TRUCKING ACTIVITY DATA WHERE IN CANADA?

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Abstract

This study examines Canadian trucking statistics by base jurisdiction compared to inter-jurisdictional travel. Potential benefits of this exercise include: (a) the presentation of trends in vehicle registration versus inter-provincial motor carrier activity between the years 2000 and 2006 as captured by the Canadian Vehicle Survey (CVS) and the National Roadside Survey (NRS); and (b) the identification of travel pattern estimates for inter-modal comparisons and environmental analysis. It is concluded that: (1) 'host' provinces that received a relatively higher share of inter-provincial trucking travel are New Brunswick, Ontario, and British Columbia; and (2) older vehicles show a higher share of inter-provincial trucking travel use in Ontario and British Columbia. During the period analyzed, the inter-provincial travel patterns seem to have evolved towards increased trucking activity relative to truck registration in Ontario and British Columbia.

Introduction

Like other modes involved in similar activities, trucks travel across jurisdictions carrying goods to satisfy our needs, while imposing environmental and other costs to society. To limit the impacts of environmental and social costs, the trucking industry is subject to some regulations that at the same time ought to respect boundaries for the industry's financial health. To aid in better policy decisions,

[1] I thank my colleagues at Transport Canada, Economic Analysis for their valuable and constructive comments. However, opinions expressed and any errors or misinterpretations remaining are entirely my own.

transportation research and analysis are in need of quality data; which in this sense becomes an asset for the trucking industry. Trucking data needs for transportation research comprise vehicle-kilometers travelled, goods carried (value and weight), broken down by truck configuration, by vehicle age, and by jurisdiction where the truck is registered versus the jurisdiction where travel took place if they are not the same.

The International Fuel Tax Agreement (IFTA) and the International Registration Plan (IRP) capture some trucking inter-jurisdictional travel data. However, these sources may not provide the level of detail data that transportation research needs. Information may be presented at the fleet level, but not for specific vehicle categories such as vehicle age or vehicle configuration. *Trucking in Canada*[2] offers a general overview of origin-destination flows and of the financial status of the trucking industry, but does not capture details of the vehicle fleet characteristics, among other limitations.

One of the data sources covering the trucking industry and some of its detailed characteristics is the Canadian Vehicle Survey (CVS) implemented in 1999. However, the CVS does not provide information on the province or provinces where trips took place; its estimates of vehicle-kilometers by Canadian province are allocated to the province of registration of the motor carrier. Perhaps due to differences in tax rates or other incentives, some provinces may exhibit a relatively high number of vehicles registered if compared to the share of kilometers travelled by those registered trucks on its road network.

This paper addresses this data limitation by combining CVS with the National Roadside Survey (NRS) focusing on inter-provincial activity. Estimates of the geographical location of travel for various truck configurations are discussed. Section 1 explains how the inter-jurisdictional vehicle-kilometers travelled (VKT) were re-allocated to the jurisdictions where the travel occurred. Section 2 develops a ratio of inter-provincial travel and presents additional related empirical

[2] Statistics Canada: "Trucking in Canada 2005"

data. Section 3 explores an additional empirical dimension: the links between the province of registration (base jurisdiction) and the trip origin and/or destination in the data set presented in this study.

1. VKT provincial re-allocation methodology

This section explains an allocation method that re-distributes vehicle-kilometers from the province of registration to the provinces where the trucks are likely to have travelled. The kilometers reported by the CVS are allocated to provinces according to the truck's base jurisdiction. It should be noted that CVS includes private as well as for-hire trucking.

Allocating truck activity according to the CVS would overstate activity in jurisdictions where truck registration is relatively high compared to the actual network use. First, estimates of inter-provincial travel were extracted from CVS micro data. Table 1 below presents the proportion of inter-provincial VKT for straight and tractor trucks for two points in time. To help understand Table 1, for example, 22 percent of the VKT by tractor-trailer trucks registered in Alberta in the year 2006 correspond to inter-provincial movements.

Despite its apparently lower share in terms of VKT, 13 to 16% for years 2000 and 2006 respectively as in Table 1, inter-provincial trucking accounted for approximately one third of the total domestic transportation revenue in 2005 reported by *Trucking in Canada*[3].

