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Commissioned Paper:
**The Vulnerability of Canada and Ontario to
International Supply Chain Disruptions in
Light of the Events of February 2022**

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TECHNICAL REPORT

**THE VULNERABILITY OF CANADA AND ONTARIO TO INTERNATIONAL SUPPLY CHAIN
DISRUPTIONS IN LIGHT OF THE EVENTS OF FEBRUARY 2022**

By

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Highlights

- **Canada** is a small, open economy **heavily reliant on trade with the United States**.
- In this regard, **Ontario's** economy is **very similar** to Canada's, but these trends are even more significant.
- As small, open economies heavily reliant on a specific trading partner, **freight transportation** is a major area of vulnerability for Canada and Ontario. **Cross-border supply chains** are especially crucial for Ontario, which has a large **manufacturing sector** that relies in large part on **integrated manufacturing processes** with the United States.
- **Road transportation** is the dominant mode of transportation in Canadian international trade, particularly in **manufacturing** sector industries and especially in **the automotive industry**. Ontario occupies an important place in the automotive industry, which **employs many people in Ontario**, especially in **Windsor and the surrounding area**.
- Trade in Canada and Ontario is very **vulnerable** to supply change disruptions related to road transportation. Exports are even more vulnerable than imports.
- While there is an abundance of **crossing points** along the Canadian border, the vast majority of trade passes through only **a limited number of them**. The most popular crossing point is the **Ambassador Bridge**, between Detroit, Michigan, and Windsor, Ontario.
- The **manufacturing** sector, especially the **transportation and electrical equipment and machinery** industries, is highly dependent on **road transportation** and shows a **marked preference for the Ambassador Bridge**.
- The dominance of road transportation in these industries makes **supply chains, imports, and exports vulnerable to disruptions in road transportation**. This, in turn, weakens the **industries** that are most reliant on ground transportation and specific crossing points, in addition to **putting jobs in these industries at risk**.
- The **Ontario manufacturing sector**, particularly **the automotive industry**, is highly concentrated in the **Windsor** region, which is served by the **Ambassador Bridge**. A significant share of Ontario's **food** supply also passes over the Ambassador Bridge. **This makes it a vulnerable nerve center for the economies of Ontario and Canada, as well as for many jobs in Ontario**.
- If the Ambassador Bridge were to become unusable, the neighboring crossing points **would be unable to absorb** all the trade that normally crosses at the Ambassador Bridge.
- Industries in sectors most reliant on the Ambassador Bridge account for about **1.8% of jobs in Canada** and about **4.4% of jobs in Ontario**, in other words, a total of **339,275 jobs**.

- **Losses** from the **blockade of the Ambassador Bridge** in February 2022 are estimated at between **150 and 400 million dollars** per day, for six days, or equivalent to approximately **0.1% to 0.2% of the Canadian GDP**.
- **Estimated losses** from the occupation of **downtown Ottawa** by the “freedom convoy” from January 29 to February 20, 2022, **are between 150 and 206 million dollars**.

Introduction

In February 2022, when barricades and occupations throughout the country disrupted the Canadian economy, particularly economic activity in Ontario, the federal government invoked the Emergencies Act to strengthen the ability of provinces and territories to put a stop to these disruptions.

In the wake of these events, on April 25, 2022, the federal government created the Public Order Emergency Commission to make an independent public inquiry following the invocation of the Emergency Act.

As part of the Commission's mandate, this analytical note summarizes the main economic repercussions of these events, concentrating on two specific elements: the blockade of the Ambassador Bridge between Detroit and Windsor during the week of February 2 to 9, 2022, and the paralysis of downtown Ottawa from January 29 to February 20, 2022.

This analytical note first provides an overview of international trade in Canada and Ontario. It then presents an analysis of vulnerability of these economies based on several factors: imports, exports, supply chains, and jobs at risk as a result of disruptions to these supply chains. This analysis then focuses on the role of the Ambassador Bridge as an economic nerve center. Lastly, this note briefly presents the economic impacts of the paralysis of downtown Ottawa.

We conclude that continued suspension of road transportation traffic on the Ambassador Bridge would have put a number of jobs at risk. The same observations apply to downtown Ottawa.

1) Canada

Canada is a small, open economy with some distinctive characteristics. In particular, it is heavily reliant on a single large, foreign economy, i.e., the United States. Furthermore, its exchange of other goods (such as manufactured goods) is highly integrated with the United States. In other words, a large share of the networks through which Canada exchanges these goods are located in the United States, and vice versa. The following tables illustrate these characteristics.

Table 1. Canada's exports, imports and trade balance, in thousands of dollars and as a percentage of GDP

	Canada		OECD average
	Level	% GDP	% GDP
Exports	\$631,248,164	29.9%	27.6%
Imports	\$613,739,580	31.0%	27.3%
Trade balance	(\$17 508 583)	-1.1%	0.3%

Source: Statistics Canada, Table 12-10-0011-01

Table 1 shows that about a third of the Canadian GDP in 2021 was the result of international trade, higher than the average for the OECD. This means that Canada internationally trades a large proportion of what it produces, relative to other countries. Canada is considered, in fact, to be a **small, open economy**.

As shown in Table 2, the United States is, by far, Canada's most important trading partner.

Table 2. Total trade¹ with Canada, by trading partner, 2021

	Total trade	
	Dollars (x1000)	%
United States	774,177,300	62.2%
China	114,043,754	9.2%
Mexico	41,683,746	3.3%
Japan	29,934,882	2.4%
Germany	25,884,178	2.1%
United Kingdom	24,144,716	1.9%
South Korea	16,651,829	1.3%
Italy	13,134,266	1.1%
Others (less than 1%)	205,333,073	16.5%

Source: Statistics Canada, Table 12-10-0130-01

Table 3 shows that the motor vehicle and parts industry represents a large proportion of imports and exports.

¹ Total trade = Imports + Exports.

Table 3. Canadian imports and exports, by industry, 2019

Exports			Imports		
Industry	Dollars (x1,000)	%	Industry	Dollars (x1,000)	%
Total	631,248,164	100.0%	Total	613,739,580.10	0.0%
Energy products	143,697,769	22.8%	Consumer goods	135,191,876.90	22.0%
Consumer goods	78,781,097	12.5%	Motor vehicles and parts	95,211,061.40	15.5%
Metal and non-metallic mineral products	72,111,215	11.4%	Electronic and electrical equipment and parts	74,505,156.50	12.1%
Motor vehicles and parts	60,917,270	9.7%	Industrial machinery, equipment, and parts	69,001,662.70	11.2%
Forestry products and building and packaging materials	55,959,277	8.9%	Metal and non-metallic mineral products	53,132,990.10	8.7%
Farm, fishing, and intermediate food products	47,968,997	7.6%	Basic and industrial chemical, plastic, and rubber products	51,919,571.90	8.5%
Basic and industrial chemical, plastic, and rubber products	38,619,552	6.1%	Energy products	31,093,583.20	5.1%
Industrial machinery, equipment, and parts	34,438,712	5.5%	Other (less than 5%)	103,683,677.40	16.9%
Other (less than 5%)	98,754,274	15.6%			

Source: Statistics Canada, Table 12-10-0130-01

2) Ontario

Like Canada, Ontario is heavily dependent on the international trade of the same goods and services and on the same trading partners.

