THE JOBS TUNNEL: THE ECONOMIC IMPACT OF ADEQUATE BORDER-CROSSING INFRASTRUCTURE

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Executive Summary

This study was conducted by two professors who specialize in the economics of freight transportation and one of the world's most respected economic forecasting firms (collectively the "research team"). It is a detailed and highly technical economic analysis that probes the risk of having only one major border crossing point in the Detroit-Windsor region. This is a region that is economically integrated - particularly in the critical area of automotive production - and yet the region finds itself at a stalemate on the issue of how to add the physical capacity to keep the goods moving and to keep our regional economy growing. This report focuses on essential economic issues and concludes that our regional economic vitality is indeed at risk. The intent of this report is to move the debate forward based on sound science rather than speculation.

The cost of doing nothing. This report documents the cost of "doing nothing" so that citizens can understand the implications and costs of NOT building the Jobs Tunnel, and how the failure to act may affect their personal economic futures.

First, this report looks at the issue of what capacity is currently available on the Ambassador Bridge. The report finds that for commercial motor freight, the Ambassador Bridge is operating at about 92 percent of optimal design capacity, far closer to saturation capacity than previously believed. This situation will continue to deteriorate and produce a ripple effect through the economy.

Second, this study objectively looks at the real costs of delay at the Ambassador Bridge. The research team has isolated costs to the truck driver and the truck operator, and the upper bounds of that added delay realistically could add up to between US$17.5 billion (CN$24.4 billion) and US$23.2 billion (CN$32.4 billion) in present value terms by the year 2030. Unabated delay costs related to truck movements across the Detroit-Windsor border will also lead to higher production costs for vehicles produced in this region. By 2010, border crossing delays could add almost US$200 to the cost of producing a new vehicle. Additionally, with border crossing delays continuing through 2030, buffer inventory costs would amount to over US$103 million. This figure is deceptively small, because in all likelihood that increased inventory cost provokes other added costs in production cycle times and in the re-positioning of specialized rack equipment.

In the next two decades hundreds of dollars added to the overall cost of production for vehicles and components produced in this region will diminish the region's competitive advantage. These added costs will have substantial effects on the region's ability to sustain or grow the automotive industry, which is so crucial to the region. In Windsor, where manufacturing accounts for 30.8% (48,900 jobs) of the total labor base, the impact will be most acute, as this region is so heavily dependent upon manufacturing jobs, particularly in auto and auto parts.

The Detroit-Windsor region has carved a strategic economic niche by growing with and around the vital auto industry. Everyone now understands competitive advantage, and that global auto producers must weigh overall production costs very carefully when plants must be closed or new plants must be built. Ensuring adequate border crossing capacity and building the Jobs Tunnel must be our region's response to this competitive advantage.

The Jobs Tunnel will help to secure the economic future of southeast Michigan and southwest Ontario. This report calculates the cost of doing nothing to expand border-crossing capacity as well as the value of improving border-crossing infrastructure. The research team has determined that by building new border-crossing capacity with the Jobs Tunnel, the future economic costs can be offset or even reversed. First and foremost the Jobs Tunnel is a unique public-private partnership, which brings US$419 million in new - and largely private - capital to improve border system capacity. With a planned construction time of five years for the Jobs Tunnel, positive impacts will be produced on both sides of the border. In southeast Michigan, the Jobs Tunnel will produce maximum employment of 547 full-time jobs during the peak year of construction and total construction expenditures of US$156.5 million (CN$218.4) would be pumped quickly into the southeast Michigan economy (Tables 18 and 19). Total output would average US$47.96 million (CN$66.95 million) annually, while the annual increase in value-added would average US$24.16 million (CN$33.73 million). Similarly, on the Ontario side, maximum employment of 893 full-time jobs would be created during the peak construction period (Tables 21 and 22). Total output would average US$80.43 million (CN$112.28 million) annually, while the annual average value-added would be US$40.51 (CN$56.55 million) per year.

