COST ELASTICITY AND PORT CHOICE FOR WEST COAST CONTAINER TRAFFIC

Philip Davies, Davies Transportation Consulting Inc

Abstract

Two phases of a major study on port and modal elasticity have been conducted by Leachman and Associates LLC for the Southern California Association of Governments to assess the impact of gateway costs on container traffic levels through West Coast ports. The study concludes that a portion of this traffic – particularly low value commodities transported inland in marine containers (Inland Point Intermodal or IPI traffic) - is highly sensitive to additional costs.

However, the data indicates that West Coast container port market shares have been remarkably stable. The most striking change has been the upward trend in the market share of the BC Lower Mainland ports (now combined as Port Metro Vancouver) from 9% in 2002 to 11% in 2009. It is difficult to reconcile this trend with a high elasticity of demand relative to gateway costs; from 2002 to 2009 the value of the Canadian dollar increased by 36% against the U.S. dollar, and (all else being equal) this change would be reflected in the cost of moving containers through the Lower Mainland gateway.

Evaluation of the factors determining West Coast ports' market shares is challenging due to the lack of reliable data on the volumes and routing of import cargo to inland destinations, and due to the difficulty in establishing shipper costs when rates for ocean shipping, port charges, and inland transportation are determined primarily by confidential contracts. For this study, analysis is simplified due to the traditional dominance of Canadian imports and exports in Lower Mainland shipments. Inland routings of cargo can be deduced from Customs data, and financial data on intermodal revenue per carload for the Canadian and U.S. Class 1 railways serving the West Coast ports provide a representative indication of cost differentials for inland transportation. Due to data limitations, this analysis assumes that relative port and ocean shipping costs were unchanged over this period; however evidence is presented to suggest that Lower Mainland port costs may have increased relative to U.S. costs.

Analysis of this data suggests that while the appreciation of the Canadian dollar increased costs in inland transportation relative to U.S. ports, the impact was outweighed by the increase in Pacific Rim imports due to lower prices for imported goods. The elasticity of port traffic to relative transportation costs is estimated at .39, significantly lower than values found in previous studies for U.S. West Coast ports. It appears that the Lower Mainland has actually lost market share in its core Canadian market, and that the largest portion of traffic lost to competing ports enters Canada by truck through land border crossings in Eastern Canada.

There are a number of factors which may account for this result. The most important is probably the lack of direct rail access for U.S. Class 1 railways to the Canadian market. Based on Canada Customs data, the share by value of Pacific Rim imports entering Canada by truck through the four major land border crossings grew from 14.6% in 2002 to 19.3% in 2009. Regression analysis indicates this increase is attributable to the increase in relative Canadian/U.S. rail costs.

This research on Lower Mainland port traffic could be usefully extended through expansion of the dataset used for the regression analysis in two areas. The first is through acquisition of data on ocean shipping cost differentials between Canadian and U.S. ports. The second is a more detailed analysis of Canadian Customs data to encompass cargo volumes rather than values across all land border crossings. Addition of variables related to inventory costs, including transit time, reliability and interest rates would also be useful to test the importance of these elements in port choice.

This analysis also suggests some useful extensions of existing research on U.S. port elasticity. The Lower Mainland example indicates the crucial role of intermodal and intramodal competition in the destination market in determining the elasticity of port traffic. Assembly of more reliable statistics on inland cargo movements within the U.S. would facilitate analysis of these factors.

The wide gap between the results of the Leachman simulation model and time series regression analysis suggests that the theoretical model may overstate the impact of cost differentials on port traffic. The simulation model relies on several key assumptions:

- It assumes that additional costs (i.e. container fees) will be passed on directly to shippers. Economic models of price discrimination suggest that the impact may be mitigated by strategic pricing decisions by supply chain participants. In particular, the theory of tax incidence from the public finance literature may provide a useful model for further analysis. This approach may also be appropriate for analysis of Canadian ports' performance in the future due to the potential price discrimination by CN between the ports of Vancouver and Prince Rupert.

- The Leachman model assumes that routing decisions are made by shippers on the basis of cost minimization. However, transportation service providers – shipping lines and railways – may have a larger role, either directly through determination of origin-destination routings or indirectly through strategic pricing decisions which influence shippers' choices. If that is the case, the more appropriate approach would be a profit-maximizing model which incorporates analysis of round trip container costs and revenues for shipping lines and/or railways.

Further regression analysis on time series data would provide a useful means of validating the Leachman simulation results against actual behaviour.

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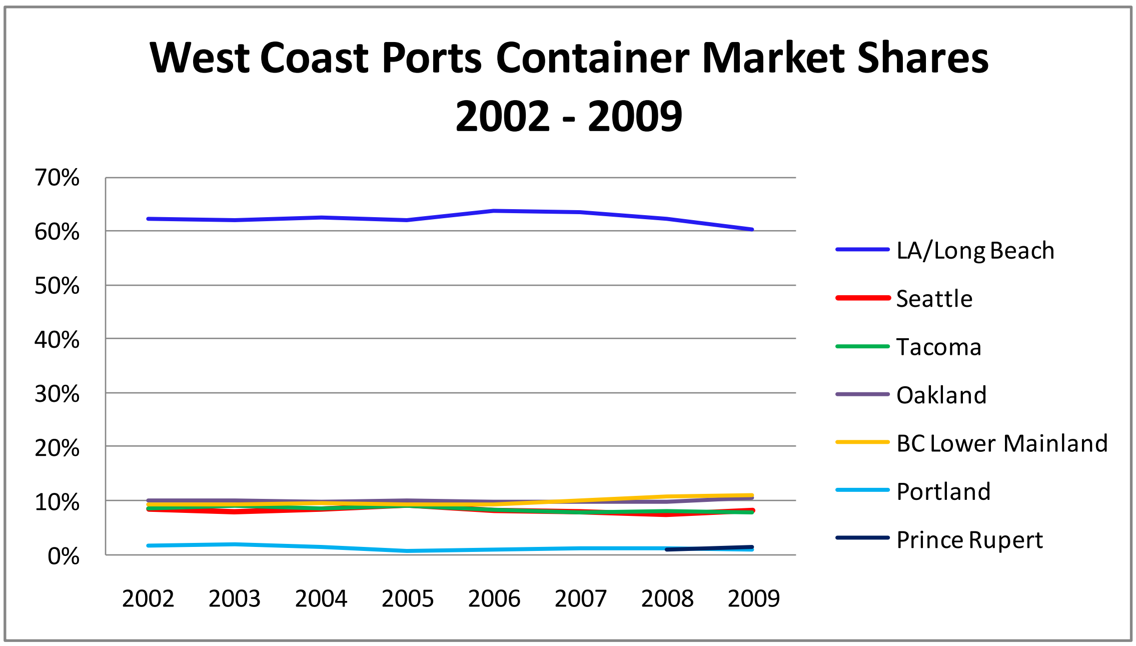
Background

Two phases of a major study on port and modal elasticity have been conducted by Leachman and Associates LLC for the Southern California Association of Governments (SCAG) to assess the impact of gateway costs on container traffic levels through West Coast ports[1]. The studies were commissioned by SCAG to assess the potential impact of container fees on the volume of containerized cargo through the Ports of Los Angeles and Long Beach. Both phases of the study concluded that the imposition of fees could have significant impacts on cargo volumes through the Southern California gateway.

Actual changes in West Coast ports market shares have been relatively minor from 2001 through 2009 in spite of significant changes in relative port costs. The Ports of Los Angeles and Long Beach dominated throughout this period, with an average market share of 62.3%. The LA/Long Beach share peaked in 2006 at 63.7%, and reached its lowest point in 2009 at 60.3%. The most striking change has been the modest upward trend in the market share of the BC Lower Mainland ports (now Port Metro Vancouver) from 9.1% in 2002 to 11.0% in 2009. Trends in West Coast ports' shares of containerized traffic are illustrated below:

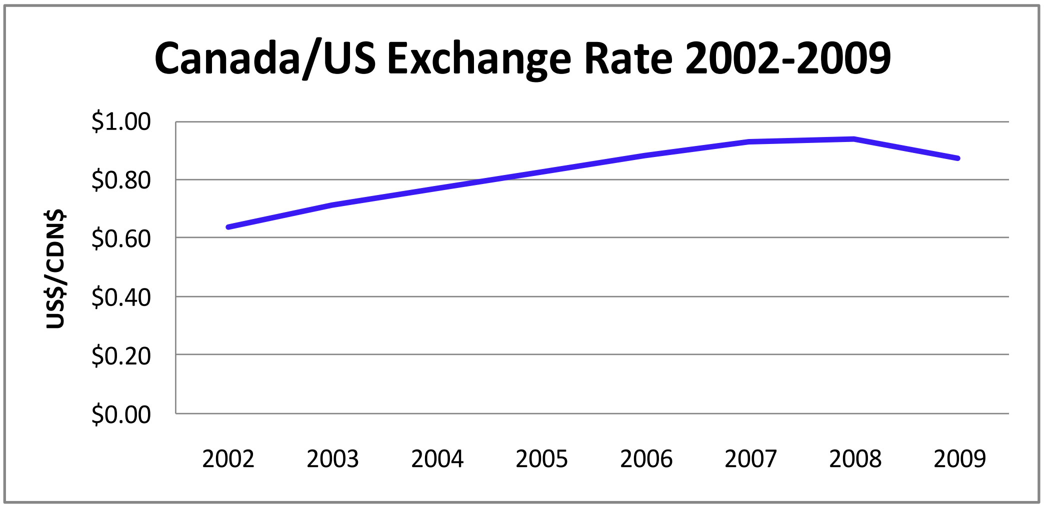
Figure 1 West Coast Ports Market Shares 2002 – 2009



It is difficult to reconcile the increase in the Lower Mainland's market share with a high elasticity for port choice. There were two major factors leading to cost increases for the Lower Mainland gateway relative to other West Coast ports over this period.

