an ex-post econometric analysis of the abolishment of the canadian wheat board

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Abstract:

This paper analyzes the impact the Canadian Wheat Board (CWB) had on facilitating grain movements and utilizing terminal capacity from 2009/10 to 2015/16 in western Canada through econometric methods. We conduct an ex-post analysis on capacity utilization for every grain delivery station in western Canada controlling for distance to port, car spots, railway companies, and production. We use a CWB dummy variable and freight rates from Quorum Corporation to estimate capacity utilization before and after CWB abolishment. We analyze whether the CWB had an impact on terminal turnover ratios. We conclude the regulatory change in abolishing the CWB significantly reduced capacity utilization and delivery performance despite record production and implementation of ad hoc policies. Current regulatory changes regarding the Minimum Revenue Entitlement (MRE) could have similar outcomes on grain handling performance.

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This paper analyzes the impact the Canadian Wheat Board (CWB) had on facilitating grain movements and utilizing terminal capacity from 2009/10 to 2015/16 in western Canada through econometric methods. We conduct an ex-post analysis on capacity utilization for every grain delivery station in western Canada controlling for distance to port, car spots, railway companies, and production. We use a CWB dummy variable and freight rates from Quorum Corporation to estimate capacity utilization before and after CWB abolishment. We analyze whether the CWB had an impact on terminal turnover ratios. We conclude the regulatory change in abolishing the CWB significantly reduced capacity utilization and delivery performance despite record production and implementation of ad hoc policies. Current regulatory changes regarding the Minimum Revenue Entitlement (MRE) could have similar outcomes on grain handling performance.

INTRODUCTION

The Canadian Wheat Board (CWB) was known for improving logistics in the grain handling and transportation system. Gray (2001) worked on setting performance benchmarks for the CWB on grain transportation from farm to Freight on Board (FOB) position as well as vessel loading and dispatch. These benchmarks were aimed at reducing the total farm gate to FOB port basis charges and were important for deregulation in handling and transportation in the 2000s. The CWB was removed by the federal government in 2012. Since it's abolishment, the grain handling industry has been subject to ad hoc policies due to poor performance in grain movements. The decision to remove the CWB was motivated by a desire to increase returns to producers by allowing them freedom in grain marketing. Whether the CWB would have provided better policy outcomes for producers and industry during the grain transportation crisis in 2013/14 warrants examination.

There has been little work comparing regulatory environments in the grain handling sector following the abolishment of the Canadian Wheat Board (CWB). Rather, academic research has focused on the future of government regulation in the grain transportation sector, in part of the Canadian Transportation Agency review in 2016. Recent literature focuses on whether regulation on agricultural commodities in the transportation sector should remain (Fulton, 2011; Gray, 2015; Nolan and Peterson, 2015). Fulton (2011) states that pressure from the industry after the removal of the CWB will eventually lead to the removal of the Maximum Revenue Entitlement (MRE) because of industry service complaints. Literature theorizes that in a non-regulatory environment, elevator companies could bid up freight rates to a monopolistic equilibrium by restricting capacity (Çakır and Nolan, 2015).

This paper analyzes capacity utilization before and after CWB abolishment using econometric methods. We explore whether performance in the handling and rail sector during the grain crisis would have been improved under the single desk seller. A CWB dummy variable is used to quantify the impact the single desk seller had on capacity utilization. Although the official out of power date for the CWB is August 1st 2012, there could be a lagged transition of operations resulting in 2012/13 remaining under the single desk seller (Veeman and Veeman, 2016). To account for this, we present two versions of this research; one with 2012/13 under CWB control, and one with 2012/13 included in the post abolishment group. The results are consistent across models.

The results of this paper show that the CWB had a positive impact on capacity utilization at inland terminals. Our results find that the CWB would have provided better outcomes to the grain handling industry in facilitating movements during the transportation crisis in 2013/14. This is in comparison with ad hoc policies such as the *Fair Rail for Grain Famers Act.*

Facilitating grain deliveries and shipments to port benefits the industry in mitigating congestion and elevated export basis levels (Gray, 2015; Torshizi and Gray, 2017). This paper examines whether capacity utilization changes in terms of terminal turnover ratio ex-post CWB abolishment. We calculate capacity utilization conditional on delivery stations in western Canada. Turnover ratio is used to measure operational performance and reflects concentration in the grain handling industry. Although producers could choose to sell to any grain buyer, the hypothesis in this paper is to test whether the CWB increased overall grain movements under central planning and regulatory oversight in the handling and transportation system. We refrain from policy suggestions of re-introducing a single-desk seller, but rather analyze how industry performance has changed in a non-regulatory environment. However, we suggest that a grain marketing agency involved in trade and the coordination of grain movements to port could benefit producers in cases of record production.

In the following section, we include background on the grain handling sector. We empirically show concentration in the grain handling system in terms of capacity. The third section includes an econometric analysis to examine the CWB's operational impact on facilitating grain deliveries and shipments. Following, the results of the econometric analysis are presented. The summary and conclusions section use the results to hypothesize how the removal of the MRE may alter capacity utilization in the grain handling sector.