The benefits of building the Jobs Tunnel are substantial and striking. The operation of the Jobs Tunnel will add US$10.14 million annually (CN$14.15 million), including labor and goods and services purchased and it will require 190 full-time positions for tunnel operations and Canadian Customs. Furthermore, the Jobs Tunnel will double truck-crossing capacity and save truckers - and shippers between US$1.3 and US$1.8 billion annually over the next 27 years.

Perhaps most critical to those who live and work in the southeast Michigan and southwest Ontario, the Jobs Tunnel will help this region retain automotive manufacturing jobs. The capacity provided by the Jobs Tunnel could prevent the additional loss of nearly US$30 billion in transportation equipment industry output (Table 16). This could save the region between 9,000 and 12,000 good jobs.

The Jobs Tunnel makes such good economic sense that the choice is clear.

I. Introduction

Sound Science, Global Insight, and Peter F. Swan (the "research team") have been contracted by the Detroit River Tunnel Partnership to study the economic effects of the proposed Jobs Tunnel project on the regions most strongly affected by this project: metropolitan Detroit (southeast Michigan) and southwest Ontario (especially Windsor), along with Michigan and Ontario. The Detroit River Tunnel Partnership, a partnership composed of the Canadian Pacific Railroad (CPR) and the Borealis Transportation Infrastructure Trust (BTIT), is proposing to construct a new single-track rail tunnel under the Detroit River between Detroit, Michigan, and Windsor, Ontario, and to modify the existing twin-tube rail tunnel and associated rail corridors into a dedicated truckway directly connecting Interstate 75 in the U.S. and Highway 401 in Canada. The official name of this proposed construction project is the Jobs Tunnel. This report addresses the delay issues for motor carrier transportation and the macroeconomic effects of not building any new border-crossing infrastructure. While the economic analysis addresses the "No-Build" scenario generally, the fact that the Jobs Tunnel can be built in five years makes it an obvious choice.

II. International Trade and the Economics of Border-Crossing Infrastructure

In 2001, the total value of surface trade between the United States and Canada reached US$346.6 billion.. (CN $485.2 billion). The Ambassador Bridge, the Detroit-Windsor Tunnel, and the Blue Water Bridge accounted for 42% of this value (US$147.5 billion (CN$228 billion), at the exchange rate in effect at the time of the study)[1]. The Ambassador Bridge alone carried approximately 25% of the value of the merchandise trade between the two nations[2]. Approximately 76% of the value of goods transported between southeast Michigan and southwest Ontario is carried on commercial trucks, demonstrating the importance of these border crossings to both the United States and Canada[3]. There is no doubt that the border crossings in the Detroit-Windsor area are of critical economic importance, and in the post 9/11 world we have learned that these crossings have significant national security implications as well. Redundancy is important, as is economic competition; no region so tightly integrated as southeast Michigan and southwest Ontario can risk its entire economy on one single component of transportation infrastructure.

Over the past thirty years, bilateral trade in goods and services between the U.S. and Canada has grown faster than GDP, increasing at an annual rate of 11 percent[4], yet new physical

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[1] Canada-U.S.-Ontario-Michigan Border Transportation Planning/Need Feasibility Study ("Bi-National Study"). "Transportation Problems and Opportunities Report," November 2002, pg. 11, Table 2.1. Source of data from the U.S. Department of Transportation, Bureau of Transportation Statistics.

[2] Associated Press. *Transport Topics.* June 23, 2003, pg. 25.

[3] Canada-U.S.-Ontario-Michigan Border Transportation Partnership ("Bi-National Study"). "Transportation Problems and Opportunities Report," November 2002, pg. 12. See also Bi-National Study, "Existing and Future Travel Demand Study," Working Paper Executive Summary; page S-2.

[4] Bi-National Study. *"Transportation Problems and Opportunities Report," November 2002, pg. 12.*

infrastructure has not been built in the Detroit-Windsor corridor to accommodate the growing level of traffic. The level of bi-national commerce is not likely to abate; rather, Global Insight forecasts it will increase by approximately two and one half times in the next twenty years, with the trade in goods increasing at an annual rate of 5 percent.[5] This is an increase from US$346 billion (CN$485.2 billion) in 2001 to approximately US$866.5 billion (CN$1,213.1 billion) in 2021 in current 2003 dollars.