The first was the substantial increase in the value of the Canadian dollar relative to the U.S. dollar. From 2001 to 2009 the value of the Canadian dollar increased by 36% against the U.S. dollar. Most of this change occurred between 2004 and 2007.

Figure 2 Canada – US Exchange Rate 2002 – 2009



The second major factor was related to initiatives to increase the capacity of the Lower Mainland container terminals. Over the study period the Lower Mainland terminals undertook capital investments and operational changes which had the impact of increasing the cost of moving containers. While other ports saw capital investments in terminal capacity, the operational changes undertaken in the Lower Mainland are unique among North American ports. These changes included the adoption of off-dock storage of empty containers, aggressive programs to minimize the dwell time of containers on the docks, and the implementation of mandatory appointment systems for trucks serving the container terminals. The major goal of these initiatives has been increasing the capacity of container operations on the existing land base (TEU's per acre).

These changes are of interest in the context of other West Coast port strategies to increase container capacity on their existing land base as a means of accommodating traffic growth. Adoption of the Lower Mainland model – increased stacking density, on-dock rail, off-dock storage and terminal appointment systems – results in higher operating costs. For this reason both port authorities and terminal operators in the U.S. have been reluctant to take these steps for fear of losing traffic to competing ports.[2] Consequently the elasticity of port choice relative to gateway costs is of major interest.

Previous Studies

The primary sources reviewed for purposes of this paper are the first and second phases of the Port and Modal Elasticity undertaken by Leachman and Associates for the Southern California Association of Governments (SCAG). A study on port elasticities led by Moffatt & Nichol was also undertaken for the Ports of Los Angeles and Long Beach. A brief review of the methodology and results of these studies is given below.

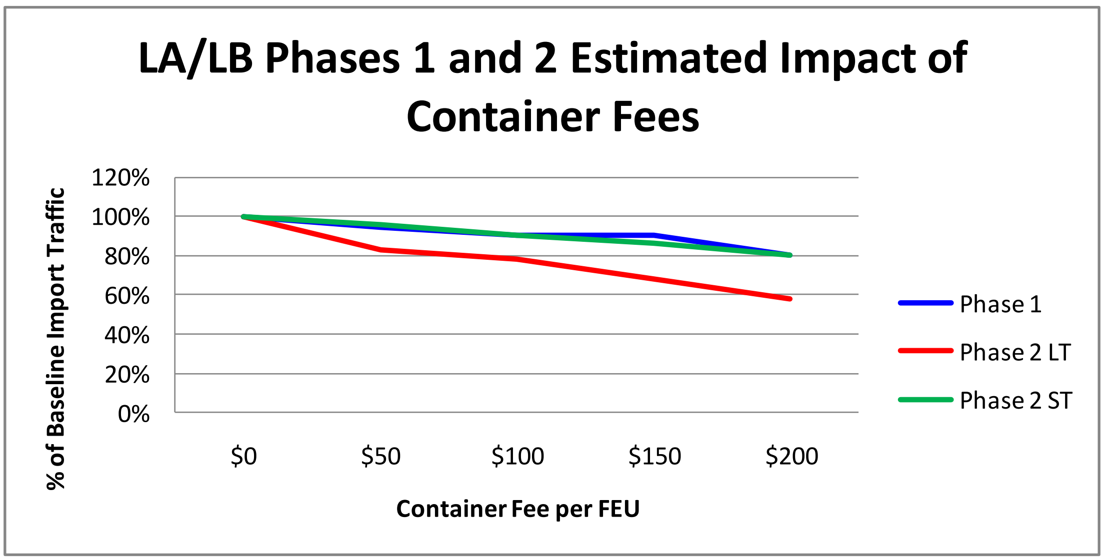
Phase 1 of the SCAG study was designed to assess the long term impacts of container fees to finance infrastructure investments to accommodate growth in container traffic. A model was developed to allocate imports among ports and modes so as to minimize total transportation and inventory costs from the point of view of importers. Data on transportation costs was obtained directly from shippers and transportation service providers. Inventory costs in the model are based on the value of goods imported and transit times for alternative routings. The distribution of value for goods imported from Asia was estimated using a combination of US Customs and PIERS data combined with data from the Pacific Maritime Association on the distribution of container sizes used for imports. These values were then applied to 83 major importers and 19 "proxy miscellaneous" importers based on the composition of imports for each from PIERS data. Total North American demand for containerized imports from Asia was allocated among 21 destination regions based on regional population and income levels. Modal options included direct rail for international containers (IPI), direct truck and local dray, transload rail, and transload truck and local dray.

On the basis of the trade-off between transportation and inventory costs, the study found that the preferred strategy for small importers, importers with few destinations, and importers with low average values of their imports was the use of direct shipping channels. Transloading in the vicinity of the port of entry was a preferred strategy for importers that are nation-wide in scope, have moderate or high average values for their imports, and have sufficient overall volume.

The elasticity estimates in the Phase 1 study were long term in nature because the model did not take into account existing capacity constraints nor the impact of traffic shifts on transit times as a result of congestion. The Phase 2 model was expanded to include these factors through the development of a methodology for estimating congestion impacts based on queuing theory. The model was calibrated to 2005 and 2006 trade data and shipper costs were based on levels prevailing in April 2007.

Approximate estimates of the impact of container fees on import traffic for the Ports of Los Angeles and Long Beach from the two SCAG studies are illustrated below. The Phase 2 study estimates suggest a much higher elasticity than the Phase 1 study.

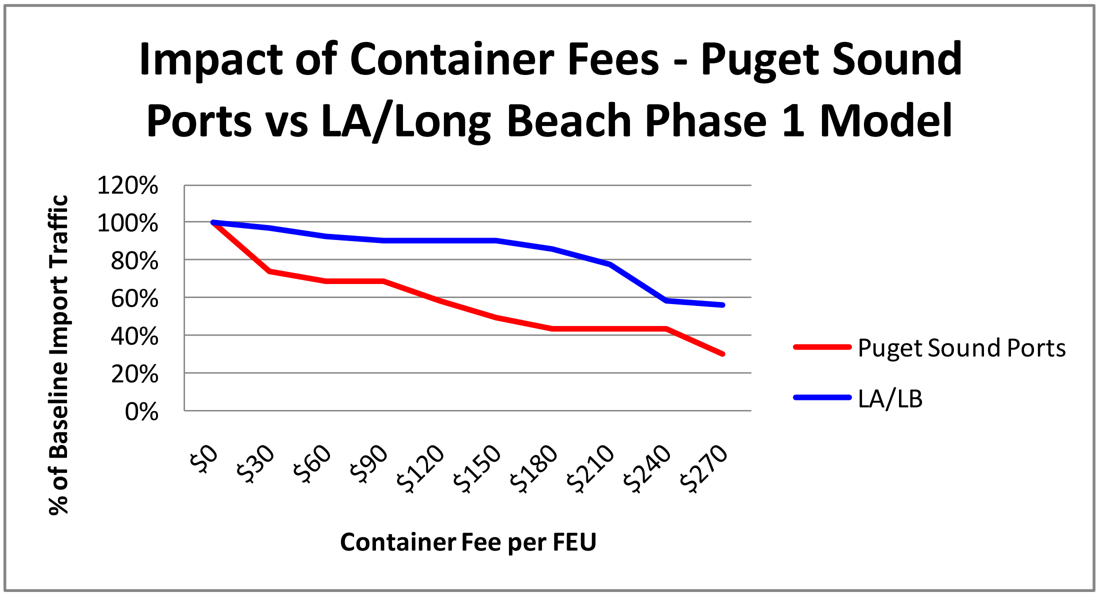
Figure 3 SCAG Study Phases 1 and 2 Impact of Container Fees



This change is attributed to increases in domestic intermodal rates relative to IPI rates; more rapid domestic intermodal rate escalation for Southern California traffic; and aggressive competition for IPI traffic from the newly-opened Port of Prince Rupert. In both phases of the SCAG study, it was estimated that investments in infrastructure to increase transit time and reliability of shipments through the Southern California ports could substantially mitigate the impacts of the fees.

A study on the elasticity of traffic through the Puget Sound ports of Seattle and Tacoma based on the Phase 1 model was conducted by Leachman and Associates in 2008 as part of a larger Freight Investment Study undertaken for the Washington State Joint Transportation Committee.[3] This study estimated that the Puget Sound ports' traffic was extremely sensitive to cost increases, with a reduction in volume of approximately 25% for a container fee of $30. Results are illustrated below:

Figure 4 Impact of Container Fees Puget Sound Ports vs SCAG Phase 1 Model



Estimation of the aggregate elasticity from the Leachman reports is difficult due to the methodology employed i.e. elasticities differ among traffic segments (IPI, transloaded, local drayage, etc.) and for specific inland destinations. Estimates of average (arc) elasticities based on transportation costs by direct rail to Chicago are summarized below, calculated based on the percentage change in volume from the baseline (i.e. no fee) total divided by the percentage change in total transportation cost. The results indicate very high elasticities, up to 20.6 for the case of the Puget Sound ports for container fees of $50.