Second, kilometers reported as inter-provincial travel by the base jurisdiction were re-allocated based on domestic origin-destination inter-provincial flows as extracted from the NRS[4]. The NRS was chosen since this survey is designed to capture inter-provincial trips. Up to 68% of its reported vehicle-kilometers correspond to inter-provincial trips, as opposed to 18% captured by the CVS.

[3] The level of coverage for the private and for-hire trucking industry segments varies from Trucking in Canada compared to the CVS and the NRS.

[4] The most recent NRS preliminary micro data was used in the estimations. Final version of this survey results to be released in 2009 may see some adjustments.

Table1: Inter-provincial VKT Percentage

Province[5]	Year 2000[6]			Year 2006		
	ST[7]	TT[8]	All trucks	ST	TT	All trucks
NL	0%	20%	12%	3%	16%	11%
PE	10%	14%	13%	0%	17%	10%
NS	1%	42%	26%	5%	32%	24%
NB	3%	2%	2%	5%	14%	8%
QC	7%	22%	17%	4%	16%	13%
ON	1%	10%	7%	0%	14%	10%
MB	1%	27%	22%	1%	51%	45%
SK	4%	29%	22%	5%	41%	30%
AB	14%	23%	20%	9%	22%	18%
BC	1%	29%	7%	6%	10%	7%
Canada	**5%**	**18%**	**13%**	**4%**	**21%**	**16%**

Source: CVS.

Five origin-destination pairs that group about ninety percent of the inter-provincial VKT by each province were extracted from the NRS for the following three truck configurations: straight trucks, tractor with one trailer, and tractor with 2 or more trailers. Three origin-destination matrices were estimated, containing the percentage of inter-provincial VKT by each origin-destination. Table 2 summarizes the main destination for each province of origin for two of these matrices corresponding to the truck configurations: tractor and one trailer; and tractor and two or more trailers. For example, the main destination for tractor-one-trailer trips that left Quebec in the base year 2000 is Ontario, given that 77% of all VKT for tractor-one-

[5] The first column on Table 1 refers to province of registration.
[6] The years 2000 and 2006 were used as base years for the study, to the maximum extent possible, although some estimates may correspond to 1999 or 2007.
[7] ST in Table 1 refers to Straight Trucks.
[8] TT in Table 1 refers to Tractor Trucks.

trailer trips that left Ontario in that base year correspond to Ontario-Quebec trips

The changes in destination for years 2000 and 2006 in Table 2 below may be partially explained by the differences in the coverage level by province between the NRS 1999 and the NRS 2006. The latest has a good coverage of Quebec and Ontario but is more limited in the case of other provinces except for the Canada-U.S. border. For example, Saskatchewan's coverage is reduced from more than two thousand surveys to approximately five hundred. The bias towards Ontario-Quebec traffic in 2006 shows in the case of trips that originate in the Atlantic provinces, with the main flow regularly switched to Quebec in 2006.

Table 2: Origin-destination of Inter-provincial Travel Percentage

Origin	VKT percentage to main destination			
	Tractor 1 Trailer		Tractor 2+ Trailers	
	Year 2000	Year 2006	Year 2000	Year 2006
NL	31% NB	60% QC	100% ON	100% QC
PE	47% NB	32% QC	100% NB	37% QC
NS	54% NB	57% QC	84% NB	57% QC
NB	44% NS	65% QC	58% QC	98% QC
QC	77% ON	38% ON	58% ON	53% ON
ON	60% QC	28% QC	49% QC	36% QC
MB	30% ON	64% ON	30% ON	91% ON
SK	41% AB	51% ON	64% AB	52% BC
AB	46% BC	69% BC	44% SK	77% BC
BC	61% AB	53% AB	60% AB	85% AB

Source: NRS.

Third, the next step is to break down the trip for each origin-destination into appropriate portions per province of travel. This was accomplished by building a vector of provincial distance traveled by the trucks for each origin-destination provincial pair in Canada. Each

provincial origin-destination pair was linked to a vector of provincial distances for the two provinces as well as for the provinces between these two (if any). For the sake of simplicity and time frame of this study, distances were calculated from the main cities of the province to the relevant border points. Only one city per province was chosen as trip origin or destination. A more realistic model for further research would allow for more than one city as origin or destination, which in turn would change the inter-provincial percentage shares per trip.