The Canada-U.S.-Ontario-Michigan Border Transportation Planning/Need Feasibility Study ("Bi-National Study") determined that since 1995, the value of freight crossings by truck and by railcar have grown at average annual rates of 5.2 and 6.6 percent, respectively. Trucks are now one-fifth of all vehicle crossings at Detroit-Windsor and Port Huron and the volume continues to grow. This suggests that trucks are the mode of choice to accommodate the Just-In-Time (JIT) delivery practices of modern manufacturing in general and the automotive industry in particular. From an economic perspective, the addition of new truck crossing capacity is fundamental to sustaining the projected trade levels and the economic vitality of the two regions.

III. The Issue of Ambassador Bridge Capacity

The Bi-National Study states that the Ambassador Bridge has "adequate" capacity for the next ten to fifteen years, while Customs' capacity and road access on both sides is "near capacity" or "at capacity[6]." Breaking down the issue of capacity into these three areas – bridge capacity, customs capacity, and road access capacity – makes it easier to assess responsibility for capacity improvement on one group or another. It ignores, however, the systems nature of the Ambassador Bridge system and the fact that road access, customs, and the Ambassador Bridge itself interact in ways that make it difficult to study one piece of the Ambassador Bridge system, separate from the other pieces. In our interviews with motor carriers and truck drivers who use the Ambassador Bridge or interact with Bridge traffic on a daily basis, the research team found that capacity is not adequate at certain times of the day. This was especially true for commercial traffic moving from Canada to the U.S. These findings on Ambassador Bridge capacity differ significantly from those of the Bi-National Study, which calculates a one-way capacity of 3,500 Passenger Car Equivalents (PCEs) per hour and a one-way peak flow of 2,543 PCEs in 2000[7].

To understand the Ambassador Bridge system, it is necessary to understand all the pieces of the system and how they interact. On the southeast (Canadian) side, the first link in the system is Huron Church Road in Windsor. Huron Church Road is a six lane arterial road that extends from the foot of the Ambassador Bridge to Highway 401, via Talbot Road, a four-lane surface street. While Huron Church Road is three lanes wide in each direction, trucks traveling to the U.S. are required to stay in the middle lane for their journey to the Ambassador Bridge. Congestion

[5] Global Insight, Inc., *World Trade Service Forecast, 2nd Quarter, 2003.*

[6] Bi-National Study. "Existing and Future Travel Demand Working Paper," November 2002, pg. 190.

[7] Bi-National Study. "Existing and Future Travel Demand Working Paper", November 2002, pg. 183. Since trucks are longer and move more slowly and unevenly climbing and descending grades, and require greater stopping distance, traffic engineers define their traffic needs as a multiple of passenger cars, and this define them as passenger car equivalents, or PCEs.

during rush hour was characterized as Level-Of-Service E, a standard that entails "significant delays and average travel speeds of one-third the free-flow speed or less."[8] Indeed, countless pictures have been taken of miles of trucks in a long line to get to the Ambassador Bridge itself, and we observed this first-hand.

Just because the approach road to the Ambassador Bridge is congested, however, does not prove that it is the problem. Our interviews and on-site inspection confirmed that when Huron Church Road is backed up to E.C. Row Expressway and beyond (even to Talbot Road), the Ambassador Bridge structure is backed up as well. If Huron Church Road were the limiting factor in the Bridge system, then the Bridge should have less congestion than the approach. This is not the case.

After receiving traffic from Huron Church Road, the Ambassador Bridge starts a 4.5% climb to the top followed by a 4.5% descent back down on the other side. The length of the Bridge is 9,200 feet[9]. Like Huron Church Road, trucks are limited to one lane[10] when traversing the Ambassador Bridge (the outside or right hand lane).