Figure 5 Leachman Studies Estimated Elasticities

Leachman Studies Estimated Elasticities				
Container fee	**$50**	**$100**	**$150**	**$200**
Phase 1 Long Term	**Inland Point Intermodal LA/LB to Chicago**			
Estimated Elasticity	4.1	3.5	2.4	3.5
Phase 2 Long Term	**Inland Point Intermodal LA/LB to Chicago**			
Estimated Elasticity	12.2	7.9	7.7	7.5
Phase 2 Short Term	**Inland Point Intermodal LA/LB to Chicago**			
Estimated Elasticity	2.9	3.6	3.4	3.6
Phase 1 Long Term	**Inland Point Intermodal SEATAC to Chicago**			
Estimated Elasticity	20.6	12.4	12.1	10.1

Another study dealing with the elasticity of port traffic was undertaken for the Ports of Los Angeles and Long Beach by Moffatt and Nichol to estimate potential cargo diversion resulting from the ports' Clean Trucks programs.[4] The methodology for this study differed in several respects from that used for the Leachman studies. Rather than allocating traffic strictly on the basis of minimum costs, the market share of the Southern California ports was estimated through regression analysis using the ratio of costs for specific traffic segments as the explanatory variable. Costs were disaggregated into ocean freight, port and inland mode categories. Ocean freight costs were estimated using a proprietary cost model. Port costs were estimated based on port authority tariffs, terminal operator rates, and stevedore charges. On-dock intermodal lift costs and off-dock intermodal drayage charges were included as appropriate. Intermodal rail costs were estimated based on the Surface Transportation Board's Uniform Rail Costing System model. Trucking costs were estimated based on a model based on mileage, driving time and fixed costs per move. Inventory costs were not explicitly included in the model. The modal cost estimates were aggregated to estimate total costs for specific container movements from specific Asian trade regions to 179 subregions of the U.S. Market shares were based on estimates of traffic derived from PIERS import data.

The Puget Sound ports were identified as the West Coast alternative to the Ports of Los Angeles and Long Beach due to the limited intermodal connectivity of the Port of Oakland. Based on a log linear regression of markets shares to cost ratios for each origin-destination pair, the weighted average elasticity for the Southern California ports vs the Puget Sound ports was estimated at .8, though the study suggests that the elasticity for destinations served by intermodal rail may be higher.[5]

Evolution of Shipping Costs for Lower Mainland Container Traffic

For purposes of this study, costs of shipping containers through the Vancouver Gateway are disaggregated into inland rail, port and ocean transportation. This facilitates the analysis of the impact of exchange rate changes, which vary among these categories; most notably, changes in the exchange rate are unlikely to affect ocean container rates directly since these are paid in U.S. dollars.

Rail Costs - Inland transportation costs represent a significant portion of total delivered costs. In 2007, Maersk claimed that inland transportation costs accounted for two thirds of total transportation costs to inland destinations.[6] The 2008 Moffatt & Nichol study estimated average rail costs for IPI shipments at approximately $1300 per container, almost 35% of total transportation costs.[7] Intermodal rail costs are particularly critical for Lower Mainland container traffic. On-dock rail shipments typically account for 65% to 70% of import traffic.

There are substantial differences between the intermodal services offered by the Canadian and U.S. railroads. The Canadian railways have historically focused on the “retail” market (providing intermodal services directly to major shippers in competition with trucking) rather than the “wholesale” market (providing service to other transportation providers including trucking firms, Intermodal Marketing Companies (IMC’s) and shipping lines). With the exception of CP’s Expressway service between Montreal and Toronto, CP and CN have abandoned TOFC service in Canada. Canadian intermodal services lack the significant variations in service levels between domestic and international container traffic which are a feature of U.S. operations. With the exception of unit train operations from the Deltaport terminal in Vancouver, domestic and intermodal containers are transported on mixed trains and therefore have identical transit times. This is in sharp contrast to BNSF and UP expedited intermodal services which provide reduced transit times for priority shipments. For Canadian shippers, the major incentive for use of domestic rather than international intermodal service is lower transportation costs based on the higher cubic capacity of 53 foot domestic containers.[8]

Ideally an analysis of intermodal rail costs for shipments through West Coast ports would be based on sufficiently detailed data to evaluate cost differentials among specific routings and traffic segments (i.e. international vs domestic intermodal traffic). Practically this data is difficult to obtain, based primarily on confidential contracts between shippers and railways. For purposes of this study, aggregate intermodal revenue per carloads among the Canadian (CN and CP Rail) and US (BNSF and UP) Class1 railways provides an indication of comparative cost increases over the study period. Data on intermodal volumes and revenue for the four Class 1 railways has been assembled from railway annual financial reports and from reports to the Surface Transportation Board,[9] and intermodal carload[10] volumes reported to the Association of American Railroads.

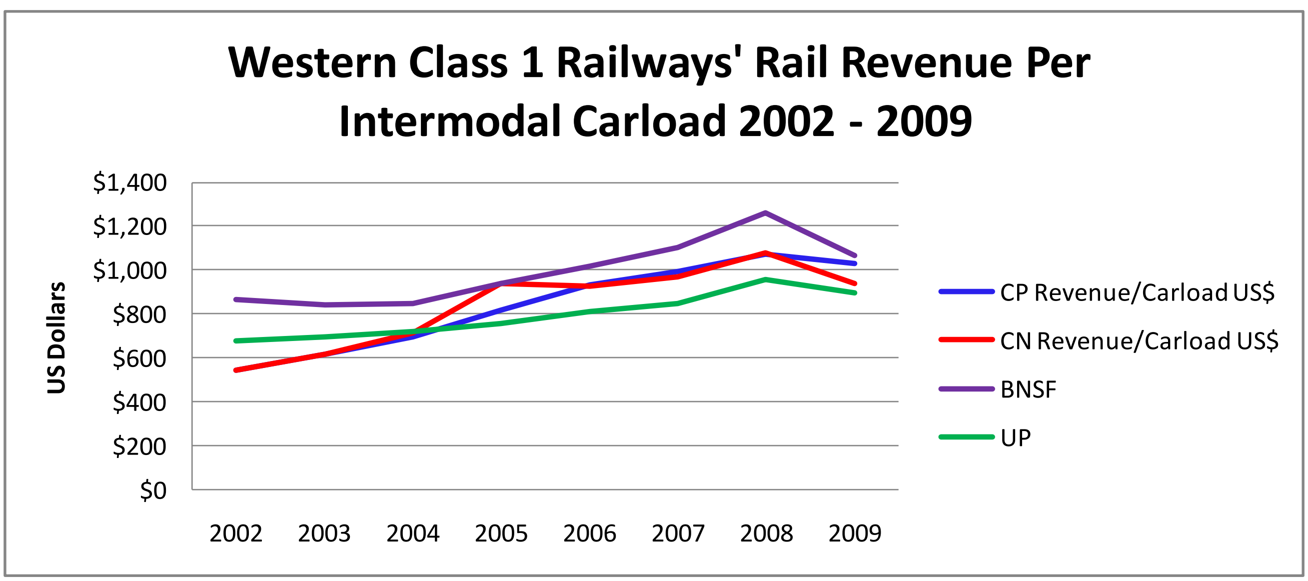
Data on Class 1 railway intermodal traffic is shown below.

Figure 6 Western Class 1 Railway Intermodal Statistics 2002 - 2009

Western Class 1 Railway Intermodal Statistics 2002 - 2009								
CP	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Intermodal Carloads	999,797	1,073,226	1,149,129	1,171,632	1,186,807	1,236,794	1,223,443	961,518
Intermodal Revenue (CDN $ Millions)	$855.4	$926.4	$1,034.7	$1,161.1	$1,257.0	$1,317.2	$1,399.8	$1,129.9
CP Revenue/Carload CDN$	$856	$863	$900	$991	$1,059	$1,065	$1,144	$1,175
% Imp/Exp	n/a	n/a	n/a	n/a	n/a	59%	n/a	n/a
CDN$/US$ Exchange Rate	$1.57	$1.40	$1.30	$1.21	$1.13	$1.08	$1.07	$1.14
CP Revenue/Carload US$	$545	$616	$692	$818	$934	$991	$1,073	$1,029
CN	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Intermodal Carloads	1,237,000	1,276,000	1,202,000	1,248,000	1,326,000	1,324,000	1,377,000	1,246,000
Intermodal Revenue (CDN $ Millions)	$1,052.0	$1,101.0	$1,117.0	$1,420.0	$1,394.0	$1,382.0	$1,580.0	$1,337.0
CN Revenue/Carload CDN$	$850	$863	$929	$1,138	$1,051	$1,044	$1,147	$1,073
% Imp/Exp	57%	55%	48%	50%	52%	52%	52%	53%
CDN$/US$ Exchange Rate	$1.57	$1.40	$1.30	$1.21	$1.13	$1.08	$1.07	$1.14
CN Revenue/Carload US$	$542	$616	$714	$939	$927	$971	$1,076	$940
UP	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Intermodal Carloads	2,851,000	2,983,000	3,127,000	3,271,000	3,457,000	3,453,000	3,165,000	2,775,000
Intermodal Revenue (US $ Millions)	$1,995.0	$2,066.0	$2,240.0	$2,473.0	$2,810.0	$2,925.0	$3,023.0	$2,486.0
UP Revenue/Carload US$	$676	$693	$716	$756	$813	$847	$955	$896
% Imp/Exp	n/a	n/a	n/a	54%	57%	58%	58%	51%
BNSF	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Intermodal Carloads	3,880,000	4,336,000	4,770,000	5,215,000	5,520,000	5,149,000	4,818,000	3,911,000
Intermodal Revenue (US $ Millions)	$3,345.0	$3,657.0	$4,025.0	$4,898.0	$5,613.0	$5,664.0	$6,064.0	$4,170.0
BNSF Revenue/Carload US$	$864	$843	$844	$939	$1,017	$1,100	$1,259	$1,066
% Imp/Exp	n/a	n/a	n/a	n/a	50%	49%	n/a	50%

A comparison between average revenue per carload for the Canadian and Western US Class 1 railways in U.S. dollars is shown below.