BACKGROUND

The CWB was initially formed as a temporary agency by the federal government to assist producers from 1917 to 1920 in marketing grain during the first world war. At the time, farmers were paying inflated handling charges and receiving low prices for their grain due to price manipulation at the Winnipeg Grain Exchange (Levine, 1987). However, a study of these prices by federal government-appointed royal commissions in the 1920s and 30s found that futures market participation actually benefitted farmers (Levine, 1987). As of 1922, farmers formed cooperative wheat pools to exert market power on the Winnipeg Grain Exchange after failing to acquire a state-run monopoly. Until 1935, western producers sold their grain to wheat pools at a pooled price or through the Exchange at an open market price (Levine, 1987). In 1935, the CWB was established as a voluntary marketing agency through the *Canadian Wheat Board Act* (Veeman and Veeman, 2016). Grain deliveries to the CWB became compulsory during the second world war in 1943 when wheat trading futures were suspended at the Winnipeg Grain Exchange.

In the 1960s, there was a push from producers and wheat pools to build inland storage capacity to mitigate volatile commodity prices (Canadian Grain Commission, 2012; Gleim, 2014).

The CWB used this additional capacity by storing more grain at elevator terminals when they had excess capacity for a storage fee. Storage of grain at remote terminals could last for months before shipments were called to port. The CWB would hold grain stocks at inland terminals releasing them into the international market when prices were above average or after long term contracts were signed (Furtan, Kraft, and Tyrchniewicz, 1999).

Into the new millennium, the CWB had to rethink its strategy, and undertook major reforms to their business structure (Schmitz and Furtan, 2000). Many short-lines connecting remote areas to main rail lines were torn up, resulting in the closure of many small elevators. The Saskatchewan Wheat Pool began building concrete elevators under their re-building elevator initiative called Project Horizon (Fulton and Larson, 2009). Other elevator companies, such as United Grain Growers, James Richardson International, and Agricore Cooperative also made investments in high through-put concrete elevators. Agricore Cooperative was formed in 1998 from the merger between the Alberta Wheat Pool and Manitoba Pool. Agricore Cooperative later merged with United Grain Growers to form Agricore United Limited. In 2008, Agricore United was amalgamated by the Saskatchewan Wheat Pool, forming the newly named Viterra (Fulton and Larson, 2009). This series of mergers pushed the grain handling market towards higher through-put of grain to port during harvest, and put pressure on existing rail transportation.

In 1995, Gray designed a Freight Adjustment Factor (FAF) for the CWB using the National Grains Bureau pooling proposal in 1990 to create more efficient grain movements. FAF was a basis adjustment calculation that charged elevator companies freight rates based on the distance to port, reducing the cost of transportation through efficient coordination of grain movements (Gray, 1995). FAF was implemented in the CWB's operating structure for rail transportation of wheat and barley. However, the MRE provided additional regulation on grain transportation setting a cap on the average revenue per tonne on western grain movements (Brewin, Nolan, Gray, Schmitz, and Schmitz, 2017).

During this time, concentration in the grain handling market increased as large companies were the only ones that had enough capital to invest in concrete elevators, and so absorbed smaller companies. Table 1 shows market share averaged over 2013 and 2015 of elevator companies in percentage terms of inland capacity. Today, the three big players are Viterra (30%), Richardson International (24%), and Cargill (12%).

After the abolishment of the CWB, record production in the 2013/14 crop year led to market failure in the grain transportation system. The federal government addressed this by implementing ad hoc policies stipulating minimum grain movements. Railway companies wanted this market failure dealt with by removing the MRE. Fulton (2011) says that continued pressure from the railway companies will eventually achieve this goal. Removal of the MRE would allow railroads to charge grain handlers a monopolistic freight rate for grain transportation. If this happens, elevator companies fear that their margins will be significantly reduced. Given the current market structure in grain handling, elevator companies could lobby against the regulatory capture by railway companies. However, market power and private interests in the handling industry could reduce the amount of grain deliveries elevating export basis levels without regulatory oversight.

TABLE 1: AVERAGE OF 2013[a] AND 2015[b] INLAND GRAIN STORAGE CAPACITY IN WESTERN CANADA BY ELEVATOR COMPANY

Elevator Company	Inland Storage Capacity (tonnes)	Market Share (% of Inland Capacity)
ADM Agri-Industries Ltd.	15,000	0.25%
AgroCorp	4,800	0.08%
Alliance Pulse Processors	7,050	0.12%
Canada Malting Co	26,850	0.45%
Cargill Limited	733,080	12.41%
Canadian Wheat Board	222,205	3.76%
Delmar Commodities Ltd	6,190	0.10%
Fill-More Seeds Inc.	5,100	0.09%
Great Northern Grain	7,920	0.13%
Ilta Grain Inc	2,500	0.04%
Linear Grain Inc.	5,310	0.09%
Louis Dreyus Canada	398,550	6.75%
Mission Terminal INC	5,800	0.10%
North American Food Ingredients	12,000	0.20%
Parrish & Heimbecker Limited	523,430	8.86%
Paterson Grain	556,380	9.42%
Providence Grain	54,240	0.92%
Richardson Pioneer Limited	1,438,513	24.35%
Southland Pulse Ltd.	6,000	0.10%
Southsask Quality Processors Ltd	3,500	0.06%
Viterra Inc.	1,773,370	30.02%
Westlock Terminals Ltd	18,310	0.31%
Westmor Terminals Inc.	26,750	0.45%
Total	5,852,848	99.06%