The Bi-National Study analyzed the Ambassador Bridge system capacity using the following methodology. The two lanes of travel in each direction have a combined capacity of 3,500 PCEs per hour. Peak hourly flow in the year 2000 was 1,616 passenger cars and 309 commercial vehicles. Assuming that commercial vehicles are equivalent to 3 passenger cars, then the 309 commercial vehicles per hour during peak periods are equivalent to 927 PCEs per hour, bringing the combined total of passenger cars and commercial vehicles to 2,543 PCEs per hour, according to the Bi-National Study[11]. While the logic of this analysis is sound for a multi-lane roadway, it is not applicable to a two-lane road such as the part of the Ambassador Bridge on which commercial vehicles may travel.

A more reasonable way to determine capacity, given the segregation of passenger cars and commercial vehicles into separate lanes, would be to model the Ambassador Bridge as two separate two-lane roadways – one for passenger cars and one for trucks – rather than as a four-lane roadway for both. Two-lane roadways offer significantly less opportunity to pass than do four-lane roadways, and for most trucks this is a two lane roadway: one over and one back. With two lane roadways, drivers are trapped more frequently behind slower moving vehicles, thus lowering the speed and effective capacity of the roadway.

The Ambassador Bridge also is a roadway with a significant grade averaging approximately 4.5%. The grade is not entirely uniform, and likely exceeds 4.5% in some areas. Such grades reduce the capacity of a roadway because vehicles – especially heavily loaded trucks – have to climb the grade with effort. The differential between heavily loaded, lightly loaded, adequately

[8] Transportation Research Board, *Highway Capacity Manual* (1994), pg. 11-4.

[9] Bi-National Study. "Existing and Future Travel Demand Working Paper", November 2002, pg. 183 uses a grade of 4.5% while other documents list the grade at 5%.

[10] Trucks carrying foods, agricultural products, livestock, and some other products are permitted to jump ahead when congestion exists by using the inside lanes.

[11] Bi-National Study. "Existing and Future Travel Demand Working Paper", November 2002, pg. 183.

powered and inadequately powered trucks will create congestion, as the slowest trucks hold back the others. Finally, as trucks slow down to 10 mph or less, Ambassador Bridge throughput and capacity are dramatically reduced, as observers have noted.

Table 1 shows how Ambassador Bridge capacity might be recalculated using the assumption that trucks stay in the right lane and using data from the Highway Capacity Manual 2000[12]. Even these numbers may overestimate capacity of the Bridge structure. While the 2000 edition of the Highway Capacity Manual does have a substantial section on two-lane roads, most of the formulae apply to roads that are used predominantly by cars. For roads that are used predominantly by trucks, the formulae may not retain their accuracy. Ratios of weight-to-horsepower and truck length dramatically affect the values used to convert trucks into PCEs[13]. This is especially true for longer grades and grades preceded by a full stop; in addition to the Ambassador Bridge's long, steep upgrade, trucks may start the grade from a stoplight and must slow down for the steep downgrade, navigate a dogleg, and make a U-turn after they exit the Ambassador Bridge. Trucks with lower weight-to-horsepower ratios will also increase the ratio of trucks to passenger car equivalents substantially and reduce the effective capacity of the roadway[14]. Using numbers out of the Highway Capacity Manual, the ratio of peak hour volume to capacity in 2000 was probably not 0.72, but probably closer to 0.92 as shown in the table below. This means that the Ambassador Bridge system is at 92% of capacity, rather than at 72% of capacity. In fact, while the Ambassador Bridge itself may have some limited amount of unused capacity, traffic on the Bridge system significantly exceeds capacity during many hours of the average workday.

[12] Transportation Research Board; *Highway Capacity Manual 2000.*

[13] Elefteriadou, Lily , Darren Torbic, and Nathan Webster (1997); *Transportation Research Record* 1572; "Development of Passenger Car Equivalents for Freeways, Two-Lane Highways and Arterials" pg. 57.

[14] Local trucks are more likely to be under-powered due to the lack of distance that they traverse. Twenty one percent of the commercial vehicles using the Ambassador Bridge are local in nature according to the Bi-National Study, "Existing and Future Travel Demand Working Paper", November 2002, pg. 55.