Table 4. Ontario's exports, imports, and trade balance, in thousands of dollars and as a percentage of GDP

	Ontario	
	Level	% of GDP
Exports	197,013,617 \$	26.4%
Imports	372,485,557 \$	49.9%
Trade balance	(\$175,471,940)	-23.5%

Source: Statistics Canada, Table 12-10-0119-01

Table 4 shows that exports represent a significant share of the province's GDP, as is the case for Canada, but Ontario's imports are especially large—accounting for nearly half of its GDP. As we will explain further on, imports play a key role in Ontario's production.

Table 5. Ontario's exports and imports, by industry, 2019

Imports			Exports		
Industry	Dollars (x1,000)	%	Industry	Dollars (x1,000)	%
Total	372,485,557	100.0%	Total	197,013,619	100.0%
Consumer goods	84,463,846	22.7%	Motor vehicles and parts	49,577,960	25.2%
Motor vehicles and parts	76,148,872	20.4%	Metal and non-metallic mineral products	40,780,738	20.7%
Electronic and electrical equipment and parts	52,629,249	14.1%	Consumer goods	34,633,526	17.6%
Industrial machinery, equipment, and parts	37,852,992	10.2%	Industrial machinery, equipment, and parts	16,810,520	8.5%
Metal and non-metallic mineral products	32,283,656	8.7%	Basic and industrial chemical, plastic, and rubber products	14,843,736	7.5%
Basic and industrial chemical, plastic, and rubber products	26,602,068	7.1%	Forestry products and building and packaging materials	11,447,387	5.8%
Other (less than 5%)	62,504,875	16.8%	Electronic and electrical equipment and parts	10,115,581	5.1%
			Other (less than 5%)	18,804,171	9.5%

Source: Statistics Canada, Table 12-10-0133-01

Table 5 shows that the motor vehicle and parts industry plays an even larger role in Ontario's trade than in Canada's; it represents more than a quarter of the province's exports and more than a fifth of its imports.

Table 6 shows that the United States is Ontario's most important trading partner as well. A particularly large share of the province's imports (77.6%) come from the United States.

Table 6. Ontario's imports, exports and total trade, by trading partner, 2021

Imports			Exports			Total trade		
	Dollars (x1,000)	%		Dollars (x1,000)	%		Dollars (x1,000)	%
Total	372,485,557 \$	100.0%	Total	197,013,617 \$	100%	Total	569,499,174 \$	100%
United States	196,034,937 \$	56.2%	United States	152,891,800 \$	77.6%	United States	348,926,737 \$	61.3%
China	49,423,315 \$	13.3%	United Kingdom	13,051,527 \$	6.6%	China	52,241,218 \$	9.2%
Mexico	25,777,804 \$	6.9%	Other (less than 5%)	31,070,292 \$	15.8%	Mexico	28,567,744 \$	5.0%
Other (less than 5%)	101,249,504 \$	23.6%				Other (less than 5%)	139,763,475 \$	24.5%

Source: Statistics Canada, Table 12-10-0119-01

One distinctive feature of Ontario's trade is the prevalence of integrated production processes with the United States. In other words, Ontario not only takes part in the exchange of goods and

finished products, but some steps of manufacturing processes are performed in the United States while others are performed in Ontario. Thus, Ontario's trade is highly dependent on the fluidity of cross-border supply chains.

Most Ontarian exports to the United States are manufactured goods, a large percentage of which come from the automotive industry and are transported by truck.

In 2010, manufactured goods from the automotive industry represented 37% of these exports, and manufactured goods made up 87% overall. A total of 74% of Ontario's exports were moved across the border via road transportation (Anderson, 2011). Tables 4, 5 and 6 illustrate the continuation of these trends today.

Food trade between Ontario and the United States is also noteworthy: Ontario's producers depend largely on American suppliers for the ingredients and packaging needed to manufacture their products (Edmiston, 2022).

3) Freight transportation vulnerability

We now examine which Canadian industries depend on different modes of transportation in their respective value chains, especially with regard to inputs imported for Canadian industries to produce products, as well as how each industry's final products are exported.

In determining the share of Canadian trade dependent on each means of transportation (road, water, air, rail, and other), we can discern which disruptions would have the greatest impact on each industry in Canada.²

Canadian merchandise exports are shipped abroad by a variety of modes of transportation, including truck, train, plane, and pipeline.

Canadian industries rely heavily on road transportation for both imports and exports; in fact, road transportation represents nearly 40% of all Canadian merchandise trade transportation (Table 7).

This phenomenon is largely attributable to the sizeable share of trade between Canada and the United-States, as well as the deeply integrated value chains between the two countries.

Table 7. Proportion of Canadian international trade, by mode of transportation, 2020

Mode of transportation	%
Road	39.0%
Water	28.0%
Air	12.0%
Rail	12.0%
Other	9.0%

Source: Global Affairs Canada

² We assume that although the supply and demand of a given industry may vary from one country to another, the type of product shipped by each means of transportation is generally similar around the world.

4) International trade vulnerability

As an example, let's examine the vulnerability of Canadian value chains in the oil industry.

Although Canada mainly uses pipelines to transport crude oil, businesses must turn to various modes of transportation, including water and road transportation, to obtain the goods necessary for production, such as machines, equipment, and other intermediate inputs used in oil production. Any transportation disruption can push businesses to modify their activities, thus disrupting the supply chain of the oil industry, not to mention the additional pressures it puts on the value chains of other industries.

As previously explained, the automotive industry, which makes up a nonnegligible share of the economy near the Ambassador Bridge, is especially vulnerable to this phenomenon, given the high cross-border integration of its value chains.

a) Import vulnerability

Although importing intermediate inputs from outside Canada makes an industry³ vulnerable to possible disruptions, this vulnerability also depends on the availability of suppliers for the input in question. If there are a number of suppliers for an input, the disruption of a single supplier will not be as drastic as for an input for which there is only one supplier.

Likewise, when an industry is concentrated around a limited number of suppliers, it is more vulnerable to regional or national disruptions. Here, we will examine the concentration⁴ of imports by country for each industry, that is, whether the industry imports from multiple countries.

We can then calculate the concentration of imports for each of these types of industry based on the modes of transportation used by means of the Herfindahl-Hirschman Index (HHI) (Boileau and Sydor, 2021). The HHI is commonly used to measure the concentration of trade. The index ranges from 0 to 1, with 1 representing the maximum degree of concentration. For example, if 100% of the manufacturing industry's imports were shipped exclusively using road transportation, the HHI would be 1. Therefore, a high HHI means that the share of imports for a given mode of transportation is high.