Figure 7 Western US and Canadian Class 1 Railways' Revenue per Intermodal Carload 2002 – 2009

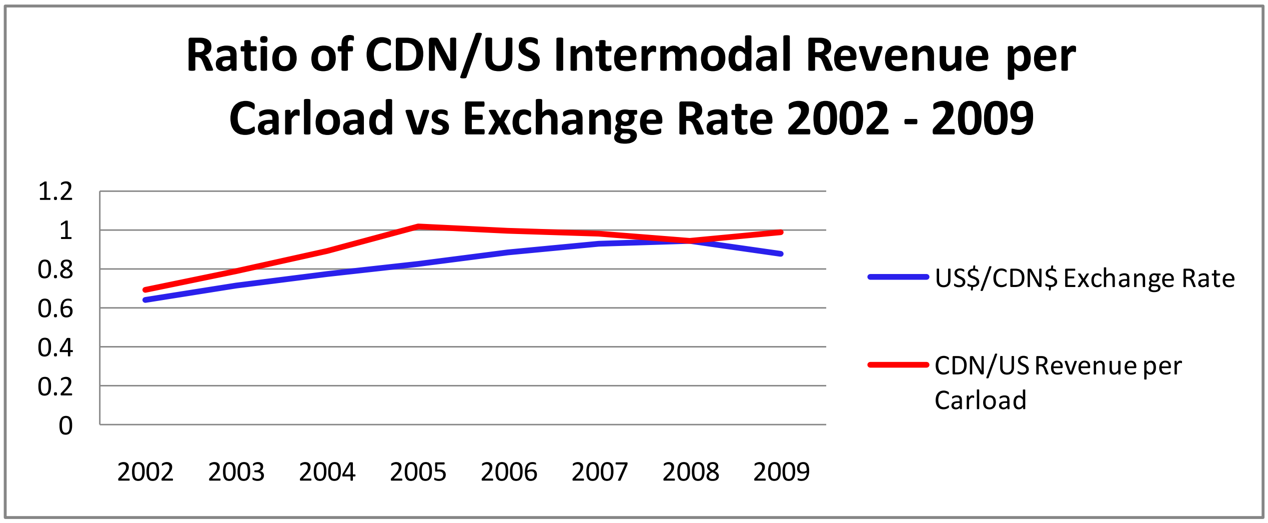


With the exception of 2005, average revenue per carload for CN and CP was virtually identical throughout the study period. The data shows a rapid escalation in Canadian dollar revenue per carload for the Canadian railways. On a US dollar basis, revenue per carload increased by 90% from 2001 to the peak in 2008.

BNSF and UP revenue per carload differed substantially throughout the period[11]. At the beginning of the period, the Canadian railways' average revenue per carload was lower than UP's, but by 2005 the Canadian rates were higher. On a weighted average basis, Canadian and US average revenue per carload has been similar since 2005.

The growth in the Canadian railways intermodal revenue per carload relative to the U.S. levels is only partially attributable to the impact of the appreciation of the Canadian dollar on relative railway costs. A comparison of this ratio to the exchange rate indicates that Canadian revenue per carload increased much more rapidly than the value of the Canadian dollar from 2003 through 2005.

Figure 8 Canadian vs US Railways Weighted Average Revenue per Intermodal Carload 2002 – 2009



Port-Related Costs - Comparisons of terminal costs among West Coast ports are difficult due to the predominance of confidential agreements in determining actual rates paid by users. Terminals and ports both publish public tariffs but they cannot generally be relied upon as indicators of actual rates paid by shipping lines for terminal services. Typical arrangements include:

- Rates paid by shipping lines to terminal operators are set out in confidential contracts. In the case of US terminals, in many cases these are wholly owned subsidiaries or joint venture operations of the shipping lines.

- Lease rates paid by terminal operators to ports are set out in confidential lease agreements.

- Port charges (berthage, dockage, etc.) are published in public tariffs. Theoretically these are collected on the port's behalf by terminal operators and remitted to the port. However, the actual amounts remitted are typically set out in the lease agreements and the terms of these (volume incentives, etc.) may significantly reduce the actual amounts.

Published tariffs for Lower Mainland container terminals are used as a means of exploring changes in port-related costs for purposes of this study. However, no attempt has been made to do rigorous comparisons of actual costs among competing West Coast ports. In the Lower Mainland, shippers serving local markets or transloading in the port area generally pay drayage costs directly. Shipping lines may incur drayage costs for repositioning of containers.

Lower Mainland terminal operations differ from those in U.S. West coast ports in several aspects:

- All Lower Mainland terminals use "stacked" operations (containers stacked on the ground) as opposed to the "wheeled" operations (containers stored on chassis) used in many U.S. terminals.

- The Lower Mainland terminals are highly dependent on on-dock rail.[12] Direct rail shipments of international containers (Inland Point Intermodal or IPI) typically account for between 65% and 70% of loaded import traffic.

There are four on-dock container terminals in the Lower Mainland: Deltaport and Vanterm operated by TSI Terminal Systems Inc (TSI); Centerm operated by DPW Canada; and Fraser Surrey Docks on the Fraser River.

During the study period the Port of Vancouver and terminal operators undertook a number of initiatives designed to increase the port's container capacity through more intensive use of the existing terminal land base. In December 2003 the Vancouver Port Authority announced a target of moving 50% of empty containers to off-dock storage. A draft protocol for achieving this target was developed, but implementation was deferred to give terminal operators time to adjust the rate structures in their contracts with the shipping lines.[13] The terminal operators have taken aggressive action to implement these practices, primarily in response to episodes of congestion at the terminals.

In late June 2005, operations at all of the container terminals were disrupted by a withdrawal of services by drayage drivers. The impact of off-dock storage on drayage productivity was identified by the drivers as a major factor in their withdrawal of service. The dispute was resolved through a federal government Order in Council which compelled trucking companies to pay owner-operators the rates contained in a Memorandum of Agreement negotiated between the drivers and trucking companies with the assistance of mediator Vince Ready. These rates remain in place under federal regulation for owner-operators who are not covered by a collective agreement. The adoption of the MOA rates increased drayage rates in the Lower Mainland by approximately 40%.

In response to congestion due to rail service problems, TSI reduced in free time for both import and export containers from 7 days to 5 working days in early 2005.[14] In 2006, the TSI terminals again experienced severe congestion due to rail service issues. TSI responded through imposition of their Fluidity Plan, which eliminated empty container storage on the docks with the exception of empty containers scheduled for evacuation on the next vessel. Empty containers not scheduled for immediate evacuation, and empty containers repositioned for export loading, were subjected to a fee of $100 per TEU per day for any period beyond the free time of 2 days. Earliest Reporting Dates (ERD's) for loaded export containers were reduced from 5 days to 4. Acceptance of import containers for each shipping line was restricted to volumes agreed in capacity agreements between the line and the railways; any containers in excess of this volume were required to be trucked off the terminal immediately. Shipping lines which did not comply were subject to a "Rail Overage Surcharge" of $200 per TEU per day, and faced a possible refusal to discharge surplus containers from vessels.[15] These provisions remain in effect; under the current TSI tariff storage charges are $108.35 per TEU per day for empty containers in excess of the free time limits of 2 days for delivery to truck ex rail car or vessel and 7 calendar days in advance of vessel arrival for empty containers scheduled for evacuation. The rail overage surcharge is currently $216.65 per day per TEU.[16]

In its submission to the Transport Canada Rail Freight Review Panel in 2010, TSI indicated that there has been a chronic undersupply of rail cars to accommodate demand at its terminals over the past five to seven years. Average dwell times from September 2006 to October 2007 were cited to show the impact on terminal operations: dwell times were above the 3 day target benchmark for 12 of 14 months, peaking at 8 days in February 2007.[17]

Changes to terminal operating practices followed a similar course at Centerm. A summary of the evolution of charges at Centerm is shown below.

Figure 9 Centerm Terminal Tariffs 2004 – 2009

Centerm Tariffs 2004 - 2009 Selected Items							
	2004	2005	2006	2007	2008	2009	% change 2004-2009
Berthage							
Berthage per hr per meter work periods	$0.192	$0.192	$0.192	$0.242	$0.342	$0.392	104.2%
Handling Lines							
Tie up Mon-Fri 0800-1630	$1,255.00	$1,285.00	$1,322.00	$1,322.00	$1,322.00	$1,470.00	17.1%
Container Handling							
Loaded container truck	$258.90	$258.90	$266.67	$266.67	$300.00	$300.00	15.9%
Loaded container rail	$289.40	$289.40	$306.67	$306.67	$375.00	$375.00	29.6%
Empty container truck	$215.35	$215.35	$221.81	$221.81	$300.00	$300.00	39.3%
Empty container rail	$215.35	$215.35	$261.81	$261.81	$375.00	$375.00	74.1%
Gate charge truck	$55.05	$55.05	$56.70	$56.70	$70.00	$70.00	27.2%
Gate charge rail	$85.00	$85.55	$96.70	$96.70	$145.00	$145.00	70.6%
Empty container storage							
Empty container storage per day	$5.00	$5.00	$12.50	$12.50	$100.00	$100.00	1900.0%
Demurrage							
Demurrage per loaded imports TEU per day	$23.40	$23.40	$25.00	$25.00	$100.00	$100.00	327.4%
Demurrage per loaded exports TEU per day	$23.40	$23.40	$25.00	$25.00	$100.00	$35.00	49.6%
Free time - import containers (working days)	5	5	5	5	3	3	-40.0%
Free time - export containers (ERD) Truck (calendar days)	7	7	7	7	5	7	0.0%
Free time - export containers (ERD) rail (calendar days)	14	7	7	7	5	7	-50.0%

Since 2004, empty container storage charges have increased from $5 per day to $100 per day and free time has been reduced. Note that these charges are in Canadian dollars – in U.S. dollars the changes from 2004 to 2009 would be approximately 23% higher.