The main cities chosen were St John's (NL); Charlottetown (PEI); Halifax (NS); Moncton (NB); Montreal (QC); Toronto (ON-South), and Sudbury (ON-North); Winnipeg (MB); Regina (SK); Calgary (AB); and Vancouver (BC). The reference border points in each province or provincial borders were Channel Port aux Basques (NL), North Sydney (NS), Aulac (NS-NB), Bayfield (PEI-NB), St-Jacques (NB-QC), Rigaud (QC-ON-North[9]), Bainsville (QC-ON-South[10]), Whiteshell (ON-MB), Moosomon (MB-SK), Walsh (SK-AB), and Banff National Park (AB-BC).

The selection of border crossing points was based on Google-map points that did not imply travel on the U.S. road network. The result of the above is a set of 45 origin-destination vectors with ten elements, one for each province. For example, based on the inter-provincial breakdown of the distance between Vancouver and Calgary, the vector British Columbia – Alberta contains two non-zero elements that assign 81 percent of the trip to British Columbia and the remaining 19 percent to Alberta.

Each distance breakdown vector was multiplied by the non-zero elements of the matrix obtained in step two above and added up by province to find the percentage of inter-provincial travel that could be assigned to each province where travel is likely to have occurred.

[9] Sudbury and Rigaud were the inter-provincial border points assumed for inter-provincial East-West travel where Ontario was neither origin nor destination.
[10] Bainsville was the inter-provincial border point assumed for travel Ontario-Quebec where Ontario was either origin or destination.

Finally, step four consisted of applying these percentages to the inter-provincial travel reported by the CVS[11] for each base jurisdiction and re-arranging the VKT as summarized in Table 3 below. To understand Table 3, for example, inter-provincial travel of trucks registered in British Columbia was about 960 million VKT in the base year 2000 according to the CVS, while inter-provincial movements from trucks registered elsewhere in Canada that travelled on British Columbia's road network accounted for about 1,304 VKT, as estimated by this methodology based on the CVS and the NRS. This suggests that the Alberta-British Columbia inter-provincial travel flow leans towards trucks registered in Alberta that travel on British Columbia's roads.

Table 3: Re-allocation of VKT by province of travel. Millions

Province	Re-allocation of inter-provincial travel VKT			
	Year 2000		Year 2006	
	Regist.	Travel	Regist.	Travel
NL	167	164	203	190
PE	66	64	61	62
NS	631	581	556	453
NB	196	284	245	330
QC	4,163	3,905	5,154	4,981
ON	8,983	9,251	9,720	10,392
MB	995	997	1,682	1,124
SK	1,154	1,251	1,628	1,403
AB	4,704	4,218	6,413	5,723
BC	960	1,304	1,352	2,355
Total VKT	**22,020**	**22,020**	**27,013**	**27,013**

Source: CVS, NRS, and this methodology.

[11] The fourth step is then based on the assumption that the base jurisdiction is closely linked to the origin or destination of each trip. This assumption is explored in Section 3.

Summarizing, section 1 describes four steps for inter-jurisdictional VKT provincial re-allocation from province of vehicle registration to province of travel. The following section expands on two additional dimensions: more detailed truck configuration, and vehicle age. It also presents a ratio of inter-provincial travel.

2. Inter-provincial travel ratio

This section expands on some detailed dimensions of the re-allocation of inter-provincial travel. Based on the allocation methodology, Tables 4 and 5 expand results of Table 3 on more detailed truck configuration and vehicle age VKT allocation by province of travel:

Table 4: Re-allocation of VKT. Tractor 1 Trailer- Body types Year 2006 Millions

	Re-allocation of inter-provincial travel VKT					
	Van body		**Flat bed**		**Tanker**	
	Rt.[12]	**Travel**	**Rt.**	**Travel**	**Rt.**	**Travel**
NL	11	4	5	2	2	1
PE	3	3	1	1	0	0.2
NS	75	11	17	3	20	3
NB	8	62	4	17	0	10
QC	408	270	86	72	54	33
ON	575	903	188	241	49	84
MB	445	89	102	24	20	7
SK	161	106	39	28	17	9
AB	378	160	193	58	97	25
BC	28	412	5	174	1	81
N/D		73		21		9
Total	**2,094**	**2,094**	**641**	**641**	**260**	**260**

Source: CVS, NRS, and this methodology.