Table 8 illustrates two things. First, manufacturing industries showed on average the highest import concentration, with an HHI of 0.36, because of their high reliance on road transportation. Manufacturing is followed by agriculture, forestry, fishing, and hunting, and service industries.

Second, we see that almost all of Canada's industries rely heavily on roads and waterways to procure their inputs, but that the manufacturing sector (46.9%) and agriculture and forestry sector (43.2%) are even more reliant on road transportation.

³ The North American Industry Classification System (NAICS) categorizes Canadian industries; we use their categories in our analysis.

⁴ Supplier concentration is usually measured on a business scale (how many businesses can supply an input necessary to the industry being studied) rather than the national level. However, a national scale is more pertinent to our analysis, and we have adapted our indicators to it.

Table 8. Industry import concentration by mode of transportation (HHI) and percentage of imports by mode of transportation, Canada, 2019

Type of industry	HHI	Import share of mode				
		Road	Water	Air	Rail	Other
Manufacturing	0,36	46,9 %	35,7 %	9,4 %	6,1 %	2,0 %
Agriculture, forestry, fishing, and hunting	0,35	43,2 %	38,6 %	7,8 %	7,9 %	2,5 %
Services	0,34	42,4 %	37,8 %	12,1 %	2,7 %	5,0 %
Construction	0,34	41,4 %	38,6 %	8,4 %	3,3 %	8,3 %
Mining, quarrying, oil and gas extraction	0,33	39,8 %	40,1 %	7,6 %	5,6 %	6,9 %
Utilities	0,30	30,2 %	42,4 %	7,4 %	4,3 %	15,7 %
All industries	0,35	43,8 %	37,2 %	10,5 %	4,4 %	4,0 %

Source: Global Affairs Canada

This suggests a significant level of global vulnerability. Moreover, industries that primarily use roads to transport imports, especially those in the manufacturing sector and the agriculture, forestry, fishing, and hunting sector, mostly use only this mode of transportation, which could make them particularly vulnerable to land crossing closures.

This applies especially to manufacturing, since roads are the main option for 58 of 82 manufacturing industries for sourcing inputs (71%) (Table 9). In particular, the use rate of roads for transporting imports reaches more than 70% for several automotive manufacturing industries.

Table 9 shows the ten industries in Canada with the highest import concentration by mode of transportation for 2019. All ten industries are in the manufacturing sector, and four of the five largest are in the automotive manufacturing sector. Likewise, eight of these ten industries rely mainly on road transportation.

Table 9. Industry import concentration by mode of transportation (HHI) and the percentage of imports by mode of transportation, Canada, 2019

Industry	Primary mode	Import share of mode of transportation	HHI
Manufacturing of steering and suspension components for motor vehicles (except springs)	Road	71,5 %	0,57
Motor vehicle transmission and power train parts manufacturing	Road	71,8 %	0,57
Petroleum refineries	Water	70,0 %	0,56
Motor vehicle seating and interior trim manufacturing	Road	70,0 %	0,55
Heavy truck manufacturing	Road	69,7 %	0,55
Meat product manufacturing	Road	69,7 %	0,54
Fruit and vegetable preserving and specialty food manufacturing	Road	67,3 %	0,53
Automobile and light-duty vehicle manufacturing	Road	68,3 %	0,52
Alumina and aluminum production and processing	Water	67,3 %	0,52
Soft drink and ice manufacturing	Road	67,1 %	0,52

Source: Global Affairs Canada

b) Export vulnerability

If we compare imports and exports, we notice that the concentration by mode of transportation varies more from one industry to another for exports than for imports (Table 10).

Table 10. Industry export concentration by mode of transportation (HHI) and the percentage of exports by mode of transportation, Canada, 2019

Type of industry	HHI	Road	Water	Air	Rail	Other
Manufacturing	0,48	66,5 %	14,1 %	10,0 %	9,3 %	0,1 %
Agriculture, forestry, fishing, and hunting	0,37	46,7 %	36,7 %	14,7 %	2,0 %	0,0 %
Construction	0,37	34,0 %	45,9 %	0,0 %	20,1 %	0,0 %
Services	0,36	50,1 %	11,9 %	30,5 %	6,4 %	1,2 %
Mining, quarrying, oil and gas extraction	0,33	21,7 %	50,4 %	8,1 %	8,9 %	11,0 %
Utilities	0,25	30,1 %	8,5 %	9,4 %	18,4 %	33,6 %
All industries	0,384	56,8 %	19,0 %	13,2 %	8,7 %	2,3 %

Source: Global Affairs Canada

On average, manufacturing industries had the highest export concentration by mode of transportation with an HHI of 0.48. This is mainly attributable to the heavy reliance of manufacturing industries on road transportation (67%). The agriculture, forestry, fishing, and hunting industry (HHI = 0.37) and construction industry (HHI = 0.37) follow.

If we extend the analysis to specific industries (Table 11), the higher export concentration relative to import concentration becomes evident. The industries with the highest export concentration used their primary mode of transportation for more than 90% of exports of finished products. This percentage contrasts with approximately 70% for imports.

In addition, this list is no longer dominated by road transportation, but rather by water transportation, which occupies three of the top five places for the category, including four mining industries.

Nonetheless, road transportation is by far the primary mode of transportation for industries related to the transportation and automotive sectors, which favour one crossing point between Canada

and the United States in particular: the Ambassador Bridge, between Windsor, Ontario, and Detroit, Michigan.

Table 11. Industry export concentration by mode of transportation (HHI) and percentage of exports by mode of transportation, Canada, 2019

Industry	Primary mode	Export share of mode of transportation	HHI
Iron ore mining	Water	100,0 %	1,00
Copper, nickel, lead, and zinc ore mining	Water	99,0 %	0,98
Diamond mining	Air	99,0 %	0,98
Coal mining	Water	98,2 %	0,96
Heavy truck manufacturing	Road	98,2 %	0,96
Bakeries and tortilla manufacturing	Road	95,8 %	0,92
Office furniture manufacturing (including fixtures)	Road	95,4 %	0,91
Motor vehicle transmission and power train parts manufacturing	Road	94,3 %	0,89
Electric power generation, transmission, and distribution	Other	94,1 %	0,89
Household and institutional furniture and kitchen cabinet manufacturing	Road	93,9 %	0,88

Source: Global Affairs Canada

Given the prevalence of automotive manufacturing in Ontario, and in the Windsor region specifically, as well as the marked preference of this sector for the Ambassador Bridge (substantiated below), this increases the vulnerability of these regions to disruptions in road transportation at the border stations.

