-15525738	4491011***
Dummy for 2013 (β_6)	19024762	4392162***
R-squared	0.82	

Adjusted R-squared	0.78
F-Statistic	21.46***
Observations after adjustment:	36

Note: Asterisks denote significance at the10% (*), 5%(**), and 1%(***) levels.

Source: Authors' estimation.

Using the results of the AR model and the approach described in section 2.2., future production is forecasted. Given the 449267 tonne time trend parameter, average production increases from approximately from 38 MMT in 1977 (see Figure 2) to approximately 55 MMT in 2016 and approximately 60 million tonnes (MMT) in 2025. Probability distributions are calculated for 2016 to 2025 (see Figures 4). Probability distributions move to the right over time. This is due to yield improvement by 449267 tonnes a year.

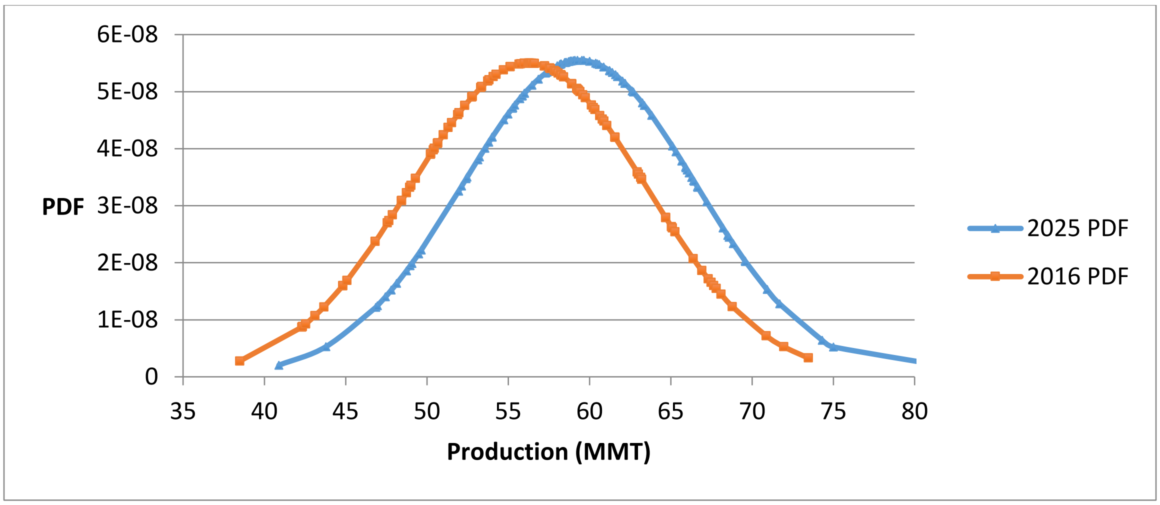

Figure 3. PDF of Forecast Production Levels in 2015 and 2025.

Source: Authors' estimation.

4.2. Removal of the MRE regulation

The main goal of this section is to explore the railways incentives for moving more grain with and without MRE regulations. In this regards, the effect of removal of the MRE regulation on expected freight rates and distribution of rents within the GH&T system are discussed as well.

In this section we first show that railways have an incentive to cut back services when there is no MRE regulation and increase service level with the MRE regulation in place. Then, graphical analysis is used to illustrate the case of 2013-14 crop year and show the railways' incentives for moving grain with and without the MRE regulation in the 2013-14 crop year. This example also shows the distribution of rents within the GH&T system with and without the MRE regulation.

4.2.1. Incentives for Moving Grain with and without the MRE

It is assumed that after the removal of the MRE regulation the railways are able to increase their freight rates by the amount of the expected shadow value of the rail constraint that is calculated in the MP model. Notice that as a constraint becomes more binding its shadow value increases. Therefore, without the MRE regulation in place, the railways have an incentive to limit their capacity (i.e. move less grain) in order to raise the shadow value of the rail constraint, which is indeed the average freight rate. However, by limiting their capacity, the railways move less grain. Therefore, there is a tradeoff between the movement level and the average freight rate.

Table 6 presents the average excess freight rates and revenues captured by the railways at various capacity levels in a normal production year and no MRE regulation in place. In order to calculate the average excess freight rate levels we first calculate the excess freight rate (i.e. shadow value of the rail constraint) levels for various production levels within the PDF (i.e. 30 to 80 MMT). Then we take the weighted average of the excess freight rate levels corresponding to the various production levels with the probabilities of occurrence of each production level as weights.

The revenue levels are calculated as sum of the products of the movement levels of each region by the expected freight rate (i.e. normal freight rate plus average excess freight rate) for that region.

As presented in Table 6, average excess freight rate increases as rail capacity decreases. As rail capacity is reduced from 40 to 25 MMT average expected shadow value (i.e. excess freight rate) increases from $10.5/t to $99.9/t. Although this decrease in capacity reduces the movement levels from 34.5 to 25 MMT, railways' revenue increases from $1.6 to $3.4 billion. Therefore, with no MRE regulation in place, railways may have a perverse incentive to reduce their current capacity service levels in order to increase their average freight rates and, thereby, their revenues.

However, a further attempt to reduce capacity to less than 25 MMT will result in a reduction in railways' revenue. It is easy to see in Table 6 that there is an optimal (i.e. revenue-maximizing) level of service for railways. If there were no MRE the railways would plan to provide the revenue-maximizing level of service, which is approximately 25 MMT for normal production levels. As it will be shown in the next section, this will result in a grain transportation crisis in any year with a production level that is significantly higher than normal.