Table 1. Capacity of Ambassador Bridge (Bridge Only)

	Bi-National Study[15]	Single Lane Commercial[16]	Single Lane Passenger Cars	Combined Single Lanes
Peak Hour Capacity (PCEs / Lane / Hour)	1,750	1,700 [17]	1,700	3,400
Commercial Vehicles Equivalency in PCEs	3	4.3 [18]	NA	4.3
Commercial Vehicle Peak Demand Converted to PCEs		1,329 [19]	NA	1,329
Total Peak Demand PCEs / Hour in 2000	2,543 [20]	1,329	1,616	2,945 [21]
Current Percent of Capacity[22]	**73%** [23]	**78%** [24]	**95%**	**92%**

Note: Peak hour demand 2000: 1,616 passenger cars per hour
Peak hour demand 2000: 309 Commercial vehicles per hour

The analysis of capacity shows that the Ambassador Bridge must be very near capacity now (in 2003). However, being near capacity does not explain the amount of delay experienced by

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[15] Bi-National Study. "Existing and Future Travel Demand Working Paper." November 2002, Table 6.3, pg. 183; calculation considers Ambassador Bridge to be a four lane bridge.

[16] This column and the next column assume the Ambassador Bridge operates as a one-lane automobile bridge and a one-lane truck bridge, because trucks are for the most part restricted to the right lane, while cars stick to the left lane.

[17] Transportation Research Board. *Highway Capacity Manual 2000*; pg. 20-3.

[18] Transportation Research Board. *Highway Capacity Manual 2000*; pg 20-17. Estimated by averaging PCE values of 3.4 (½ mile grade >=3.5 < 4.5) and 5.1 (½ mile grade >=4.5 < 5.5)

[19] 309 x 4.3 = 1,329

[20] Peak hour demand of 1616 passenger cars per hour in 2000 + peak hour demand of 309 trucks per hour at assumed conversion rate of 3 trucks to 1 truck; 1,616 + (309 x 3) = 2,543.

[21] 1,329 + 1,616 = 2,945.

[22] Ratio of peak hour volume to capacity.

[23] 2,543 / (1,750 x 2).

[24] 1,329 / 1,700.

commercial traffic moving from Canada to the U.S. that has been reported to us in interviews with Bridge stakeholders, and which we have observed. U.S. Customs has been singled out by some as the cause of delays in moving commercial traffic from Canada to the U.S. The number of customs booths was recently increased from six to nine[25] for commercial vehicles entering the U.S. at the Ambassador Bridge, but problems with delays have persisted.

To understand why U.S. Customs may be only part of the problem causing delays in the Detroit-Windsor border crossing, it is necessary to look at the whole Ambassador Bridge corridor system. The border crossing for U.S.-bound trucks at the Ambassador Bridge is operated as a long one-lane road that begins at Highway 401 and ends at U.S. Customs. Trucks must stay single-file moving down Huron Church Road, with up to 17 traffic lights and city traffic on Huron Church Road limiting the capacity of the approach system. Finally, they ascend and descend the Ambassador Bridge, and exit the through a "chute," angling off on a dog-leg and cornering around a 180-degree curve.

Underpowered trucks moving slowly as they start and stop at the signals along this road can slow all trucks down. In addition, each time a loaded truck stops going up the Ambassador Bridge, the major effort used to get rolling again further adds to the congestion. These and other restrictions are important because when speed falls below 10 miles per hour, effective capacity of any highway declines substantially.[26] During congested periods, trucks may encounter stop-and-go traffic going up and down the Bridge.

The Ambassador Bridge policy of allowing trucks carrying agricultural and perishable products to get ahead of the queue, traveling in the left lane that otherwise is reserved for automobiles, may also serve to increase congestion. When trucks in the right lane reach the bottom of the grade, they often have to stop to let in a truck that used the inside (left) lane. This serves to reduce capacity further; every time a truck stops, everyone behind stops, and the whole process begins again, all the way back over the Ambassador Bridge. At the U.S. end of the Bridge, trucks may also have to wait for cars that have entered the truck lane to clear before the trucks can proceed to U.S. Customs. During hours of peak automotive congestion or during security alerts, the backup of passenger cars from U.S. Customs (a different area than used by the trucks) can be long enough to impede the flow of trucks as well.