Source: Adapted from Canadian National (2013) and Canadian Pacific (2015)
[a]Terminal capacity on Canadian National rail lines are collected from the Western Canada Grain Elevator Directory from 2013
[b]Terminal capacity on Canadian Pacific rail lines are collected from the Canadian Grain Elevator and Terminal Directory from 2015

In the next section, we use terminal capacity data from Canadian National (2013) and Canadian Pacific (2015) railways to estimate capacity utilization through turnover ratios. The construction of our econometric model depends on the facilitation of grain movements before and after CWB abolishment. Freight rates and a CWB dummy are used to examine whether the CWB had an impact on grain handling performance.

ECONOMETRIC MODEL

In the econometric model, capacity utilization is the dependent variable. Capacity utilization is the terminal turnover ratio, conditional on the railway delivery station and terminals at the station. Railway delivery station grain movements are acquired from the Canadian Grain Commission (2016). We acknowledge that there may be multiple companies (and/or terminals) located at a delivery station, and account for that in the model. Railway delivery stations with more terminals tend to be in higher producing regions. These terminals also have larger capacity making the turnover ratio comparable to the ratio at a smaller terminal in a low producing area. Capacity utilization at smaller terminals is above average and we control for this through the number of car spots available at a terminal's siding.

Equation 1 shows capacity utilization as a function of the turnover ratio of each terminal, conditional on delivery station. Grain deliveries to terminals are unknown, however grain deliveries to station and the total capacity at each railway delivery station are known. There are 220 unique railway delivery stations in the data set across five-time periods.

$$UTIL_{i,t} = f\left(Turnover\ Ratio_{i,t} | Delivery\ Station_i\right) \tag{1}$$

Where:

$i \epsilon (1{:}220)$ a delivery station identifier

$t \epsilon (1{:}5)$ a time identifier

Equation 2 shows the turnover ratio. It is calculated by dividing annual grain deliveries over terminal capacity (Quorum Corporation, 2015). Grain movements and terminal capacity are both measured in tonnes. The turnover ratio is the number of times a terminal turns over its capacity each year. To ensure turnover ratios are consistent, we use the total grain deliveries regardless of how many terminals are at each railway station. However, this causes a measurement error in our dependent variable because at some delivery stations there are two or more terminals so exact terminal deliveries are unknown. For larger areas there are two delivery stations. For example, in Regina there are two delivery stations, Regina east and Regina west. Because this measurement error is in the dependent variable and uncorrelated with independent variables, our estimators remain consistent.

We use the turnover ratio as a measure of capacity utilization because it is an industry benchmark ratio when measuring terminal performance. Grain auditors that work for elevator companies report turnover ratios to field representatives and their Board of Directors as a measure of performance for the elevator company. Managers have an incentive to purchase as much grain as their terminal can handle to maximize the turnover ratio and company profits.

$$Turnover\ Ratio_{i,t} = \frac{Deliveries_{i,t}}{Capacity_i} \tag{2}$$

Table 2 shows the descriptive statistics for this data set categorized by pre-CWB and post-CWB years showing the mean and standard deviation of each variable. Assuming there is a lag in transitioning the single desk seller to an open market, the pre-CWB period contains the crop years 2009/10 to 2012/13. Although varying across delivery stations, freight rates are constant throughout the five-year study period due to the MRE. The deliveries and production after CWB abolishment are higher because of record production in 2013/14 and above average production in 2014/15.

TABLE 2: DESCRIPTIVE STATISTICS FOR CAPACITY UTILIZATION IN WESTERN CANADA (2009/10-2015/16)

	pre-CWB[1]	**post-CWB[2]**
Dependent Variable:	*mean/(s.d.)*	
Capacity Utilization	18.39	21.28
(Deliveries/Capacity)	(37.07)	(40.80)
Deliveries *(tonnes)*	285,000	342,000
	(253,000)	(283,000)
Capacity *(tonnes)*	24,300	24,400
	(21,200)	(21,200)
Independent Variables:		
Canadian Wheat Board	1.00	0.00
(reference is no CWB)	0.00	0.00
Freight Rates: *($/tonne)*		
Thunder Bay	40.61	40.60
	(9.30)	(9.31)
Vancouver	56.61	56.61
	(6.61)	(6.62)
Prince Rupert	46.80	46.84
	(8.25)	(8.26)
Churchill	56.27	56.16
	(12.41)	(12.40)
Controls:		
Production *(tonnes)*	408,000	490,000
	(343,000)	(417,000)
Distance to Thunder Bay *(miles)*	803.68	804.18
	(276.77)	(277.25)
Distance to Vancouver *(miles)*	1,233.89	1,233.37
	(200.27)	(200.72)
Canadian Pacific	0.55	0.55
(reference is Canadian National)	(0.50)	(0.50)
Both CP and CN at Station	0.16	0.16
(reference is a single railway company)	(0.36)	(0.36)
50 Car Spot Siding	0.25	0.25
(reference is 100 car spot siding)	(0.43)	(0.43)
Observations	877	655