Road transportation also plays an important role in industries where it is not the primary mode of transportation. For example, 46% of construction industry exports depend on water transportation, and 34% on road transportation. Thus, a disruption in road transportation could also have significant repercussions on the supply chain of the construction industry.

All in all, Canadian international trade is highly dependent on road transportation, especially for industries belonging to the transportation and automobile sectors and the electric machinery and equipment sector.

5) Supply chain logistics vulnerability

Here we will analyze the vulnerability of Canadian industries to unexpected disruptions in logistics, with a focus on road transportation.

Vulnerability is generally defined as “exposure to serious disturbance arising from risks within the supply chain and external to the supply chain.”⁵

By evaluating trade based on mode of transportation, we can understand how Canada imports and exports merchandise.

Thus, even if an alternative nearby crossing point might serve as a substitute for a given route, a particular industry could feel the impact of delays, especially if we take into account the importance of “just-in-time” procurement.⁶

A slowdown or interruption in traffic, especially at the most heavily used crossing points, entails measurable economic costs.

Nguyen and Wigle (2011) measure the impact of a 1% increase in transportation time between Canada and the United States on economic well-being, international trade, and interprovincial trade in Canada. As seen in Table 12, their findings suggest that such an increase would decrease economic well-being by 1.3% of Ontario’s GDP and cause Ontario a 5.1% drop in international trade, while for Canada as a whole, economic wellbeing would decrease by 1% of the GDP and international trade by 3.6% (Anderson, 2011).

Table 12. Effect of a 1% increase in shipping time between Canada and the United States

Region	% change in		
	Economic well-being (% GDP)	International trade	Interprovincial trade
Atlantic	-0.9	-5.3	-1.4
Quebec	-0.9	-2.0	-0.2
Ontario	-1.3	-5.1	-0.2
Prairies	-0.8	-1.4	-0.5
British Columbia	-0.6	-1.6	-0.5
Canada	-1.0	-3.6	-0.4

Source: Nguyen, T. and R. Wigle (2009), via B. Anderson, Cross-border transportation centre, University of Windsor (2011).

⁵ Nowakowski, T and S. Werbińska-Wojciechowska (2014), “Problems of Logistic Systems Vulnerability and Resilience Assessment.” In: Golinska, P. (eds) Logistics Operations, Supply Chain Management and Sustainability. EcoProduction. Springer, Cham. https://doi.org/10.1007/978-3-319-07287-6_12

⁶ “Just-in-time” is a method of organizing and managing production that consists of minimizing inventories and work in progress.

Vulnerability can also be evaluated quantitatively based on the intersection of the entry and exit points and the mode of transportation. To do this, each point and mode of transportation combination is considered as one crossing. The intersection of the crossing and mode of transportation is what we call “logistics.”

It is also necessary to take into account the elements that make up a product. In fact, each small component is essential to the production process. A disruption affecting a single product could have consequences for the entire production process. For example, if just one of the 700 parts needed to manufacture a ventilator is missing, the ventilator cannot be manufactured.

Most entry and exit points handle only a negligible amount of Canadian trade for both imports and exports (see Tables 14 and 15). Note, however, the prevalence of road transportation.

In fact, though there are more than 400 exit points and 600 entry points along the Canadian border, the vast majority of the country’s trade is concentrated at a small number of crossings.

Table 13. Import distribution by crossing, Canada, 2019

Type of crossing	Share of imports	Number of crossings	Share of imports at most used crossing
Air	13,3 %	123	52,0 %
Other	2,5 %	144	32,6 %
Rail	8,7 %	82	36,2 %
Road	52,6 %	200	27,3 %
Water	22,8 %	82	22,9 %
Total	100 %	421	11,6 %

Source: Global Affairs Canada

Table 14. Export distribution by crossing, Canada, 2019

Type of crossing point	Share of exports	Number of crossings made	Share of exports at the most used crossing points
Air	10.9 %	83	56.9 %
Other	16.8 %	48	69.2 %
Rail	16.0 %	73	25.4 %
Road	36.7 %	115	29.8 %
Water	19.6 %	102	40.0 %
Total	100 %	421	11.6 %

Source: Global Affairs Canada

To further our analysis, we can add the dimensions of product and industry. Thus, for each type of crossing, Table 15 (imports) and Table 16 (exports) show:

- The number of observations

- The average amount of each product exported by a given mode through a crossing point (i.e., for exports made by air, each airport for a given product processes an average of 6% of this product)
- The average amount of each product for the most used crossing for a given product (e.g., for exports by air, the most used airport for a given product processes an average of 18.3% of the product)
- The average HHI for each product (based on mode of transportation)
- The average vulnerability for all industries and the maximum vulnerability of each industry

The data presented in these tables clearly show the vulnerability of exports and imports to potential disruptions in road transportation and, to a lesser extent, to water transportation (exports). Vulnerability is measured from 0 to 100. Zero means no vulnerability while 100 is maximum vulnerability. It is particularly interesting to compare the averages for different modes of transportation.

Table 15. Import vulnerability

Summary statistics on the vulnerability of imports by product and crossing point					
Type of crossing point	Comments	Mean share of a product exported at a crossing point	Mean of the most used crossing point	Mean HHI of the product	Mean vulnerability of industries
Air	86,304	1.4 %	8.0 %	0.029	2.6
Other	97,944	0.2 %	0.8 %	0.003	1.5
Rail	20,048	1.7 %	5.2 %	0.019	1.4
Road	253,780	2.3 %	22.7 %	0.109	13.8
Water	48,166	5.1 %	17.0 %	0.072	5.8
Total	506,242	2.0 %	30.9 %	0.068	25.1

Source: Global Affairs Canada

Table 16. Export vulnerability

Summary statistics on the vulnerability of exports by product and crossing point					
Type of crossing point	Comments	Mean share of a product exported at a crossing point	Mean of the most used crossing point	Mean HHI of the product	Mean vulnerability of industries
Air	16,987	6.0 %	18.3 %	0.100	4.0
Other	533	2.0 %	5.7 %	0.034	1.2
Rail	4,252	4.6 %	13.3 %	0.063	2.7
Road	37,834	7.8 %	33.0 %	0.199	20.8
Water	14,796	7.7 %	18.8 %	0.108	9.4
Total	74,402	7.1 %	43.0 %	0.150	38.0

Source: Global Affairs Canada

These results corroborate the assertion that most crossings process a negligible amount of Canadian trade, while a few crossings process most trade. The average share of imports per crossing is only 2% (Table 15) and 7% for exports (Table 16).

However, the statistical averages are somewhat deceptive. On average, 31% of the value of an imported product and 43% of the value of an exported product, respectively, are routed through a single crossing.

Therefore, even though the majority of products enter or exit the country through dozens of crossings, most of the value passes through only a few.

Tables 17 and 18 show the total logistics vulnerability with regard to imports and exports, by industry.