Once across the Ambassador Bridge and through the turns, the trucker approaches U.S. Customs. This curve before customs is a bottleneck, and limits the effect of improvements in processing commercial vehicles at U.S. Customs[27]. Only after exiting this curve can commercial vehicles spread out into multiple lanes. Finally, after trucks get through customs, they have to stop again to pay their toll. This delay may be exacerbated if truck drivers choose to change currency at this point, leading to another restriction that may create congestion. Finally, they must exit onto Fort Street, turning right or left at a traffic light. The capacity of this intersection may soon

[25] Bi-National Study. "Existing and Future Travel Demand Working Paper." November 2002, pg 187

[26] Transportation Research Board. *Highway Capacity Manual* (1994); pg 2-29 The effect can also be shown be estimating truck length in relation to speed

[27] Booz-Allen & Hamilton. "Final Evaluation Report: Ambassador Bridge Border Crossing System." May 2000; pg 70-71

become the limiting factor for capacity of the Bridge system[28]. Every one of these factors limits capacity of the Bridge system at one time or another.

Some people argue that the problem is all the result of inadequate and inefficient Customs inspection – either excessively strict or understaffed so that trucks are not processed as quickly as possible. To evaluate this claim, the research team looked at data on 20 U.S.-Canada border crossings collected by Canadian Customs. The research team found that across the board, U.S. Customs takes longer than Canadian Customs. Indeed, while the average commercial truck crossing from the U.S. to Canada took 4 minutes, the average crossing from Canada to the U.S. took 10.73 minutes, more than twice as long. Limiting our analysis to just Canada-to-U.S. crossings, however, the average commercial crossing at the Ambassador Bridge took 28.82 minutes from the time the vehicle stops in traffic until it is released across the border, nearly three times the U.S. Customs average for such border crossings. While it is plausible that Customs at this particular border crossing is slower in processing trucks compared with its peers, it is more plausible to attribute the delays to the physical restrictions and limitations of this crossing (see Table 2).[29]

Table 2. Comparative Delay, Canada to U.S.

Delays	**Times**
Average Commercial Delay at Ambassador Bridge	28.82
Average Commercial Delay at All Other Crossings	10.09
Excess Commercial Delay at Ambassador Bridge	18.73
Ratio of Ambassador Commercial Crossing Delay to Commercial Crossing Delays at Other Bridges	**2.69**

What is the true commercial vehicle capacity of the current Ambassador Bridge System?

Trucks entering the U.S. encounter the restrictions discussed above, but no such restrictions exist on the Canadian side. While our estimated number of 395 trucks per hour may be accurate for traffic moving from the U.S. to Canada, the well-known chronic backups on Huron Church Road demonstrate that Ambassador Bridge system capacity is lower for trucks heading to the U.S. To estimate the capacity of the Bridge system, the research team compared the hourly commercial vehicle counts in Exhibit 2.30 in the Bi-National Study[30] with known hours of backups. The peak flows shown in Bi-National Exhibit 2.30 come in the period between 9 a.m. and 3 p.m. Monday through Thursday for traffic moving from Canada to the U.S. (see Table 3). Fully

[28] Booz-Allen & Hamilton. "Final Evaluation Report: Ambassador Bridge Border Crossing System." May 2000; pg. 50.

[29] Canada Customs, *Border Delay Archive Database for Commercial and Personal Travel North and Southbound*, November, 2001 – August, 2002, as referenced by John C. Taylor, Douglas R. Robideaux, and George C. Jackson. "The U.S.-Canada Border: Cost Impacts, Causes, and Short to Long Term Management Options." Report to the Michigan Department of Transportation, the U.S. Department of Transportation, and the New York State Department of Transportation May 21, 2003.