Source: Author's estimates, Quorum Corporation[3], Canadian Grain Commission (2016), Canadian National (2013), and Canadian Pacific (2014)

[1]pre-CWB period as single desk seller is from 2009/10 to 2012/13

[2]post-CWB period as single desk seller is from 2013/14 to 2015/16

[3] Quorum Corporation confidential data for freight rates contains the rate and mileage data from delivery station to Thunder Bay, Vancouver, Prince Rupert, and Churchill. Freight rates are shown in $CDN per tonne for single car lot movements. Incentives are approximately $4/tonne for 50 car blocks and $8/ tonne for 100 + car blocks.

The freight rates from each delivery station for the crop year of 2013/14 are acquired from Quorum Corporation. These rates are expressed in single car lot movements, however rates in 50 car block and 100-plus car block movements include discounts. This provides grain handlers with an incentive to contract unit trains to reduce the cost of transportation. We use the single car rates instead of discounting larger car blocks to accurately reflect the change in freight rates between terminals. Because freight rates are regulated by the MRE, it is appropriate to use the 2013/14 freight rates as proxies for all years in the dataset.

Production data for each delivery station is only available for the 2013/14 crop year, which was record production across western Canada. However, overall Canadian production is available for the entire period. We assume that the production for each delivery station is proportional to deliveries at that station. We take total Canadian production, and multiply it by the fraction of total deliveries each station is responsible for. In this way, we construct production for each delivery station for each year in the study period. This transformation limits variation in production across stations for the same year, not accounting for regional differences in yield. Due to the law of one price and arbitration this does not cause a problem in estimation. For example, if Kindersley had record production and Swift Current had low production, the price in Swift Current would attract deliveries from producers in Kindersley resulting in price convergence. This way we control for overall production in our model.

We control for serial correlation within elevator company by using cluster robust standard errors. Serial correlation within elevator companies across terminals and through time results in misleading standard errors (Bertrand, Duflo, and Mullainathan, 2004). Serial correlation exists in the data because internal structure varies by company. These companies have different performance incentives and possibly different technology.

In checking the robustness of the model, we modify the CWB dummy to equal one only in 2009/10, 2010/11 and 2011/12 crop years. In this regression, shown in columns (2) and (4) in tables 3 and 4, we do not assume there is a lag in transitioning the single desk seller to an open market. The change in the abolishment year for the CWB dummy variable provides comparable results that remain statistically significant.

We construct an econometric model shown in equation 3 using capacity utilization as the dependent variable. Freight rates and a CWB dummy variable are regressed on capacity utilization. Control variables are production, distance to port, car spots at terminal siding, and the railway company at each station. The control variables, excluding production, are time-invariant and do not change from year to year in our time-series.

$$UTIL_{i,t} = CWB_{i,t}\beta_1 + FR_{i,t}\beta_2 + c_{i,t} + \Gamma_\text{t} + \mu_{i,t} + \nu_{\ i,t} \tag{3}$$

Where:

$CWB_{i,t}$= dummy variable for the Canadian Wheat Board

$FR_{i,t}$= freight rate to port locations

$c_{i,t}$ = control variables for grain production, distance to port, railway company, car spots, and elevator company

Γ_t = time trend

$\mu_{i,t}$ = error term

$\nu_{\ i,t}$= dependent variable measurement error

Control variables are used in our model in place of instruments to mitigate potential endogeneity problems. Endogeneity problems in the model above may include reverse causality and omitted variable bias.

Gray (2015) shows that as production reaches the capacity constraints in the grain transportation system, the turnover ratio becomes constant. For many terminals, capacity utilization becomes constrained when production exceeds a grain handlers’ ability to move grain.

These constraints are predicted to be binding at port terminals in Vancouver, and overall railway capacity (Gray, 2015). We construct a restricted cubic b-spline in production to control for these constraints. B-splines are polynomial piece-wise functions that aim to improve the overall fit of the model. Although b-splines are commonly estimated non-parametrically, the restricted least squares (RLS) estimator allows us to construct and estimate splines where discontinuities exist.