[12] In Table 4 Rt. stands for Province of Registration.

Similar to Table 3, to help understand Tables 4 and 5, for example, the number of VKT for a tractor-one-trailer truck that is less that five years old in the base year 2006 and registered in Newfoundland is about 11 million, while VKT for the same category of truck registered elsewhere in Canada and travelled on Newfoundland's road network is only 4 million. Tables 4 and 5 confirm the dominance of the van body over flat bed or tanker within the tractor-one-trailer configuration, as well as the composition of the tractor-one-trailer fleet by age where the 0-to-5 year-old truck dominates. Inter-provincial main travel flows also show in a consistent manner for all categories in these tables.

Table5: Re-allocation of VKT. Tractor 1 Trailer- Vehicle age Year 2006 Millions

	Re-allocation of inter-provincial VKT by Vehicle Age					
	0 to 5 years		**6 to 10 years**		**11 years +**	
	Rt.[13]	**Travel**	**Rt.**	**Travel**	**Rt.**	**Travel**
NL	11	4	6	2	1	0
PE	1	2	3	2	1	0.5
NS	68	10	38	6	7	1
NB	6	54	5	28	2	7
QC	375	236	118	107	55	32
ON	480	718	273	390	59	121
MB	280	63	221	43	67	14
SK	102	74	76	51	40	18
AB	427	140	158	71	84	31
BC	22	404	7	176	5	86
N/D		65		29		9
Total	**1,770**	**1,770**	**904**	**904**	**321**	**321**

Source: CVS, NRS, and this methodology.

[13] In Table 5 Rt. stands for Province of Registration.

For example, the largest flow being Ontario-Quebec with Ontario shows more road use than kilometers travelled by trucks registered in Ontario.

This result is explained by using distance travelled as a measure of road use, rather than number of trips. It could be argued that distance travelled is relevant to environmental and road use impacts; however the number of trips may provide some other dimension, as well as remove the geographical differences.

An inter-provincial travel ratio could be estimated to show the degree of surplus/deficit or imbalance on road use by comparing each province's travel to that of other provinces. Let us define that for each province *j*: *t* is the vehicle-kilometers travelled by any trucks on its road network; and *r* is the vehicle-kilometers travelled by trucks registered in province *j* anywhere else (within Canada). Then the ratio of inter-provincial travel *i* could be expressed as:

$$i = \frac{t_j - r_j}{\sum_j^{10} t_j}$$

A negative value for any given province implies that the inter-provincial VKT anywhere in Canada by trucks registered in this province is greater than the VKT on this province's road network by trucks registered anywhere else. In other words, the net balance of inter-provincial travel is such that this province "sends" its registered trucks somewhere else, for example, the case of Alberta in Table 6. A low absolute value of this ratio may indicate either: a) a province with a relatively small share of the total VKT registered or traveled, such as the Atlantic provinces (see Table 6); or b) small gap between registration VKT and travel VKT, with lower values meaning that volumes of travel and registration compensate each other indicating a low imbalance in terms of inter-provincial travel shares. The case of Manitoba, for example illustrates this point, with a greater imbalance in 2006 compared to 2000.