[30] Bi-National Study. "Existing and Future Travel Demand Working Paper." November 2002, pg 46

71.4% of all truck traffic on the Ambassador Bridge crosses on these four days and 53.3% of the car traffic also moves on these four days, as indicated in Table 3 below. Also on those days, between the hours of 9 a.m. to 3 p.m. truck traffic spikes up to 600-700 or more commercial vehicles per hour.[31]

The peak delays on Huron Church Road for this traffic begin at 10 a.m. and last throughout the afternoon, as Exhibit 3.3 of the Bi-National Study shows.[32] While the Ambassador Bridge itself may have the capacity to handle the flow of traffic between 10 a.m. and 3 p.m., the Bridge system does not. Given that average commercial truck traffic during this period appears to range around 330 trucks per hour, the research team estimates the capacity of the Ambassador Bridge system to be 315 trucks per hour moving between Canada and Detroit. Table 4 shows that the Ambassador Bridge system is at capacity now during peak periods, according to this analysis.

Table 3. Ambassador Bridge Traffic Distribution by Day of the Week; Summer 2000

	Trucks		**Cars**		**Total Vehicles**	
	Total	**% Share**	**Total**	**% Share**	**Total**	**% Share**
Sunday	147,104	9.3%	532,558	16.5%	685,808	14.4%
Monday	277,197	17.4%	460,504	14.3%	725,806	15.2%
Tuesday	292,469	18.4%	396,938	12.3%	694,464	14.6%
Wednesday	297,253	18.7%	421,855	13.1%	709,265	14.9%
Thursday	268,914	16.9%	437,496	13.6%	623,229	13.1%
Friday	194,702	12.3%	489,136	15.2%	645,879	13.6%
Saturday	111,114	7.0%	487,476	15.1%	679,222	14.3%
	1,588,753	100%	**3,225,963**	100%	**4,763,673**	100%

Future improvements to the geometry of the roadway leading to U.S. Customs and the exits from U.S. Customs, along with increased staffing at U.S. Customs, have the potential to increase the capacity of the Bridge system for moving traffic from Canada to the U.S. Throughput improvements on the U.S. side sufficient to handle the projected increase in truck traffic, however, probably will come at the expense of using more land in southwest Detroit and Mexicantown, further encroaching on this vibrant community. Whether or not the Gateway project removes restrictions to the U.S. side of the Ambassador Bridge, the estimated capacity of the Bridge itself of 395 trucks per hour will not increase without building a new crossing. Table 5 shows that assuming a true throughput of 315 trucks per hour on this Bridge system for Canada-to-U.S. freight, the number of trips exceeding capacity will increase dramatically if capacity is not added. If we do not experience the delays inherent in such a constraint, it will be because manufacturing production has been forced to leave the region for better infrastructure.

[31] Bi-National Study. "Existing and Future Travel Demand Working Paper." November 2002, Table 2.28 "Daily Variation With Hourly Detail," pg. 44.

[32] Bi-National Study. "Existing and Future Travel Demand Working Paper." November 2002, pg 84

Table 4. Capacity of Ambassador Bridge System, Canada to U.S.

	Bi-National Study[33]	**Peak Truck Usage**
Peak Hour Capacity (PCEs per lane per hour)	1,750	1,700 [34]
Peak Hour Demand 2000: Passenger cars per hour	1,616	1,616
Peak Demand 2000: Commercial vehicles per hour	309	309
Commercial Vehicles Equivalency in PCEs	3	4.3 [35]
Commercial Vehicles converted to PCEs		1,329 [36]
Commercial Vehicle Lane Capacity: Trucks per hour		315 [37]
Total PCEs per hour	2,543 [38]	2,945 [39]
Current Percent of Capacity[40]	**72%** [41]	**98%** [42]

[33] Bi-National Study. "Existing and Future Travel Demand Working Paper." November 2002, pg 183. This table follows the pattern set by Table 1 above.

[34] Transportation Research Board. *Highway Capacity Manual 2000*; pg. 20-3.