In contrast to the linear b-splines, we use a cubic b-spline polynomial ordering to the fourth degree. We believe that turnover ratios are not linear with production; instead, exponentially increase and decrease when capacity constraints at terminals are binding. In terms of handling grain, expected deliveries and shipments for each month can vary depending on whether trains arrive on time and producers can haul grain. Deliveries and shipments at terminals depend on good weather for both railways and producers. In our production subset, cubic b-splines have discontinuities to the fourth derivative continuously joining at each knot. The subset for production shown in equations 4 to 6 represents the restriction matrix in the RLS estimator.

$$\alpha_{11} + \beta_{11}PROD_{11} + \cdots + \beta_{14}PROD_{14}^{4} = \alpha_{21} + \beta_{21}PROD_{21} + \cdots + \beta_{21}PROD_{21}^{4} \tag{4}$$

$$\alpha_{21} + \beta_{21}PROD_{21} + \cdots + \beta_{24}PROD_{24}^{4} = \alpha_{31} + \beta_{31}PROD_{31} + \cdots + \beta_{34}PROD_{34}^{4} \tag{5}$$

$$\alpha_{31} + \beta_{31}PROD_{31} + \cdots + \beta_{34}PROD_{34}^{4} = \alpha_{41} + \beta_{41}PROD_{41} + \cdots + \beta_{44}PROD_{44}^{4} \tag{6}$$

In estimating b-splines, research finds that one-way estimators are inefficient because they ignore the covariance structure in the disturbance term (Henderson and Ullah, 2005; Su and Ullah, 2007). Su and Ullah (2005) find that two-step estimators are appropriate for and perform the best in estimation. Ma, Racine, and Ullah (2015) confirm this theory that two-step estimators, such as the non-parametric random effects estimator, are asymptotically efficient for b-splines and computationally attractive for practitioners.

We refrain from two-step estimators and panel data methods such as the random and fixed effects model because our time-invariant controls do not account for the within variation in our dataset. Instead, we use cluster-robust standard errors to account for the covariance structure in the disturbance term, and to improve the efficiency in the model. We assume that errors are independent across clusters. We find this an appropriate estimation method and assume the variance structure is clustered by elevator company.

In the results section, four models are presented. Two OLS are differentiated from each other by whether or not 2012/13 is included in the post CWB abolishment group or not. Two RLS models incorporating b-splines for production are differentiated the same way.

RESULTS

The estimates of the coefficient for the CWB dummy range from 3.904 to 4.893 (tables 3 and 4). All models show statistically significant results, suggesting that the turnover ratio for terminals on average is greater under the CWB. With average turnover ratios post-CWB being 21.23 and pre-CWB being 18.39, these results are considered to have a sizeable impact on capacity utilization.

The coefficient on 50 car spot siding is positively significant in the OLS models, but insignificant in the cubic b-spline models. This lends weak evidence supporting the theory that smaller terminals have a higher turnover ratio. Higher throughput concrete elevators require at least 100 car spots in order to utilize capacity, whereas smaller wooden elevators can function with 50 car spots.

As expected, production is significant in the OLS models, showing that terminal turnover ratios increase with higher grain production. Production is included as b-splines in the RLS model, and acts more of a control than as an interpretable outcome. In years with higher production, terminals handle more grain.

Freight rates to Vancouver are statistically significant. As the cost of moving one tonne of grain by rail to Vancouver increases by $1, the terminal turnover ratio decreases by 1.450 on average. This means that an elevator manager would handle less grain, contracting 1.450 times their terminal capacity fewer tonnes per year. Deliveries to Vancouver in the past decade have been important for reducing the basis producers pay on their grain. Shipping grain through Thunder Bay is expensive because of the elevation charges on vessels traveling through dredged canals in the Great Lakes Waterway and St. Lawrence Seaway. The port in Vancouver is more accessible. This has resulted in more producers shipping to Vancouver in western Canada.

Surprisingly, distance to port has no significant impact on capacity utilization. We would expect terminals far from port to have a lower turnover ratio due to their larger catchment area. Terminals with a larger catchment area tend to store grain for longer periods of time, reducing their terminal turnover ratio. However, non-discriminatory rail service explains the insignificance. Rail capacity is dispersed through western Canada to serve all terminals that demand rail cars, without bias in favour of those closer to port.

Distance to Vancouver is highly correlated with distance to Thunder Bay, and with freight rates. We conduct a Variance Inflation Factor (VIF) test to examine whether both the OLS and RLS models suffer from severe multicollinearity. A VIF greater than 10 indicates severe multicollinearity (O'brian, 2007). We conclude that our estimates do not suffer from severe multicollinearity, as the test statistics are less than 10. The VIF scores can be found in table A1 in the appendix. Notably, cubic b-splines in the RLS model are severely correlated because they are transformations of the same variable.

The results are consistent between models with and without b-splines. The significance of the splines depends on the number of knots specified. Many researchers prefer more knots equally spaced, or to use a penalized b-spline estimator (Huang, Wu, and Zhou. 2004; Ruppert, and Carroll. 2000). We use Harrell's default principle of equally spaced percentiles at the original variables marginal distribution (Harrell, 2001). The values of production at each knot are shown in Table A2 in the appendix.

These results suggest that facilitation of grain movements and producer deliveries were greater under regulatory oversight in grain marketing. From a policy perspective, ad hoc policies such as the *Fair Rail Grain Farmers Act* attempt to achieve similar outcomes. The results of the model show that a regulatory agency in charge of grain marketing at the port could provide better outcomes to the current ad hoc policies on grain movements. Because of private interests and concentration in the grain handling industry, operational performance could be improved under better operational oversight of western grain deliveries and shipments.