This ratio by province evolved for all trucks through 2000 to 2006 as presented in Table 6 below. In understanding Table 6, it helps to think of positive values as "host" provinces that receive more share of inter-provincial travel than its own-registered trucks do elsewhere. The ratio is also presented for specific categories of tractor with 1 trailer, by far the most frequent truck configuration in the base year 2006 as follows:

Table 6: Ratio of inter-provincial travel. Tractor 1 Trailer-Body Type

	All Trucks		Tractor 1 Trailer Year 2006		
	Y 2000	**Y 2006**	**Van**	**Flat bed**	**Tanker**
NL	-0.1%	-0.3%	-0.3%	-0.5%	-0.4%
PE	-0.1%	0.02%	0.0%	0.0%	-0.1%
NS	-1.7%	-2.5%	-3.1%	-2.2%	-6.8%
NB	3.1%	2.1%	2.6%	2.0%	3.8%
QC	-9.0%	-4.2%	-6.6%	-2.1%	-8.0%
ON	9.3%	16.4%	15.7%	8.3%	13.5%
MB	0.1%	-13.7%	-17.0%	-12.2%	-5.1%
SK	3.4%	-5.5%	-2.7%	-1.8%	-3.2%
AB	-16.9%	-16.9%	-10.4%	-21.1%	-27.7%
BC	11.9%	24.6%	18.3%	26.3%	30.6%

Source: CVS, NRS, and this methodology.

On one hand, Newfoundland and Labrador experienced an above-average GDP growth from 2001 to 2006[14]. Interestingly, despite this province's small share of total VKT, the above table shows a growing degree of its participation in road travel. Due to its location, it is not a net 'host' but a net user of other provinces road network. On the other hand, another net user Quebec experienced a below-average GDP growth during the period. Quebec also shows a smaller imbalance in inter-provincial travel. Manitoba and Saskatchewan changed from

[14] Statistics Canada "Provincial and Territorial Economic Accounts Review 2007"

'host' to net user, perhaps compensating for the flows Ontario-Alberta and Ontario-British Columbia. By vehicle age, as shown in Table 7, the ratio shows above-average road use of Ontario and British Columbia network by vehicles in the older category:

Table 7: Ratio of inter-provincial travel. Tractor 1 Trailer-Age

	All Trucks		**Tractor 1 Trailer Year 2006**		
	Y 2000	**Y 2006**	**0 to 5**	**6 to 10**	**11 +**
NL	-0.1%	-0.3%	-0.4%	-0.4%	-0.2%
PE	-0.1%	0.02%	0.1%	-0.1%	-0.1%
NS	-1.7%	-2.5%	-3.3%	-3.6%	-1.8%
NB	3.1%	2.1%	2.7%	2.6%	1.7%
QC	-9.0%	-4.2%	-7.8%	-1.2%	-7.3%
ON	9.3%	16.4%	13.5%	12.8%	19.3%
MB	0.1%	-13.7%	-12.3%	-19.7%	-16.5%
SK	3.4%	-5.5%	-1.6%	-2.8%	-6.9%
AB	-16.9%	-16.9%	-16.2%	-9.6%	-16.4%
BC	11.9%	24.6%	21.6%	18.7%	25.2%

Source: CVS, NRS, and this methodology.

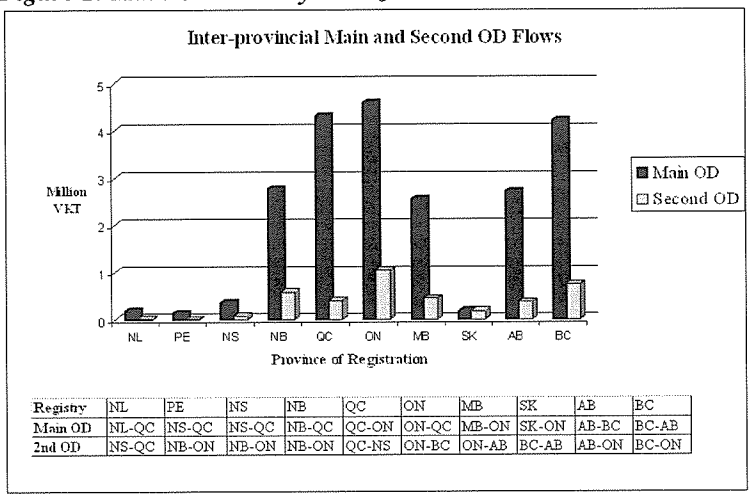
This section concludes that provinces that receive more road use compared to the activities of their own registered trucks somewhere else are New Brunswick, Ontario and British Columbia. In the case of Ontario and British Columbia that receive the highest volume of inter-provincial travel due to their extension and geographical location, the pattern over time seems to have evolved towards a greater imbalance in inter-provincial travel, specifically for old vehicles. The results of this exercise are also consistent with some of the main trade flows identified by Transport Canada Annual Report 2007.