The impact of these changes on the shipping lines includes additional costs for container storage at off-dock facilities and drayage costs for containers which have to be trucked off of the terminals to avoid punitive storage charges. As of the spring of 2010, offdock storage charges in the Lower Mainland averaged $25 to $40 per lift plus storage charges of $1 per day. A representative drayage rate (Deltaport to Delco in North Delta) under the MOA rates with a typical markup is approximately $140.

The actual costs incurred by shipping lines will depend on the extent to which they can coordinate their container movements. For example, if empty containers are picked up for reloading with export commodities within the two day free time no additional costs will be incurred by the shipping line (i.e. the export shipper will pay drayage costs and no offdock storage charges will be incurred). However under the rail volume quotas in place at the TSI terminals, container movements from vessel in excess of the levels specified in capacity agreements with the railways will incur additional costs for drayage.

Direct comparison of Lower Mainland port costs with other West Coast ports is not within the scope of this study. However, the analysis of Lower Mainland port costs is presented to support the use of the assumption that relative port costs were unchanged over the study period in estimation of the elasticity of traffic. It seems probable that Lower Mainland port costs have actually increased relative to U.S. ports; in that case the costs of shipping through the Lower Mainland will have increased more and the elasticity estimate developed in this study will overstate the responsiveness of traffic to cost increases.

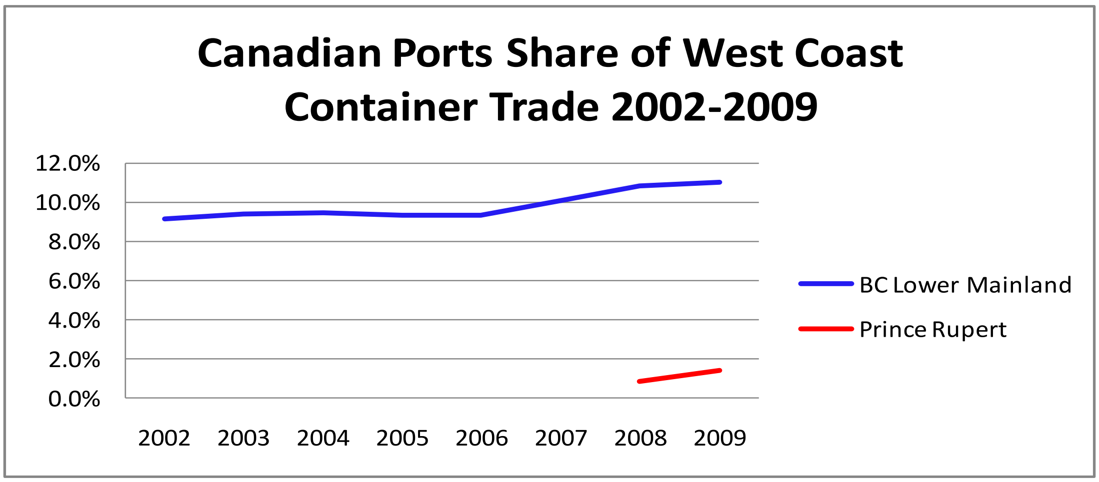
With the exception of drayage costs paid by shippers, all port-related costs are incurred by shipping lines. The most probable mechanism for recouping these costs is increases in ocean shipping rates by the shipping lines. An examination of ocean shipping rate differentials between the Lower Mainland and competing West Coast ports may be a more promising method of testing this hypothesis than direct comparisons of port costs in future research.

Ocean Shipping Costs - As noted in the introduction to this section, changes in the exchange rate are unlikely to affect ocean container rates directly since these are paid in U.S. dollars. No comparative ocean shipping rate data was available for this analysis.

Trade Performance of the Lower Mainland Ports

Based on their share of total West Coast container trade, the Lower Mainland ports performed well, with market share increasing by 21% from 2002 to 2009.

Figure 10 Canadian Ports Share of West Coast Container Traffic 2001 – 2009



However, in order to more fully assess port performance it is useful to examine the specific origin/destination markets served by the Lower Mainland ports. Origins and destinations of containerized freight handled at the Port of Vancouver in 2005 are summarized below:

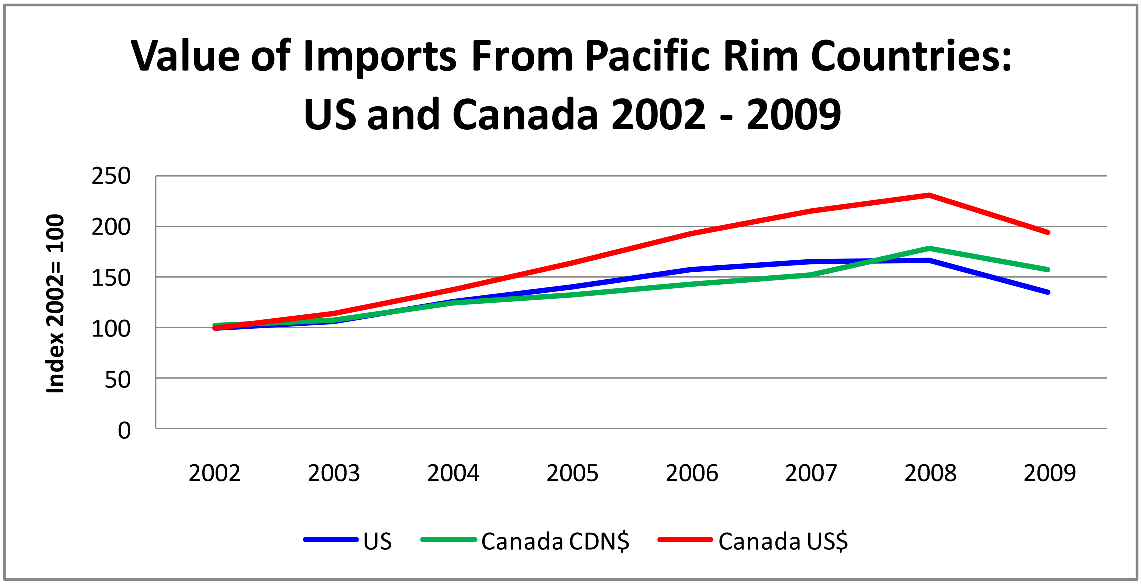
Figure 11 Port of Vancouver Containerized Freight Origins/Destinations 2005

Port of Vancouver Containerized Freight Origins/Destinations 2005						
	Imports		Exports		Total	
	Tonnes	%	Tonnes	%	2005	%
Canada	5663716	94.5%	8224560	97.8%	13888276	96.5%
US	328602	5.5%	168069	2.0%	496671	3.4%
Misc.	144	0.0%	14104	0.2%	14248	0.1%
Total	5992462	100.0%	8406733	100.0%	14399195	100.0%
US Midwest	292939	4.9%	105093	1.3%	398032	2.8%
% of US	292939	89.1%	105093	62.5%	398032	80.1%

The Canadian market accounted for 94.5% of import traffic and 97.8% of export traffic. U.S. traffic accounted for only 3.4% of total traffic; of this, the Midwest market (i.e. Chicago) accounted for 89% of import traffic and 63% of export traffic.

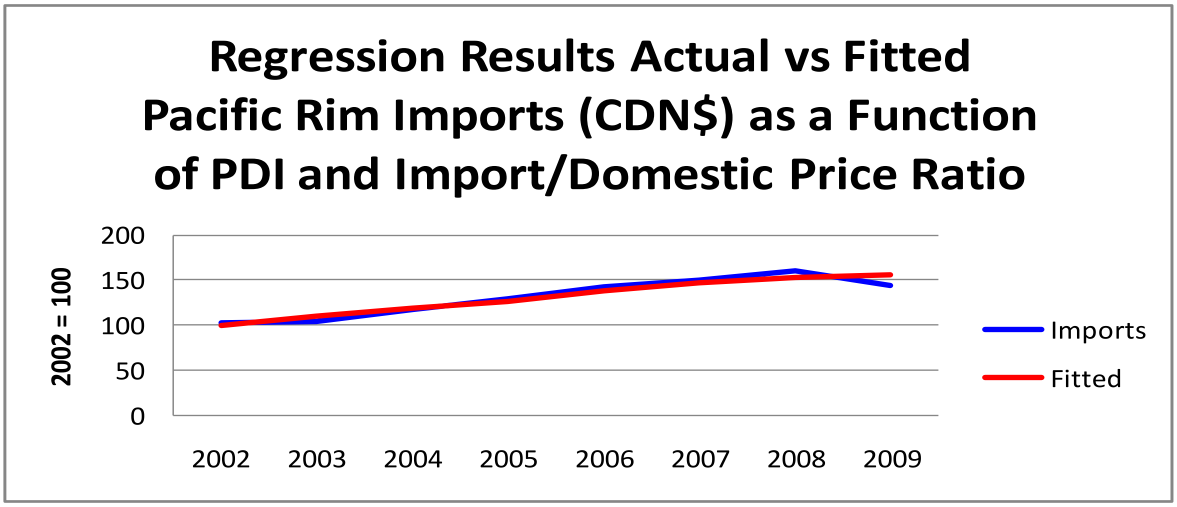
The overwhelming reliance of Lower Mainland port traffic on the Canadian market suggests that the performance of the Lower Mainland ports should be assessed relative to the trade volumes of its key markets rather than on total West Coast traffic. In domestic currencies, the value of Canadian imports from Pacific Rim countries increased at a rate slightly below that of the U.S. from 2001 to 2009. However, due to the appreciation of the exchange rate the growth in Canadian import values in US dollars was substantially higher. Under the assumption that the composition of this traffic was similar, this would imply an increase in traffic volume which was substantially higher for the Canadian market. For both countries, the largest portion of Asian imports consists of consumer goods.