TABLE 3: OLS ESTIMATES OF CAPATICITY UTILIZATION WITH RESPECT TO THE CWB AND FREIGHT RATES

	OLS (1)[1]	OLS (2)[2]
	b/t	
CWB[1,2]	4.101*	3.904**
(reference is CWB abolishment period)	1.84	2.41
Freight Rates:[3]		
Thunder Bay	-1.183	-1.183
	-1.63	-1.62
Vancouver	-1.450**	-1.450**
	-2.09	-2.09
Prince Rupert	0.184	0.184
	0.79	0.79
Churchill	0.113	0.112
	0.45	0.45
Controls:		
Production[4]	0.0428***	0.0426***
	3.14	3.15
Distance to Thunder Bay[5]	-0.0121	-0.0122
	-0.91	-0.91
Distance to Vancouver[5]	-0.0232	-0.0233
	-1.3	-1.30
Canadian Pacific	2.832	2.828
(reference is Canadian National)	0.87	0.87
Both CP and CN at Station	0.0643	0.157
(reference is a single railway company)	0.01	0.01
50 Car Spot Siding	7.259*	7.235*
(reference is 100 car spot siding)	1.84	1.79
Constant	144.809**	145.663**
	2.3	2.28
Time Trend	Yes	Yes
Clustered S.E.	Yes	Yes
R-Square	0.2109	0.2107
F-Statistic	55.19	35.51
Sample Size	1316	1316

Source: Author's estimates, Quorum Corporation, Canadian Grain Commission (2016), Canadian National (2013), and Canadian Pacific (2014)

[1]CWB is equal to 1 in years 2009/10, 2010/11, 2011/12 and 2012/13, otherwise CWB is equal to 0
[2]CWB is equal to 1 in years 2009/10, 2010/11, and 2011/12, otherwise CWB is equal to 0
[3]Freight Rates are measured in dollars per tonne transportation cost from inland terminal to port
[4]Production is measured in (000s) tonnes of grain
[5]Distance is measured in miles from inland terminal to port
*p<0.10, **p<0.05, and ***p<0.01

TABLE 4: RLS ESTIMATES OF CAPATICITY UTILIZATION WITH RESPECT TO THE CWB AND FREIGHT RATES (CUBIC B-SPLINE)

	RLS (3)[1]	RLS (4)[2]
	b/t	
Canadian Wheat Board	4.893*	4.206**
(reference is CWB abolishment period)	1.95	2.44
Freight Rates:[3]		
Thunder Bay	-0.897	-0.899
	-1.56	-1.56
Vancouver	-0.941**	-0.947*
	-1.91	-1.90
Prince Rupert	0.20	0.199
	0.80	0.80
Churchill	0.11	0.105
	0.41	0.41
Controls:		
Production Cubic B-Spline:[4,5]		
b-spline order 1	-0.02	-0.0163
	-0.30	-0.30
b-spline order 2	1.04	1.034
	0.96	0.96
b-spline order 3	-2.529	-2.512
	-1.02	-1.01
b-spline order 4	2.15	2.129
	1.14	1.13
Distance to Thunder Bay[6]	-0.01	-0.00542
	-0.42	-0.43
Distance to Vancouver[6]	-0.0193	-0.0195
	-1.15	-1.16
Canadian Pacific	2.43	2.431
(reference is Canadian National)	0.75	0.74
Both CP and CN at Station	-0.73	-0.605
(reference is a single railway company)	-0.08	-0.06
50 Car Spot Siding	6.19	6.171
(reference is 100 car spot siding)	1.50	1.49
Constant	101.153**	103.296
	2.11	2.11
Time Trend	Yes	Yes
Clustered S.E.	Yes	Yes
R-Square	0.2242	0.2238
F- Statistic	56.17	51.36
Observations	1316.00	1316

Source: Author's estimates, Quorum Corporation, Canadian Grain Commission (2016), Canadian National (2013), and Canadian Pacific (2014)

[1]CWB is equal to 1 in years 2009/10, 2010/11, 2011/12, and 2012/13, otherwise CWB is equal to 0
[2]CWB is equal to 1 in years 2009/10, 2010/11, and 2011/12, otherwise CWB is equal to 0
[3]Freight Rates are measured in dollars per tonne transportation cost from inland terminal to port
[4]Production is measured in (000s) tonnes of grain
[5] Restricted Cubic Spline Knots are determined by Harrell's default principle of equally spaced percentiles of the original variable's marginal distribution
[6]Distance is measured in miles from inland terminal to port
*p<0.10, **p<0.05, and ***p<0.01

SUMMARY AND CONCLUSIONS

The CWB had a significant impact on facilitating grain movements and utilizing additional inland capacity in western Canada. Given the record crop production in 2013/14 and the *Fair Rail for Farmers Act* in 2014, capacity utilization was significantly lower ex-post CWB abolishment. These two factors should have worked to increase capacity utilization post CWB abolishment, yet the results still find a significant relationship. The operational efficiency of grain movement in western Canada may have been reduced in 2013/14 due to private interests in triggering congestion constraints at the port and elevating export basis levels. Further policies seeking to improve the performance of the grain handling system could include regulatory oversight that coordinates grain movements. Results in this paper show that these regulatory frameworks provide better outcomes in handling performance when compared to ad hoc policies.