The next section explores one basic assumption that lies under step number four described in the methodology in Section 1: the link between base jurisdiction and trip origin-destination.

3. Base jurisdiction versus trip origin-destination

This section briefly explores the assumption that the base jurisdiction, the trip origin or the trip destination to a great extent match the main origin-destination flows as measured by VKT. Figure 1 below shows the number of VKT for the main and second origin-destination flows by each base jurisdiction.

Figure 1: Main OD Flow by Base Jurisdiction



Registry	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC
Main OD	NL-QC	NS-QC	NS-QC	NB-QC	QC-ON	ON-QC	MB-ON	SK-ON	AB-BC	BC-AB
2nd OD	NS-QC	NB-ON	NB-ON	NB-ON	QC-NS	ON-BC	ON-AB	BC-AB	AB-ON	BC-ON

Source: NRS.

For example, for trucks registered in British Columbia, main origin-destination flow is the provincial pair British Columbia-Alberta; and the second OD flow considered is British Columbia-Ontario. The source for Figure 1 is the preliminary data for the most recent NRS, which may explain the reduced coverage for Saskatchewan. The second flow for Ontario is British Columbia the second flow for Alberta is Ontario. This result also matches the main interprovincial trades as identified on the Transport Canada Annual Report 2007. In addition, Figure 1 shows the main flow for Manitoba-based trucks as Ontario in 2006; the allocation method assigns most of the VKT travelled in Canada from Winnipeg to Toronto to Ontario, which explains why Manitoba appears as main user or sender in 2006.

The assumption of linking the VKT by base jurisdiction to either origin or destination of the VKT as captured by the NRS is not likely to introduce significant distortions. Besides the main origin-destination flow, four other important flows were considered for each base jurisdiction that is likely to capture more than ninety percent of its traffic.

Concluding Remarks

This study shows the specific degree of inter-provincial travel surplus/deficit among provinces in Canada. Ontario and British Columbia emerge as the 'host' provinces that receive a relatively higher share and imbalance of road use by trucks registered in other provinces compared to the traveling that their own trucks do somewhere else in Canada. In both Ontario and British Columbia the inter-provincial travel imbalance has increased from 2000 to 2006. New Brunswick also received a higher share of travel compared to its truck registration. However, the degree of inter-provincial travel received by New Brunswick has decreased. For Manitoba and Saskatchewan the study shows an interesting change in imbalance patterns from the year 2000 to 2006. Results were obtained by combining the Canadian Vehicle Survey and preliminary National Roadside Survey results for two points in time: roughly base year 2000 and 2006.

Limitations and assumptions include the following. First, the bias introduced by the locations/timing where/when the CVS or NRS surveys were taken. Second, the travel patterns are simplified by not considering travel on the U.S. network, but only within Canada, meaning that in this study inter-jurisdictional and inter-provincial are synonyms; and also by selecting one city within each province for the sake of simplicity.

Third, the kilometers travelled are considered for the estimation of origin-destination percentages rather than the number of trips. This assumption responds to the fact that VKT is a more comparable variable between the CVS and the NRS; the definition of trip could vary considerably between the two surveys and through the years

considered. Also, kilometers travelled are better linked to emissions and other environmental impacts than the number of trips. Fourth, the trip origin/destination and base jurisdiction are assumed to be linked for simplicity. Finally, the trip intensity is considered by trip length rather than by tonnage carried or other intensity measure, provincial re-allocation could vary by trip intensity measure chosen but this is not considered.

Future research on inter-provincial travel, could explore the following avenues. First, to expand this analysis to other trucking activity measures such as tonnage carried, value carried, types of commodity flows. Second, to analyze international flows to the United States and compare to other sources such as IFTA and IRP data sets. Finally, the inter-provincial travel ratio could be combined with GHG emissions or other environmental data or measures of passenger road user.

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