Figure 12 Value of Imports from Pacific Rim Countries US and Canada 2001 – 2009



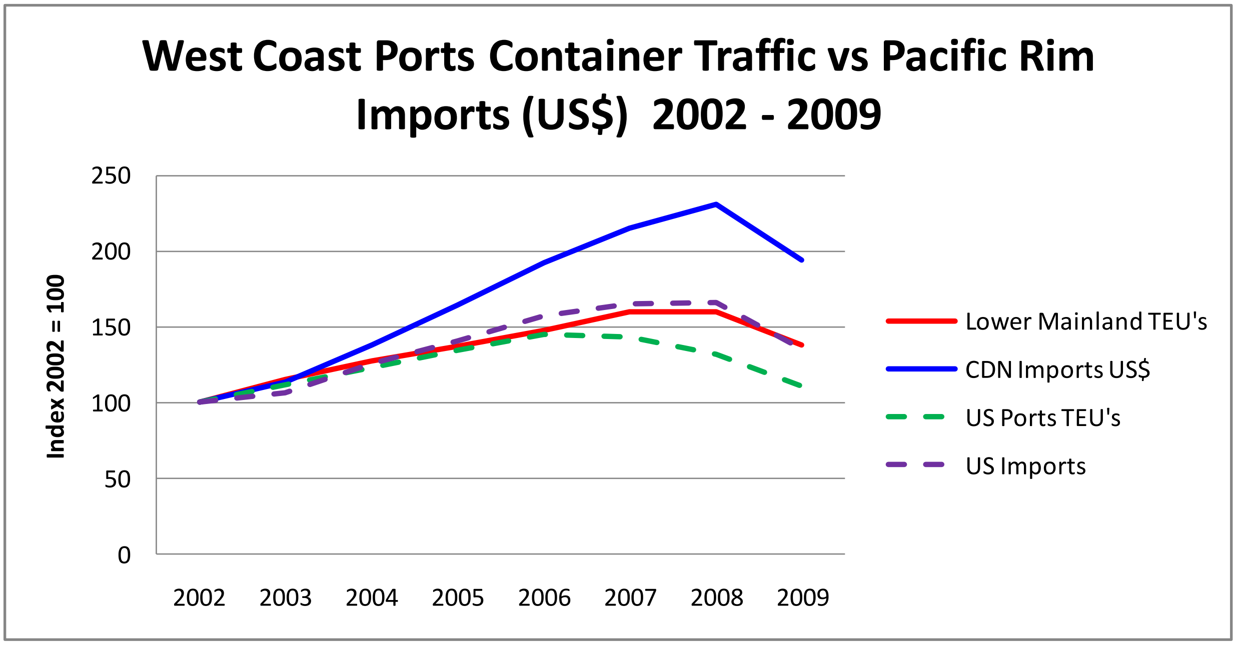
The growth in Canadian imports can be attributed to growth in personal income, and to the relative decline in import prices which resulted from the increased value of the Canadian dollar. A simple linear regression of the index of the value of import (in Canadian dollars) on indexes of personal disposable income and the ratio of import to domestic prices gives an adjusted R^2 of .83 with appropriate signs for the coefficients. The actual vs fitted values are shown below.

Figure 13 Actual vs Fitted Canada Pacific Rim Imports 2002 - 2009



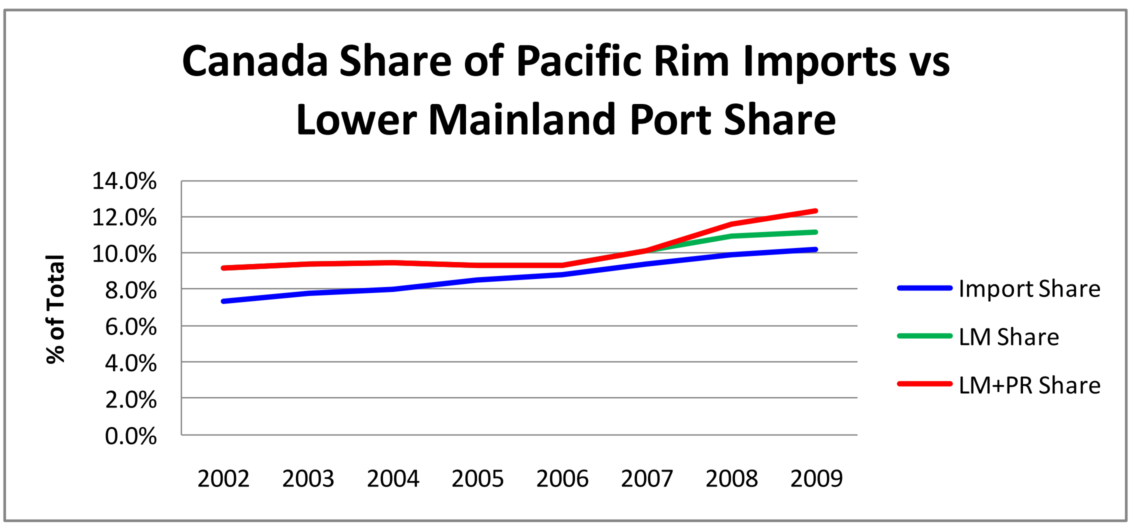
The performance of Lower Mainland and U.S. West Coast ports container traffic relative to the value of imports from Pacific Rim countries is profiled below. The data indicate that growth in traffic for both groups lagged the growth in trade value. Starting in 2006, the gap is more pronounced for the Lower Mainland.

Figure 14 West Coast Ports' Container Traffic vs Pacific Rim Imports 2002 - 2009



The Lower Mainland share of West Coast container traffic relative to the Canadian share of the total value of U.S. and Canadian imports is shown below. Note that growth in the Lower Mainland market share lagged behind the relative growth of Canadian imports.

Figure 15 Canada Share of Pacific Rim Imports vs Lower Mainland Port Share 2002 – 2009



Elasticity of Lower Mainland Port Traffic

The methodology for estimating the elasticity of traffic through the Lower Mainland ports in this study is similar to that used in the Moffatt & Nichol study, i.e. it incorporates a regression of market share based on cost differentials. However this analysis is based on time series rather than cross-sectional data and includes consideration of the differential growth rate between Canadian and U.S. Pacific Rim imports from 2002 to 2009, reflected in the Canadian share (measured in U.S. dollars) of total imports.

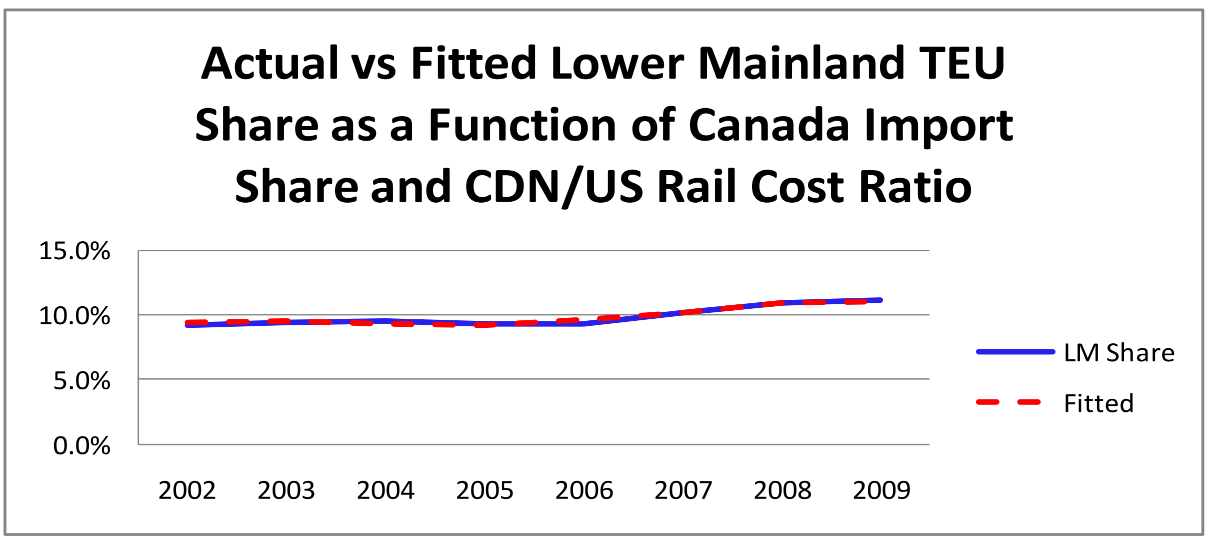
The cost variable included in the regression is the ratio of Canadian vs Western U.S. Class 1 intermodal revenue per carload, measured in U.S. dollars. Ideally the analysis would incorporate ocean and port costs as well, but data was not available for purposes of this study. As noted above, port cost differentials may be reflected in ocean shipping rates and therefore detailed analysis of comparative port costs may be superfluous. For purposes of the regression analysis, we have assumed that differentials between port and ocean shipping costs between the Lower Mainland and U.S. West Coast ports were unchanged over the study period. Therefore the equation is used to estimate the partial elasticity of port traffic based on intermodal rail costs.