Many academics are certain that the grain handling system cannot perform adequately under multiple sellers (Fulton, 2011). These academics also express concerns that railway companies could potentially restrict capacity to charge higher freight rates to grain handlers (Fulton and Gray, 1998; Nolan and Skotheim, 2008). Nolan and Skotheim (2008) show that inter-switching could potentially increase competition in the grain handling sector, reducing freight costs absorbed by grain handlers and producers. Fulton and Gray (1998) show that open running rights on rail lines would be a feasible solution if regulation on agricultural commodities were to be removed.

The reason for discussion on regulatory options for the rail sector is due to the recent Canadian Transportation Agency (CTA) recommendation to eliminate the MRE. Results in this paper suggest that CWB abolishment lowered capacity utilization in western Canada which may have led to the elevated export basis levels and rail congestion in 2013/14. An open market could lead to further reductions in grain movements lowering producer income and increasing export basis levels (Torshizi and Gray, 2017). The big players in the handling market such as Viterra, Richardson, and Cargill, are more likely to collude and act as a monopsony under complete deregulation.

Following the CTA recommendation in 2016, the federal government put into effect the *Transportation Modernization Act*, which retains the MRE (Sask Wheat Development Commission, 2017). However, the Act does not require that railway companies perform a periodic cost review, allowing them to gain profit margins while lowering capacity. As a result of the Act, costs built into the MRE do not accurately reflect the current industry. Because of this, railways could have an incentive to move less grain given grain handlers are willing to implicitly participate.

The likelihood of further crises in the grain handling and transportation system depends on the quality of government oversight in the industry. A grain marketing agency that takes part in trade and coordination of grain movements would play a crucial role in sustaining grain production in western Canada. How the federal government decides to facilitate grain movements in years to come will dictate improvements in efficiency and how performance standards are set. With the current regulatory framework, reduced handling and transportation performance is likely to reduce producer income and elevate export basis in cases without a marketing agency similar to the CWB.

REFERENCES

Bertrand, M., Duflo, E., and S. Mullainathan. 2004. How much should we trust differences-in-differences estimates? The Quarterly journal of economics, 119(1): 249-275.

Brewin, D., Nolan, J., Gray, R., Schmitz, T., and A. Schmitz. 2017. The Canadian Grain Handling Supply Chain in the Post Canadian Wheat Board Era (No. 17-00784).

Çakır, M., and J. Nolan. 2015. Revisiting concentration in food and agricultural supply chains: The welfare implications of market power in a complementary input sector. Journal of agricultural and resource economics, 40(2): 203-210.

Canadian Grain Commission. 2016. Grain Deliveries at Prairie Points: Crop Year 2015-16. Government of Canada. https://www.grainscanada.gc.ca/statistics-statistiques/gdpp-lgpcp/gdppm-mlgpcp-eng.htm (Accessed January 23, 2017)

Canadian Grain Commission. 2012. Grain elevator and storage capacity totals combined for all provinces and elevator types, 1962 to 2016. Government of Canada. https://www.grainscanada.gc.ca/wa-aw/geic-sgc/summary-results-sommaire-resultats-eng.asp (Accessed March 23, 2017)

Canadian National. 2013. Western Canada Grain Elevator Directory. https://www.cn.ca/-/media/Files/Your...Grain/Cdn-Grain-Elevator-Directory-en.pdf (Accessed January 17, 2017)

Canadian Pacific Railway. 2015. Canadian Grain Elevator and Terminal Directory. http://www.cpr.ca/en/customer-resources-site/Documents/canada-grain-directory.pdf (Accessed January 17, 2017)

Fulton, M. 2011. Challenges Facing the Grain Handling and Transportation System in Western Canada in a Post Canadian Wheat Board Environment. Johnson-Shoyama Graduate School of Public Policy, University of Saskatchewan. http://www.schoolofpublicpolicy.sk.ca/_documents/_publications_reports/working_paper_series/WPS7_MFulton_NOVEMBER2011.pdf (Accessed March 15, 2017)

Fulton, M. E., and R.S. Gray. 1998. The Provision of Rail Service: The Impact of Competition (No. 29164). Montana State University, Department of Agricultural Economics and Economics.

Fulton, M. E., and K. Larson. 2009. The restructuring of the Saskatchewan wheat pool: overconfidence and agency. Journal of Cooperatives 23: 1-19. http://accc.k-state.edu/ncera210/jocpdfs/v23/FultonLangSWP.pdf (Accessed March 25, 2017)

Furtan, W.H., Kraft, D.F., and E.W. Tyrchniewicz. 1999. Can the Canadian Wheat Board Extract Monopoly Rents? The Case of the Spring Wheat Market. International Journal of Business Economics 6(3): 417-437.
http://www.tandfonline.com/doi/abs/10.1080/13571519984160 (Accessed March, 20, 2017)

Gray, R.S. 1995. Basis Deductions for CWB Deliveries in Western Canada: A Proposal for Basis Calculations.