Table 17. Logistics vulnerability of imports (taking modes of transportation into account), by industry

Total import vulnerability, by industry	
Industry	Vulnérabilité
Non-ferrous metal (except aluminum) production and processing	80.4
Seafood product preparation and packaging	64.1
Other miscellaneous manufacturing	59.6
Motor vehicle seating and interior trim manufacturing	54.3
Motor vehicle gasoline engine and engine parts manufacturing	53.3
Motor vehicle transmission and power train parts manufacturing	53.3
Resin, synthetic rubber, and synthetic fibres and filaments manufacturing	51.5
Automobile and light-duty motor vehicle manufacturing	50.4
Motor vehicle metal stamping	50.3
Motor vehicle steering and suspension components manufacturing	50.1
Basic chemicals manufacturing	48.9
Heavy-duty truck manufacturing	48.7
Iron and steel mills and ferro-alloy manufacturing	47.9
Pharmaceutical and medicine manufacturing	47.6
Petroleum and coal products manufacturing (except petroleum refineries)	44.2
Other electrical equipment and component manufacturing	44.2
Other transportation equipment manufacturing	44
Steel product manufacturing from purchased steel	44
Other provincial and territorial administration	43.3
Coal mining	41.8
Urban transit systems	41.3
Hardware manufacturing	41.2
Meat product manufacturing	40.3
Foundries	39.1
Forging and stamping	39
Motor vehicle body and trailer manufacturing	38.6
Postal services	37.8
Spring and wire product manufacturing	37.7
Electric power generation, transmission, and distribution	37.5
Dry cleaning and laundry services	37.2

Source: Global Affairs Canada

Table 18. Logistics vulnerability of exports (taking modes of transportation into account), by industry

Total export vulnerability, by industry	
Industry	Vulnérabilité
Coal mining	100
Tobacco manufacturing	99.1
Oil sands extraction	90.9
Gold and silver ore mining	89.6
Non-ferrous metal (except aluminum) production and processing	79.9
Motor vehicle transmission and power train parts manufacturing	79.6
Motor vehicle gasoline engine and engine parts manufacturing	79.1
Motor vehicle steering and suspension components manufacturing	78
Copper, nickel, lead and zinc ore mining	77.5
Motor vehicle seating and interior trim manufacturing	76.1
Other metal ore mining	75.6
Greenhouse, nursery and floriculture production (except cannabis)	75.5
Motor vehicle metal stamping	70.1
Metalworking machinery manufacturing	69.7
Diamond mining	67.9
Forestry and logging	67.7
Motor vehicle brake system manufacturing	64.6
Fishing, hunting and trapping	64.4
Aquaculture	63.8
Wineries and distilleries	63.4
Meat product manufacturing	63
Agricultural products (except cannabis, greenhouse, nursery and floriculture production)	60.6
Seafood product preparation and packaging	60.6
Iron ore extraction	59.6
Motor vehicle electrical and electronic equipment manufacturing	56.6
Heavy-duty truck manufacturing	56.5
Animal production (except aquaculture)	55.8
Steel product manufacturing from purchased steel	54.9
Hardware manufacturing	54.7
Pharmaceutical and medicine manufacturing	54.7

Source: Global Affairs Canada

The average vulnerability is 25.1 for imports and 38.0 for exports. Export vulnerability is much higher than import vulnerability, particularly for mining industries and the automotive sector.

The following table lists the sectors with the highest levels of both types of vulnerability (import and export) for each mode of transportation and by industry. If organized so that imports represent the primary criterion and exports represent the secondary criterion (the figure in parentheses), we see that non-ferrous metal production is significantly vulnerable to air transportation.

Table 18. The most vulnerable industries, by mode of transportation

The most vulnerable industries, according to mode of transportation				
Mode of transportation	Imports	Logistics vulnerability (based on mode of transportation)	Exports	Logistics vulnerability (based on mode of transportation)
Air	Non-ferrous metal (except aluminum) production and processing	80.4 (44.4)	Diamond mining	67.9 (67.8)
	Other miscellaneous manufacturing	59.6 (41.6)	Non-ferrous metal (except aluminum) production and processing	79.9 (59.8)
Other	Petroleum and coal products manufacturing (except petroleum refineries)	44.2 (27.8)	Oil sands extraction	90.9 (90.3)
	Coal mining	41.8 (16.9)	Electric power generation, transmission, and distribution	34.8 (33.2)
Rail	Resin, synthetic rubber, and synthetic fibres and filaments manufacturing	51.5 (24.8)	Automobile and light-duty motor vehicle manufacturing	49.0 (33.0)
	Basic chemicals manufacturing	48.9 (11.1)	Resin, synthetic rubber, and synthetic fibres and filaments manufacturing	39.6 (27.4)
Road	Manufacture of seats and interior trim for automobiles	54.3 (50.1)	Tobacco manufacturing	99.1 (83.0)
	Manufacture of steering and suspension components for automobiles (except springs)	52.3 (49.2)	Motor vehicle transmission and power train parts manufacturing	79.6 (79.2)
Water	Iron and steel mills and ferro-alloy manufacturing	47.9 (33.1)	Coal mining	100.0 (99.9)
	Oil refineries	37.1 (29.6)	Gold and silver ore mining	89.6 (88.6)

Source: Global Affairs Canada

In the context of Ambassador Bridge, the automotive industry is highly dependent on road transportation disruptions.

If exports are used as the primary sorting criterion, we note that the automotive industry (particularly motor vehicle transmission and power train parts manufacturing) is especially exposed to the vicissitudes of road transportation.

6) The intersectoral model and multiplier analysis

To measure the vulnerability of production and jobs, there is a methodological tool that allows us to comb through these activities exhaustively: intersectoral models.

This type of model evaluates the final impact of a given shock to each sector of a given economy in terms of production, jobs, and tax revenues. It uses an input-output table illustrating interindustrial transactions, i.e., all purchases made by one sector from all other sectors of an economy. In addition, the businesses studied are classified according to the North American Industry Classification System (NAICS).

Statistics Canada has built such a model for the Canadian economy, which includes a breakdown by province. It's the latter that we used for the quantitative part of this study, with particular attention to Ontario's economy.

This type of model lets us explore hypothetical scenarios at a fairly detailed level, by examining the incidence of exogenous changes in final demand on production while taking into account the interdependence of various industries and economic regions, and leakages to imports and taxes.

For example, we can use these models to look at the following question: if Canadian oil and gas exports doubled, which industries would be the most affected and in which provinces?

The use of an intersectoral model to answer a question of this type would allow us to estimate the indirect effects, and some of the induced effects, of such a demand shock and to calculate the corresponding multipliers.

Aside: The concept of economic multiplier

What is an economic multiplier? Applied to a local community, a multiplier measures how the dollars injected into a community (i.e., a village, a city, a province, or even a country) are re-spent, thus leading to additional economic activity. Thus, for one dollar of economic activity, the production multiplier measures the combined effect of a \$1 change in sales on the production of all local industries.