A simple linear regression of the Lower Mainland's share of West Coast container traffic from 2002 to 2009 on the Canadian share of U.S. and Canadian Pacific Rim imports (in U.S. dollars) and the ratio of Canadian relative to U.S. rail intermodal costs an adjusted R^2 of .92 with all variables significant at the 95% level. The estimated regression equation is shown below:

Lower Mainland TEU Share = .0506 + 1.005 (Canadian Import Share) - .0436 (Canadian/US Rail Cost Ratio)

Actual vs fitted data is shown below.

Figure 16 Actual vs Fitted Lower Mainland Market Share 2002 – 2009



Based on this regression, the elasticity of Lower Mainland container traffic to cost increases is equal to .39, much lower than estimates for U.S. ports in previous studies. On this basis, an import container fee of US$200 – assumed to be equivalent to an equal increase in average Canadian intermodal revenue per carload[18] – on Lower Mainland container would result in a loss of only 171,000 TEU's, 8% of Port Metro Vancouver's total 2009 traffic.

When combined with the regression analysis of Canadian import values in the previous section, we can estimate the impact of the exchange rate on Lower Mainland container volume by substituting the 2002 values for the Canadian/U.S. rail cost ratio and the import/domestic price ratio into the regression equations. Based on the import equation, the value of imports in 2009 would be 5.6% lower at the 2002 exchange rate. At the Canadian/U.S. rail rate ratio prevailing in 2002, the Lower Mainland market share would be only 1.3% higher. This suggests that the impact on container traffic through the Lower Mainland has been overwhelmingly positive since the impact on trade volumes of the increasing value of the Canadian dollar is more than four times the impact of higher rail costs (which in fact increased relative to U.S. rates by more than the exchange rate differential).

Alternative Routings

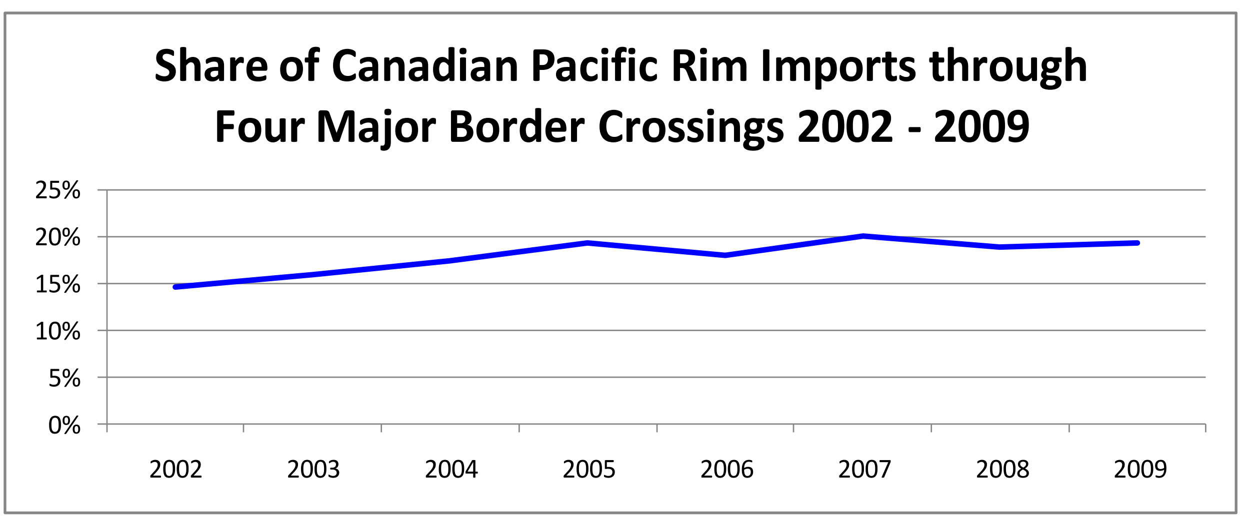
The data suggests that the Lower Mainland share of Canadian import traffic from Asia has declined. Alternative routings for this traffic can be deduced from Statistics Canada import trade data.

Data on imports available from Statistics Canada includes details of value and quantity by commodity, country of origin, port of clearance and mode of transport. This data enables estimation of the level of Canadian import traffic through U.S. ports. Conceptually, Pacific Rim imports through U.S. ports could be identified by mode of transport (truck or rail). However, the mode of transport reported in the trade data cannot be relied on due to the methodology used to collect the statistics. This variable represents the last mode of transport to the port of clearance. Thus for a container unloaded at the Port of Vancouver which travels by rail to Toronto and is drayed to a sufferance warehouse, the mode of transport is recorded as truck. Based on this data, 35% of Canadian imports from Asia arrived by truck in 2009[19]. For this reason, data on Pacific Rim import traffic cleared at land border crossings is used to identify shipments via U.S. ports.

The data available for purposes of this analysis was limited by costs. Detailed data on shipment quantities of imports from China by port of clearance for 2003 and 2004 was available from a previous study. This data showed that in 2003, 34% by tonnage and 42% by value of imports arrived at the port of clearance by truck. The share arriving by rail was approximately 1% by both tonnage and value. Four border crossings - Windsor (Ambassador Bridge), Pacific Highway, Sarnia (Blue Water Bridge), and Fort Erie (Peace Bridge) – accounted for 76% of traffic in 2004.

The 2003 and 2004 data was used as a guide in purchasing data for use in this analysis. Data on the value of imports from Pacific Rim countries through these four border crossings from 2000 through 2009 was purchased from Statistics Canada. The share by value of Canada’s Pacific Rim imports cleared through these crossings from 2002 to 2009 is shown below.

Figure 17 Share of Canadian Pacific Rim Imports - Four Major Border Crossings 2002 - 2009



The negligible share of rail in Canadian Pacific Rim import traffic is reflective of the lack of direct rail connections to major Canadian markets for U.S. Class 1 railways. The closest access of the Western U.S. Class1 railways to major Eastern Canadian markets is Chicago, 521 miles (840 km) by road from Toronto via either the Ambassador or Blue Water Bridges. None of the U.S. Class 1 railways have intermodal facilities in Canada.

The shares of Pacific Rim imports by value among the top four land border crossings are shown below.

Figure 18 Top Four Border Crossings Shares of Pacific Rim Imports 2009

Canada Pacific Rim Imports - Four Major Land Border Crossings 2002 and 2009					
	2002 (Million CDN$)	**Share of Total Imports**	**2009 (Million CDN$)**	**Share of Total Imports**	**% Change2002 - 2009**
Windsor - Ambassador Bridge	$3,090	6.3%	$5,583	8.1%	81%
Sarnia - Blue Water Bridge	$1,334	2.7%	$3,441	5.0%	158%
Fort Erie - Peace Bridge	$1,491	3.0%	$2,337	3.4%	57%
Pacific Highway	$1,208	2.5%	$1,970	2.9%	63%
Four Major Crossings	$7,122	14.6%	$13,331	19.3%	87%
Total Pacific Rim Imports	$48,896	100.0%	$68,928	100.0%	41%

The routing of these shipments can be inferred from the location of the border crossings:

- The Ambassador Bridge and Blue Water Bridge crossings lie on the major highway routes connecting the major intermodal hub of Chicago to major Southern Ontario population centres including Toronto. The most probable routing for this traffic is through U.S. West Coast ports.

- The Peace Bridge between Buffalo NY and Fort Erie provides a link between U.S. East Coast ports (particularly New York/New Jersey) and Southern Ontario.

- The Pacific Highway crossing between Seattle and the Lower Mainland provides access to the Lower Mainland local market and the Canadian rail system for inbound traffic from the Ports of Seattle and Tacoma.

As a means of testing the hypothesis that the increase in relative intermodal rail costs has increased the share of Canadian imports transhipped via U.S. ports, a regression analysis of the share of Canadian imports cleared at the four major land border crossings was carried out. The regression results are shown below:

Land Border Share = 0.0376 + .1556 (Canadian/US Rail Cost Ratio)

This equation provides an adjusted R^2 of .91 with all variables significant at the 95% level. This provides an estimated elasticity of .80 for the share of Canadian Pacific Rim imports shipped via the four major land border crossings relative to relative Canada/U.S. rail costs.

This analysis puts a different perspective on the competitiveness of the Lower Mainland relative to U.S. ports. While the Lower Mainland's share of West Coast TEU traffic increased, the share of the core Canadian market declined, as evidenced by the 4.5% increase in the share of Canadian imports by value through the major land border crossings.

Conclusions and Further Research

In spite of data limitations, the analysis provides a coherent picture of the major factors influencing Lower Mainland port traffic from 2002 to 2009. The increase in the share of West Coast container traffic is attributable to the more rapid growth of Pacific Rim imports to the Canadian market due to appreciation of the Canadian dollar. The elasticity of port traffic to relative transportation costs is found to be .39, significantly lower than values found in previous studies for U.S. West Coast ports. It appears that the Lower Mainland has actually lost market share in its core market, and that the largest portion of traffic lost to competing ports enters Canada by truck through land border crossings in Eastern Canada.

There are a number of characteristics of the destination market which may be responsible for the relatively low elasticity of Lower Mainland container traffic.