Gray, R. 2001. Benchmarks to Measure CWB Performance - Recommendations. A Report Submitted to the Canadian Wheat Board. June 2001. 27 pp.

Gray, R.S. 2015. The Economic Impacts of Elevated Export Basis Levels on Western Canadian Grain Producers 2012/13, 2013/14, and 2014/15. A report submitted to the Saskatchewan Wheat Development Commission. August.

Gleim, S. W. 2014. Canada's grain handling and transportation system: a gis-based evaluation of policy changes (Master's Thesis, University of Saskatchewan Saskatoon).
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.918.5978&rep=rep1&type=pdf (Accessed March 24, 2017)

Harrell, F. E., Jr. 2001. Regression Modeling Strategies: With Applications to Linear Models, Logistic Regression, and Survival Analysis. New York: Springer.

Henderson, D. J., and A. Ullah. 2005. A nonparametric random effects estimator. Economics Letters, 88(3), 403-407.

Huang, J. Z., Wu, C. O., and L. Zhou. 2004. Polynomial spline estimation and inference for varying coefficient models with longitudinal data. Statistica Sinica, 763-788.

Levine, A. 1987. Open Market or" Orderly Marketing": The Winnipeg Grain Exchange and the Wheat Pools, 1923-1929. Agricultural history, 61(2): 50-69.

Ma, S., Racine, J. S., and A, Ullah. 2015. Nonparametric Regression-Spline Random Effects Models (No. 2015-10).

Nolan, J., and J. Skotheim. 2008. Spatial competition and regulatory change in the grain handling and transportation system in western Canada. The Annals of Regional Science 42(4): 929-944.

Nolan, J., and S. Peterson. 2015. Grain Handling and Transportation Policy in Canada: Implications for the United States. Choices 30(3).

O'brien, R. M. 2007. A caution regarding rules of thumb for variance inflation factors. Quality & Quantity, 41(5): 673-690.

Pratt, S. 2012. CWB may market pulses, canola. Western Producer. Western Producer Publications 90(7).

Quorum Corporation, 2015. Reports: 2014-15 Annual Report, Data Tables. Quorum Corporation http://www.quorumcorp.net/reports.html (Accessed March 20, 2017)

Ruppert, D., and R.J. Carroll. 2000. Theory & Methods: Spatially-adaptive Penalties for Spline Fitting. Australian & New Zealand Journal of Statistics, 42(2): 205-223.

Sask Wheat Development Commission. 2017. Response to Bill C-49 the Transportation Modernization Act. Submitted by the Saskatchewan Wheat Development Commission, Agricultural Producers Association of Saskatchewan, Saskatchewan Barley Development Commission, September 5, 2017.

Schmitz, A., and W.H. Furtan. 2000. The Canadian Wheat Board: marketing in the new millennium (Vol. 38). University of Regina Press.

Su, L., and A. Ullah. 2007. More efficient estimation of nonparametric panel data models with random effects. Economics Letters, 96(3): 375-380.

Torshizi, M., and R, Gray. 2017 An Economic Analysis of Western Canadian Grain Export Capacity. Canadian Journal of Agricultural Economics.

Veeman M.M., and T.S. Veeman. 2016. Canadian Wheat Board, Historica Canada. http://www.thecanadianencyclopedia.ca/en/article/canadian-wheat-board/ (Accessed March 23, 2017)

APPENDIX

TABLE A1: VARIANCE INFLATION FACTOR FOR CAPACITY UTILIZATION OLS & RLS REGRESSION MODELS

	(1)	(3)
	VIF	
Production	1.4	
Production Spline 3		89202.53*
Production Spline 2		45866.33*
Production Spline 4		9871.91*
Production Spline 1		192.18*
Thunder Bay Freight Rate	7.71	8.25
Vancouver Frieght Rate	6.2	6.82
Distance to Thunder Bay	6.08	6.28
Distance to Vancouver	4.9	4.93
Canadian Wheat Board	3.22	3.23
Year	3.18	3.18
Prince Rupert Frieght Rate	2.03	2.08
Churchill Frieght Rate	1.94	1.96
Both CP and CN Station	1.37	1.38
50 Car Spot Siding	1.08	1.2
Canadian Pacific	1.1	1.12

Source: Author's Estimates
*VIF>10 severe multicollinearity (O'brien, 2007)

TABLE A2: HARRELL'S DEFAULT PRINCIPLE OF EQUALLY PLACED PERCENTILES CUBIC B-SPLINE KNOTS FOR GRAIN PRODUCTION

Variable/Knot	Knot 1	Knot 2	Knot 3	Knot 4
Production[1]	24,890	171,148	343,946	576,915

Source: Author's Estimates
[1] Production is measured in terms of tonnes for each delivery station