In this regard, we can think of the community as a closed economy, with dollars and resources circulating between entities in the community, and between these entities and the outside world.

The concept of a multiplier, therefore, can be envisaged as successive rounds of spending. Thus, when a dollar is introduced into a community based on a good that was sold to the outside world (e.g., soybeans), this same dollar then leads to additional local spending.

For example, to produce a dollar's worth of soybeans, farmers must buy local inputs, pay themselves, make investments, and, maybe, hire local labor.

Local purchases also lead to further spending in the community, while purchases of inputs from outside the community are called leakages, since the money is not confined to the jurisdiction. Consequently, in the real world, imports represent leakages, as they don't stimulate the local economy.

Let's take a concrete example where the leakage rate is 60%. For each dollar spent, \$0.60 is spent on imported goods. Therefore, \$0.40 remains, which stimulates the local economy in the first round of spending.

The remaining \$0.40 constitutes the point of departure for the second round of spending and, therefore, this time, 40% of \$0.40, or \$0.16, is spent within the local economy (i.e., $0.4 \times \$0.40 = \0.16), while the remaining \$0.24 (i.e., $0.6 \times \$0.40 = \0.24) is spent on inputs from the outside world.

The \$0.16, in turn, triggers a third successive round, which reinjects \$0.06 into the local economy. This process is repeated until there is no more local money to spend.

By adding all the rounds of spending together, we get a multiplier of \$1.66, based on the initial expenditure of \$1.00.

The intersectoral model reproduces this same simplified multiplier process, but in much greater detail.

The intersectoral model calculates a certain number of multipliers: GDP, employment income, and employment. Different simulations will produce multipliers with a different scope depending on the size of leakages (e.g., imports). Multipliers provide a summary statistic on the economic impact of a given shock and may be used to predict the economic impacts of expenditure or investments of a similar magnitude.

As with any quantitative exercise, this scientific approach has certain limits, which are well known to experts. However, the tool represents the best way to quantify the economic impacts of an

interruption economic activity in a given sector out of all sectors of the Canadian economy. These limits include:

- Input-output models are linear: They assume that a given change in demand for a good or products of a given industry will result in a proportional change in production.
- The change is immediate: Intersectoral models don't take into account the time it takes for changes to actually occur in reality. These models assume that the economic adjustments resulting from a change in demand occur immediately, and not over a period of time.
- No capacity constraints: The hypothesis is that there are no limits on capacity and that an increase in demand for labour will lead to increased jobs (rather than a simple redeployment of workers).

It is important to keep in mind that while this methodology allows us to quantify the direct and indirect effects of an economic shock, specialists generally accept that most of the impacts will be felt within two years. The impacts of changes in the nature of investments over time, which are generally more long-term (over 10 years), cannot be taken into account in this type of model.

A simple example may help clarify the results that follow. Let's imagine that while a 100-million-dollar factory is being built, there is an interruption in the construction sector (a strike, for example). The industry is paralyzed over the year slated for the construction of the factory.

Here are the main impacts of such a scenario:

- 1) Additional business valued at 100 million dollars will not happen.
- 2) All of the suppliers of the construction sector will be affected.
- 3) All of the sectors that depend on the construction sector will also be affected.
- 4) If the strike continues and the project is permanently canceled, the economic activity, jobs, and tax revenues that would have resulted from the business activity of the factory (not construction) would be lost.

7) Job and industry vulnerability

Supply chain vulnerability with regard to road transportation threatens production and jobs in the industries that are most concentrated in terms of suppliers and road transportation. As previously explained, the Canadian manufacturing sector depends significantly on road transportation, and a large share of this sector is in Ontario.

The number of jobs in an industry depends on, among other things, the extent to which the industry is able to meet production demands. Thus, we can measure the job impact of each dollar of output supplied on demand for a given industry.

This gives us a “multiplier” corresponding to the number of jobs⁷ added to the industry by millions of dollars of additional output supplied on demand. These multipliers are calculated by Statistics Canada using the Canadian intersectoral model (Statistics Canada, 2021).

⁷ Jobs are measured in “person-year equivalents,” i.e., production divided by what a representative full-time worker can accomplish.

For example, in Canada, each time the manufacturing industry produces the equivalent of an additional million dollars, it generates the equivalent of 4.647 jobs. Conversely, if the industry can produce the equivalent of a million dollars less than usual, it will lose the equivalent of 4.647 jobs.

The following table shows the economic impacts on Ontario’s automotive industry. In this table, the number of jobs corresponds to the total number of jobs per million dollars of production. The multiplier indicates that there are 2.747 jobs in Ontario for every million dollars of production for the light-duty vehicle industry.

Table 14. Example of multiplier effects on production and jobs

Ontario: Multiplier total						
	GDP at market price			Jobs		
Industry	Automobile and light-duty vehicle manufacturing			Automobile and light-duty vehicle manufacturing		
	2016	2017	2018	2016	2017	2018
	By dollar of production			By million dollars of production		
All provinces	0.420	0.434	0.422	2.905	3.123	3.146
Within provinces	0.379	0.388	0.375	2.532	2.730	2.747

Source: Statistics Canada

The concentration of several Canadian industries around certain suppliers and road transportation, making their production capacity vulnerable to interruptions at these stages of the supply chain, put a certain number of jobs at risk.

According to the most recent data available on the final demand for each industry in the country, the Canadian manufacturing sector accounts for around 17% of Canadian jobs. That is equivalent to 3,165,411 jobs, representing as many people at risk of losing their job as the result of a decrease in production in their sector due to an interruption in road transportation, for example.

These jobs include direct, indirect, and induced jobs. Direct jobs serve the production of the industry. Indirect jobs are associated with the suppliers of the industry. Induced jobs are jobs that are dependent on consumption by the two previous categories of workers. For example, Chrysler assembly-line workers eat in a restaurant near the factory. If they lose their job and stop eating at the restaurant, some servers will lose their jobs because of decrease in the demand for meals. The servers’ positions that depend on the consumption of the factory workers are induced jobs.

Of these jobs, more than a third (1,148,833) are based in Ontario, where a production decrease equivalent to a million dollars costs the manufacturing industry the equivalent of 3.588 jobs.

Furthermore, within the manufacturing sector, which is closely integrated with the United States, certain industries display a marked preference for certain crossings between the two countries.

Several industries related to the automotive sector, among other industries, route a significant share of their inputs and output over Ambassador Bridge, between Windsor, Ontario, and Detroit, Michigan.