Table 6. Average Excess Basis and Revenues Captured by Railways at Various capacity

Capacity	Movements	Storage	Average Excess Freight	Revenue
40	34.5	0	10.5	1.6
35	34.5	0	34.4	2.4
30	30	1	62.4	3.0
26	26	4.7	90.7	3.3
25	**25**	**5.7**	**99.9**	**3.4**
24	24	6.7	100.0	3.3
20	20	10.7	112.3	3.0

Source: Authors' estimation.

Table 7 presents the revenues captured by the railways at various capacity levels in a normal production year and the MRE regulation in place. In this case freight rates are at their normal levels because the MRE regulation is in place. Therefore, average excess freight rate levels are equal to zero for any capacity level.

The revenue levels are calculated as sum of the products of the movement levels of each region by the normal freight rate (i.e. freight rate under the MRE) for that region. As illustrated in Table 7, when the MRE regulation is in place, it is in the railways favour to move all the exportable supplies of grain. In the example provided in Table 7, there are 35.5 MMT of exportable supplies resulting from 55.5 MMT of production. If railways limit their capacity and movement level to 30 MMT they only earn $1.1 billion of revenues. By increasing their movement level to 35.5 MMT or higher, however, they earn $1.2 billion of revenues.

Table 7. Average Excess Basis and Revenues Captured by Railways at Various capacity

Capacity	Movements	Storage	Average Excess Freight	Revenue
30	30.0	0.7	0	1.1
40	35.5	0	0	1.2
50	35.5	0	0	1.2

Source: Authors' estimation.

5. Limitations

In this study we assume the two main railways act as local monopolies. This is because many inland elevators have access to only one of the railways. Nevertheless, the two railways may still compete with one another. The level of this competition is unclear to us. However, future studies could investigate the level of competition between the two railways and the consequences for the freight rates after the removal of the MRE. Similarly, one could incorporate trucking into the MP model. Lastly, our analysis assumes no market power for the grain companies. Given the fact that very few grain companies control the Western Canadian market, it seems plausible to assume some level of market power for them.

6. Conclusion and Policy Recommendations

Results indicate that without the MRE regulation the railways may benefit significantly from cutting back their services, especially in high price or crop years when there is high demand for GH&T. In 2013-14 crop year the railways could have earned an additional $3.7 billion if there were no MRE regulation. Under the MRE regulation, however, the railways have an incentive to move all the exportable supplies of grain in order to maximize their revenue. Removing the MRE will change the distribution of rents in the GH&T system significantly. With no MRE regulation the grain handlers would have to bid on rail cars, similar to the U.S. system. Given that the railways offer the most inelastic (i.e. most scarce) resource in the GHTS, they would capture the above-normal rents that are currently realized by the grain handlers when capacity is limited.

The MRE regulation caps average revenue per ton-mile of grain moved by the railways. This policy, which manages the market power of the two railways, eliminates the possibility of selling less service at higher prices. The MRE gives railways strong incentives to lower their cost per ton-mile and to move the volume offered to them. Also, railways can earn higher revenue levels by moving greater volumes of grain. It is therefore important that this key aspect of the MRE mechanism be retained.

Nevertheless, the existing MRE can be refined to create incentives to increase rail capacity, including additional incentives for early crop year and winter grain movement. If these additional incentives are developed it is important that they are done so through negotiation with producers groups and shippers within the MRE structure to avoid the perverse incentives that are created when the railways can drive up service rates by reducing service levels.

Additional research is needed to examine how the MRE formula can be refined to create railway incentives to increase rail capacity and other rail service enhancements including infrastructure and rail access to the United States.

References

Agriculture and Agri-Food Canada (AAFC). 2016. Canada: Outlook for Principal Field Crops, 2015-06-18. http://www.agr.gc.ca/eng/industry-markets-and-trade/statistics-and-market-information/by-product-sector/crops/crops-market-information-canadian-industry/canada-outlook-for-principal-field-crops/?id=1378743094676 (accessed July 16, 2016).

Baumol, W., J. Panzar and R. Wiltt B. 1982. *Coutestable Markets and the Theory of Industrial Structure*, Harcourt, Brace, Jovn.ovtch, New York.

Billingsley, P. 1979. *Probability and Measure.* New York: John Wiley and Sons.

Canadian Grain Commission (CGC). 2015. Canadian Grain Exports, 1997-2015. https://www.grainscanada.gc.ca/statistics-statistiques/cge-ecg/cgem-mecg-eng.htm (accessed January 27, 2015).

Government of Canada. 2016. Canada Transportation Act Review-Report. http://www.tc.gc.ca/eng/ctareview2014/canada-transportation-act-review.html (accessed October 23, 2016).

Gray, R. 1995. Basis Deductions for CWB Deliveries in Western Canada: A Proposal for Basis Calculations. Canadian Wheat Board, Winnipeg, MB.

Gray, R. 2015. The Economic Impact of Elevated Export Basis Levels on Western Canadian Grain Producers. Saskatchewan Wheat Development Commission, Saskatoon, SK.

Greene, W. 2002. *Econometric Analysis, 5th ed.* Upper Saddle River: Pearson Education.

Quroum Corporation. 2015. 2013-14 Annual Report. http://www.quorumcorp.net/reports.html (accessed August 20, 2015).

Schumpeter, J. 1950. *Capitalism, Socialism and Democracy*, 3rd ed., Harper and Row, New York.

Statistics Canada. 2015a. Estimated areas, yield and production of principal field crops by Small Area Data Regions, in metric and imperial units, annual (CANSIM Table 001-0071). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=10071 (accessed June 3, 2015).

Statistics Canada. 2015b. Farm supply and disposition of grains as of March 31, July 31, August 31 (soybeans only) and December 31 (CANSIM Table 001-0043). http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=10043 (accessed January 27, 2015).

United States Wheat Associates (USWA). 2014. Weekly Price Report. http://www.uswheat.org/ (accessed January 27, 2015).