- Intramodal competition in the Lower Mainland's core Canadian market is limited by the lack of direct access by U.S. Class 1 railways. In order to provide direct intermodal service to the major Eastern Canadian market, UP and BNSF would have to interchange traffic with the Canadian railways in Chicago. It is hard to imagine a scenario (short of a merger) which would induce CN or CP to offer an interline rate or level of service which would make the Western U.S. Class 1 railways competitive with the Canadian routing.[20]

- Intermodal competition from trucking is limited by the distance from West Coast ports to Eastern Canadian markets. The Canadian trade data indicate that the largest share of Pacific Rim imports routed through the U.S. enters via the Ambassador and Blue Water Bridges by truck. While it is difficult to determine the exact routing it seems probable that the cargo is either transloaded at a U.S. West Coast port location to a domestic container which is shipped via rail to Chicago and transferred to a truck for final shipment across the border; or shipped in an international container and transloaded to truck at a location in the Chicago area. In either case the shipment would incur transloading and trucking costs, as well as potential additional costs for customs processing and border delays.

The lower growth rate of traffic across the Pacific Highway crossing, which provides the option of trucking containers from the Ports of Seattle and Tacoma to Lower Mainland intermodal yards, suggests that shippers are using the U.S. West Coast ports to bypass the Canadian railways, rather than simply bypassing the Lower Mainland.

This research on Lower Mainland port traffic could be usefully extended through expansion of the dataset used for the regression analysis in two areas. The first is through acquisition of data on ocean shipping cost differentials between Canadian and U.S. ports. The second is a more detailed analysis of Canadian Customs data to encompass cargo volumes rather than values across all land border crossings. Addition of variables related to inventory costs, including transit time, reliability and interest rates would also be useful to test the importance of these elements in port choice.

Lessons for Further Studies

This analysis also suggests some useful extensions of existing research on U.S. port elasticity. The Lower Mainland example indicates the crucial role of intermodal and intramodal competition in the destination market in determining the elasticity of port traffic. Assembly of more reliable statistics on inland cargo movements within the U.S. would facilitate analysis of these factors.

The wide gap between the results of the Leachman simulation model and time series regression analysis suggests that the simulation model may overstate the impact of transportation cost differentials on port traffic. The simulation model relies on several key assumptions:

- It assumes that additional costs (i.e. container fees) will be passed on directly to shippers. Economic models of price discrimination suggest that the impact may be mitigated by strategic pricing decisions by supply chain participants. In particular, the theory of tax incidence from the public finance literature may be provide a useful model for further analysis. This approach may be appropriate for analysis of Canadian ports' performance in the future due to the potential price discrimination by CN between the ports of Vancouver and Prince Rupert.

- The Leachman model assumes that routing decisions are made by shippers on the basis of cost minimization. However, transportation service providers – shipping lines and railways – may have a larger role, either directly through determination of origin-destination routings or indirectly through strategic pricing decisions which influence shippers' choices. If that is the case, the more appropriate approach would be a profit-maximizing model which incorporates analysis of round trip container costs and revenues for shipping lines and/or railways.

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[1] Leachman & Associates LLC In Association with T. Prince & Associates LLC, Strategic Directions LLC, & George R. Fetty & Associates, Inc. Modal Elasticity Study Prepared for Southern California Association of Governments, , Sept. 8, 2005; Leachman & Associates LLC Final Report Port and Modal Elasticity Study Phase II Prepared for Southern California Association of Governments, Sept. 14, 2010.

[2] The impacts of initiatives to increase land utilization at the Ports of Los Angeles and Long Beach are discussed in Hanh Dam Le-Griffin Assessing Container Terminal Productivity Experiences of the Ports of Los Angeles and Long Beach Metrans Applied Research Project AR 05-06, , February 2008, pp. 24-27.

[3] Freight Investment Study prepared for Washington State Joint Transportation Committee by Cambridge Systematics, Inc. in association with the Puget Sound Regional Council, Gill Hicks & Associates, Foster Pepper PLLC, BST Associates and Dr. Robert Leachman; January 2009. Dr. Leachman's analysis is included as Appendix B in the report.

[4] Moffatt & Nichol and BST Associates Container Diversion and Economic Impact Study Effects of Higher Drayage Costs at San Pedro Bay Ports Study for the Ports of Los Angeles and Long Beach, September 27, 2007.

[5] Moffatt & Nichol, p. 15. Because the Moffatt & Nichol study focused on the impact of drayage cost increases, it did not estimate the elasticity of the portion of IPI traffic which would be unaffected by drayage cost increases.

[6] "Shippers wait to see whether other carriers will follow Maersk's lead in restructuring inland network" Shipping Digest February 26, 2007 http://postandparcel.info/16787/companies/shippers-wait-to-see-whether-other-carriers-will-follow-maersk%E2%80%99s-lead-in-restructuring-inland-network/

[7] Moffatt & Nichol, p. 17.

[8] See Supply Chain Solutions International and University of Manitoba Institute, Use of International Marine Containers in Canada A Review of Regulations Governing Use of International Marine Containers in Canadian Domestic Cargo Carriage December 2005 http://www.tc.gc.ca/eng/policy/report-acg-containers-menu-1973.htm

[9] Data on intermodal traffic is taken from Class 1 Railroad Annual Reports (Report R-1) to the Surface Transportation Board.

[10] The concept of "intermodal carloads" is not straightforward due to the use of multi-platform car configurations of varying capacity. The data on intermodal carloads reported in railway financial reports appears to be based on the convention of quantifying carloads based on two intermodal units (containers or trailers) per carload.

[11] This may be attributable to a differing mix of international, domestic and expedited services. The contractual arrangements between UP and Intermodal Marketing Companies (IMC's) may also be a factor; for example, UP's legacy contract with Pacer International Inc. provided lower rates for domestic container ("big box") traffic than "market" rates. This agreement was renegotiated in 2009, with the result that Pacer's rates for domestic containers were to transition to higher "market" prices over a two year period. See Pacer International Inc. Form 10-K - February 23, 2010 pp. 19-20.

[12] CN Rail withdrew on-dock service from three out of four (Vanterm, Centerm and Fraser Surrey Docks) of the container terminals due to low traffic volumes. Service has since been restored to Vanterm.

[13] The impact of off-dock storage on port-related costs was explored in Philip Davies Off-Dock Storage of Empty Containers in the Lower Mainland of British Columbia: Industry Impacts and Institutional Issues Paper presented at the National Urban Freight Conference, Long Beach CA, February 2006.

[14] TSI Terminal Systems Inc. TSI Balanced Growth Program TSI March 10, 2005.

[15] TSI Terminal Systems Inc. TSI Fluidity Program April 21, 2006.

[16] TSI Terminal Systems Inc. Tariff for Deltaport and Vanterm, January 14, 2010.

[17] TSI Terminal Systems Inc. Submission to the Review Panel Rail Freight Service Review Transport Canada Vancouver, BC April 29, 2010 http://www.tc.gc.ca/media/documents/policy/068-terminal-systems-eng.pdf

[18] The Class 1 railways carloads are estimated based on two units (containers or trailers) per carload; therefore on a round trip basis the revenue for a carload would be equivalent to the revenue for a single intermodal unit, for purposes of this analysis assumed to be a 40 foot International container (FEU). A fee

assessed on imports only would increase costs per container by the equivalent amount on a round trip basis.

[19] Table EC13: Canada's Imports by Origin, Destination and Mode of Transport, Transport Canada Transportation in Canada 2009 http://www.tc.gc.ca/eng/policy/report-aca-anre2009-2316.htm

[20] This is equivalent to the "bottleneck" pricing issue which has been dealt with extensively in the context of U.S. rail regulation and is a topic of current interest; see for example Surface Transportation Board Competition in the Railroad Industry Surface Transportation Board Notice Docket No. EP 705 January 2011 http://www.stb.dot.gov/decisions/readingroom.nsf/cac42df635267da4852572b80041558c/e109569bb0ebfb0d85257815006262a4?OpenDocument

Bibliography

Hanh Dam Le-Griffin Assessing Container Terminal Productivity Experiences of the Ports of Los Angeles and Long Beach Metrans Applied Research Project AR 05-06, , February 2008.

Leachman & Associates LLC In Association with T. Prince & Associates LLC, Strategic Directions LLC, & George R. Fetty & Associates, Inc. Modal Elasticity Study Prepared for Southern California Association of Governments, , Sept. 8, 2005.

Leachman & Associates LLC Final Report Port and Modal Elasticity Study Phase II Prepared for Southern California Association of Governments, Sept. 14, 2010.

Moffatt & Nichol and BST Associates Container Diversion and Economic Impact Study Effects of Higher Drayage Costs at San Pedro Bay Ports Study for the Ports of Los Angeles and Long Beach, September 27, 2007.

Philip Davies Off-Dock Storage of Empty Containers in the Lower Mainland of British Columbia: Industry Impacts and Institutional Issues Paper presented at the National Urban Freight Conference, Long Beach CA, February 2006.

Surface Transportation Board Competition in the Railroad Industry Surface Transportation Board Notice Docket No. EP 705 January 2011 http://www.stb.dot.gov/decisions/readingroom.nsf/cac42df635267da4852572b80041558c/e109569bb0ebfb0d85257815006262a4?OpenDocument

Transport Canada Transportation in Canada 2009 http://www.tc.gc.ca/eng/policy/report-aca-anre2009-2316.htm

TSI Terminal Systems Inc. TSI Balanced Growth Program TSI March 10, 2005.

TSI Terminal Systems Inc. TSI Fluidity Program April 21, 2006.

TSI Terminal Systems Inc. Tariff for Deltaport and Vanterm, January 14, 2010.

TSI Terminal Systems Inc. Submission to the Review Panel Rail Freight Service Review Transport Vancouver, BC April 29, 2010. http://www.tc.gc.ca/media/documents/policy/068-terminal-systems-eng.pdf