The multipliers for these industries are relatively high nationally, but are even higher in Ontario. Among other things, a million dollars less in production costs 4.973 jobs in motor vehicle body

and trailer manufacturing and 5,000 jobs in motor vehicle brake system manufacturing. In Ontario, these industries account for 5,954 and 3,060 jobs, respectively. Electrical machinery and equipment is another sector heavily dependent on the Ambassador Bridge, and industries in this sector also have a high multiplier in Ontario, especially metalworking machinery manufacturing (5.974 jobs per million dollars) and industrial machinery manufacturing (5.680 jobs per million dollars). These industries account for 25,333 and 14,090 jobs, respectively. Overall, the industries in these two sectors that are highly dependent on the Ambassador Bridge (see Appendix 1) account for 339,275 jobs, i.e., 1.8% of all Canadian jobs and 4.4% of all jobs in Ontario.

8) The Ambassador Bridge

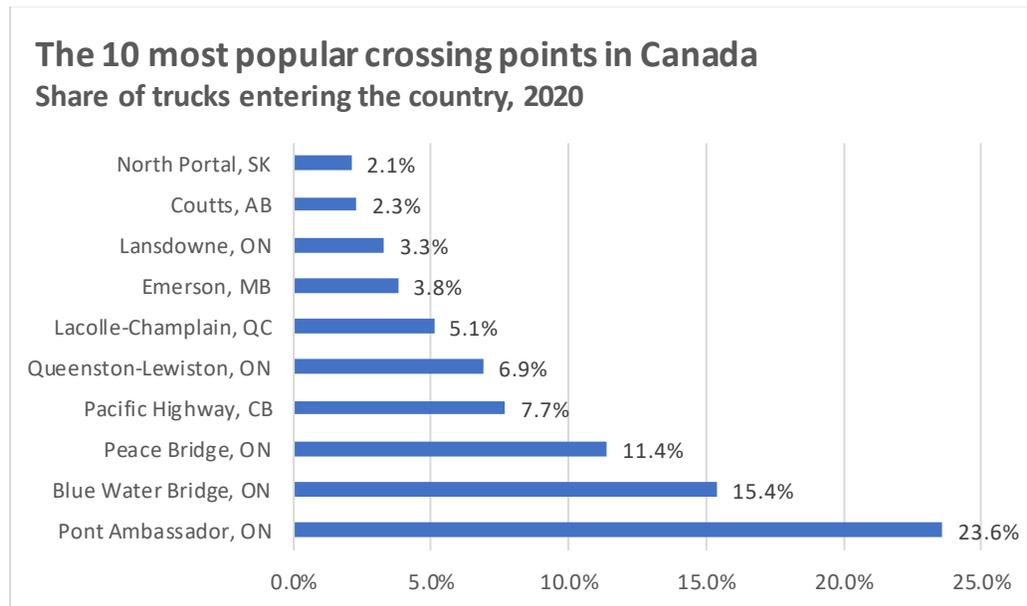
The road part of the Ambassador Bridge at Windsor, Ontario, is the country's biggest port of entry, processing 14.4% of Canada's imports. It is also the road crossing point where the greatest volume of exports passes through customs (Global Affairs Canada, 2019).

A closure of the Ambassador Bridge would cause other major problems since the other customs offices wouldn't be able to deal with the some 30% of total road transportation trade processed at this crossing point. This trade volume translates to approximately 8,000 to 10,000 trucks per day crossing the bridge (Savage, 2015), for a total of approximately 2.3 million crossings per year (Gingerich et al., 2015).

It should be noted that the commercial and industrial machinery and equipment industry and the transportation service industry route extensively through the Ambassador Bridge (Gingerich et al., 2015).

Of the three most important crossing points between Canada and the United States (the Ambassador Bridge and the Blue Water Bridge in Ontario, and the Cascade Gateway in British Columbia), the Ambassador Bridge receives the greatest share of trade and trucking. In fact, the largest share of the total cross-border trucking in the country crosses via the Ambassador Bridge (27%), followed by the Blue Water Bridge with 16%, then by the Cascade Gateway with 10%. The Ambassador Bridge is also first in cross-border trade, receiving 31% of the Canadian volume in 2017, followed again by the Blue Water Bridge with 16%, and the Cascade Gateway with 6%. As for personal vehicle traffic, the Ambassador Bridge receives 15%, after the Blue Water Bridge (18%) and the Cascade Gateway (19%) (Border Policy Research Institute et al., 2019). Even during the pandemic, the Ambassador Bridge retained its status as the most popular crossing point in Canada (Graph 1).

Graph 1. Truck transportation, by crossing point



Source: Professor Ambarish Chandra, University of Toronto, via Bianca Bharti (Financial Post)

Of Canadian imports crossing over the Ambassador Bridge in 2017, 37% came from the transportation industry and 27% from the electrical equipment and machinery industry, two key industries in the automotive sector.

Percentages for Canadian exports crossing the Ambassador Bridge were found to be 49% and 13% for these two industries, respectively.

These industries are by far the two most important at this crossing point. By way of comparison, of Canadian imports borne by the nearest major crossing point, the Blue Water Bridge at Sarnia, 20% are associated with the transportation industry and 24% with the electrical machinery and equipment industry. For exports, the percentages are 29% and 12%, respectively.

The marked preference of these industries, and particularly the transportation industry, for the Ambassador Bridge, attests to the prevalence of the automotive industry near the Ambassador Bridge, particularly in Windsor, on the Canadian side of the bridge. In fact, the city has more than 10,000 auto workers, of which the two largest private employers are a Chrysler assembly plant (the world's only producer of several Chrysler models) and a Ford engine plant (Anderson, 2011).

In light of the strong concentration of the Canadian manufacturing sector and the heavy reliance of the country's economy on road transportation, a break in the supply chain linked to road transportation poses a particular risk to Ontario and the Windsor region.

The daily flow of people traveling across the Ambassador Bridge also reflects the area's economic integration: more than 6,000 Windsor residents cross the bridge to work in the United States (Border Policy Research Institute et al., 2019).

The most popular crossing point into the country in 2020, the Ambassador Bridge welcomed 23.6% of the trucks entering Canada, followed by the Blue Water Bridge with 15.4% (Bharti, 2022).

The president of Food Producers of Canada, Denise Allen, also stresses that, in winter, about half of the consumer food products in the country come from the United States, hence the importance of the fluidity of transportation channels between the two countries.

The Ontario Food Terminal in Toronto, a wholesaler supplying several grocery stores in the province, receives 40% of its products via trucks crossing the Ambassador Bridge (Brend, 2022). The proximity of the city of Leamington, the Canadian capital of greenhouse farming, which exports about 80% of the vegetables it produces to the United States, should also be noted (Edmiston, 2022).

As during the examination of distribution by crossing point, we note that even though the majority of products enter or exit the country through dozens of crossing points, most of the value crosses the border at only a few of these points. The analyses done by Global Affairs Canada tell us that industries related to the automotive sector are twice as vulnerable as the mean of all industries to logistics disruption in international trade.

The director of the Automotive Parts Manufacturers' Association says that during the blockade of the Ambassador Bridge last February, members lost the equivalent of a week of production that they will not be able to make up. In fact, there is a finite number of plannable shifts in a year, as well as a specific possible production volume given the number of shifts, which makes certain losses unrecoverable, he explains. This again illustrates the automotive sector's vulnerability to breaks in the supply chain, of which the Ambassador Bridge is a key element, (Edmiston, 2022).

In addition, the blockade of Ambassador Bridge and the demonstrations in downtown Ottawa raised concerns about Canada's reputation as a stable and attractive country for foreign investment. Nonetheless, Professor Ambarish Chandra at the University of Toronto's Rotman School of Management explains that investment decisions are ultimately made by private companies. According to him, the blockades wouldn't directly cause American firms to flee. However, he maintains that the longer the blockades were to continue, the more likely it is that American firms would plan to relocate.

9) Downtown Ottawa

Our reading of the impact of the occupation of downtown Ottawa by the convoy of truck drivers from January 29 to February 20, 2022, relies largely on the analysis conducted by Barry Nabatian, a retail analyst.

According to his analysis, daily losses for businesses in downtown Ottawa are thought to come to about \$900,000 in sales per day, notwithstanding other costs and lost revenue such as rent, insurance, taxes, and employee wage support.

For businesses in the Rideau Centre, these losses are thought to come to approximately 2.3 million dollars per day. Overall, lost sales are thought to equal about 73 million dollars over the 23 days of the occupation.

Counting the lost income of employees in businesses affected by the occupation, Nabatian estimates losses at between 150 and 206 million dollars for the duration of the occupation (Ki Sun Hwang, 2022).

The occupation of downtown Ottawa also led to certain municipal expenses. The work of the Windsor police is thought to have cost the city a total of \$5,110,000, including 2.5 million dollars in overtime, \$540,000 for lodging, the same amount for meals, \$130,000 for assistance from the London police, and an additional \$100,000 in “miscellaneous costs” (Bellacicco, 2022).

Conclusion

This analysis examines the dependence of Canadian industries on different modes of transportation and their vulnerability to the closure of a border crossing.

As a whole, we found that Canadian industries are heavily dependent on road transportation, both for supplies (imports) and to export their merchandise. As Canada is a small, open economy with significant trade with the United States, as is Ontario to an even greater extent, both economies and their trade are vulnerable to disruptions in road transportation, especially within the context of integrated supply on both sides of the Canada–US border.

While road transportation is dominant across all industries, the auto manufacturing industry is particularly vulnerable to disruptions in this mode of transportation, as it has some of the highest concentrations of imports and exports in road transportation.

This industry also has a high level of economic integration with the United States and follows the trend of Canadian trade in transporting a large share of its merchandise through a single crossing point between the two countries. For the automotive industry, this point is the Ambassador Bridge, which receives the country's largest share of merchandise trade.

The region of Windsor, Ontario, on the Canadian side of the Ambassador bridge, has a significant number of jobs in the automotive industry, which is a major employer for the entire province. Overall, a prolonged disruption in industries with the highest preference for the Ambassador Bridge threatens nearly 420,000 jobs, 400,000 of them in Ontario.

The blockade of the Ambassador Bridge is thought to have resulted in total losses estimated at between 150 and 400 million dollars per day, for a total equivalent to 0.1% and 0.2% of the Canadian GDP.

Losses due the occupation of downtown Ottawa are thought to come to between 150 and 200 million dollars.

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APPENDIX 1

Table A1: Production, multipliers, and number of jobs for industries belonging to sectors showing a preference for the Ambassador Bridge, Canada.

Industries	Millions of dollars of output	Multiplier	Number of jobs
Industrial machinery manufacturing	5208.90	5.852	30482
Manufacturing of machinery for trade and service industries	4526.07	5.233	23685
Metalworking machinery manufacturing	3988.85	6.575	26227
Manufacturing of engines, turbines and power transmission equipment	1584.49	5.803	9195
Manufacturing of other electronic products	7723.10	4.729	36523
Manufacturing of electrical equipment	4644.23	4.828	22422
Manufacturing of other electrical equipment and components	4191.60	4.534	19005
Automobile and light-duty vehicle manufacturing	42477.23	2.393	101648
Heavy truck manufacturing	2453.19	3.296	8086
Motor vehicle body and trailer manufacturing	3330.84	5.571	18556
Manufacturing of gasoline engines and engine parts for motor vehicles	4413.30	3.306	14590
Manufacturing of electrical and electronic equipment for motor vehicles	1242.77	4.507	5601
Manufacturing of steering and suspension components for motor vehicles (except springs)	2927.64	3.813	11163
Motor vehicle brake system manufacturing	205.87	5.538	1140
Motor vehicle transmission and power train parts manufacturing	3983.64	4.029	16050
Manufacturing of seats and interior trim for motor vehicles	4448.20	4.937	21961
Metal stamping for motor vehicles	5987.53	4.272	25579
Manufacturing of other motor vehicle parts	5347.53	4.716	25219
Total	108684.97		417132

Source: Statistics Canada, Table 36-10-0594-01 and Table 31-10-0001-10

Table A2: Production, multipliers, and number of jobs for industries belonging to sectors showing a preference for the Ambassador Bridge, Ontario.

Industries	Millions of dollars of output	Multiplier	Number of jobs
Industrial machinery manufacturing	2,480.66	5.68	14,090
Manufacturing of machinery for trade and service industries	2,706.29	4.225	11,434
Metalworking machinery manufacturing	4,240.58	5.974	25,333
Manufacturing of engines, turbines and power transmission equipment	547.88	5.573	3,053
Manufacturing of other electronic products	4,171.11	3.926	16,376
Manufacturing of electrical equipment	2,364.73	4.451	10,525
Manufacturing of other electrical equipment and components	2,344.03	3.701	8,675
Automobile and light-duty vehicle manufacturing	56,725.84	2.118	120,145
Heavy truck manufacturing	255.63	2.378	608
Motor vehicle body and trailer manufacturing	1,197.24	4.973	5,954
Manufacturing of gasoline engines and engine parts for motor vehicles	5,523.40	2.716	15,002
Manufacturing of electrical and electronic equipment for motor vehicles	1,333.18	3.92	5,226
Manufacturing of steering and suspension components for motor vehicles (except springs)	2,212.17	3.453	7,639
Motor vehicle brake system manufacturing	611.86	5.001	3,060
Motor vehicle transmission and power train parts manufacturing	4,716.48	3.688	17,394
Manufacturing of seats and interior trim for motor vehicles	5,833.50	4.419	25,778
Metal stamping for motor vehicles	7,107.47	3.837	27,271
Manufacturing of other motor vehicle parts	5,350.18	4.058	21,711
Total	109,722.21		339,275

Source: Statistics Canada, Table 36-10-0595-01 and catalog 15-211-X