[35] Transportation Research Board. *Highway Capacity Manual 2000*; pg 20-17. Estimated by averaging PCE values of 3.4 (½ mile grade >=3.5 < 4.5) and 5.1 (½ mile grade >=4.5 < 5.5).

[36] 309 x 4.3 = 1,329.

[37] Sound Science estimate of maximum truck capacity in current configuration; see above.

[38] Peak hour demand of 1616 passenger cars per hour in 2000 + peak hour demand of 309 trucks per hour at assumed conversion rate of 3 trucks to 1 truck; 1,616 + (309 x 3) = 2,543.

[39] 1,329 + 1,616 = 2,945.

[40] Ratio of peak hour volume to capacity.

[41] 2,543 / (1,750 x 2).

[42] 309 / 315.

Table 5. Ambassador Bridge Annual Truck Trips that Exceed Bridge System Capacity [43]

	2000	2010	2020	2030
U.S. to Canada Trips Exceeding Capacity	0	300,072	1,174,220	2,418,031
U.S. to Canada Total Trips	1,690,008	2,040,327	2,692,590	3,635,402
Canada to U.S. Trips Exceeding Capacity	348,658	665,361	1,405,742	2,809,062
Canada to U.S. Total Trips	1,795,992	2,231,836	2,866,930	3,947,198

Even these measures will not buy much time in avoiding more serious capacity problems. With certain bottleneck components of the Ambassador Bridge system at or near capacity already, the Ambassador Bridge may effectively be at capacity now. In other words, Ambassador Bridge capacity is a current problem rather than one that we can anticipate developing 10-15 years in the future.[44]

Gauging the delay that traffic will encounter when using the Ambassador Bridge is a difficult proposition. There is no consensus on the amount of delay that commercial truck traffic is currently experiencing. Taylor[45] finds that truckers encounter delays of 90 minutes to 120 minutes frequently. While these numbers generally agree with what the research team heard from drivers who we interviewed, they do not completely agree with numbers in the Bi-National

[43] The research team estimated Bridge system traffic flow exceeding capacity based on peak traffic flow during each hour. For this reason, the calculations are very conservative and include average peak hourly demand by average hour, but not actual peak hourly demand for any specific day.

The research team used the time of day distributions shown in Exhibit 2.30 of the Existing and Future Travel Demand study to allocate trips by time of day. These tend to be average distributions and probably underestimate the delays that actually occur during peak days.

To estimate traffic delay in 2000 on the Ambassador bridge, the research team used the following lane capacities: U.S. to Canada - 395 truck trips per hour, and Canada to the U.S. - 315 truck trips per hour. The Canada to U.S. lane capacity was raised to 395 starting in 2010 on the assumption that the Gateway project will be complete by then, so that the Ambassador Bridge system lane capacities in both direction are 395 in 2010, 2020, and 2030.

The research team calculated zero trips exceeding capacity from U.S. to Canada on the Ambassador Bridge system in 2000. During a number of hours in 2000 the forecast number of trips from the U.S. to Canada over the Ambassador approaches 395, but does not exceed it. Thus, the combination of the average hourly figures from the Bi-National Study and the higher capacity from the U.S. to Canada on the Ambassador Bridge does not yield any over-capacity trips during that year**.**

The figures in Table 5 represent the total number of trips in year that are above the rated lane capacity. For example, if 400 trips during one hour are forecast on the Ambassador bridge from Canada to the U.S. in 2000, when the capacity is assumed to be 315, the research team used difference or 85 For the worst-case scenario, the research team assumed that all trips will be delayed if they occur during an hour when the rated lane capacity will be exceeded; continuing with the above example, all 400 were considered to be delayed in traffic.

[44] Bi-National Study. "Transportation Problems and Opportunities Report", November 2002, pg. 43.

[45] Taylor, John C., Douglas R. Robideaux, and George C. Jackson. "The U.S.-Canada Border: Cost Impacts, Causes, and Short to Long Term Management Options." Report to the Michigan Department of Transportation, the U.S. Department of Transportation, and the New York State Department of Transportation May 21, 2003, pg. 10.

Study.[46] Taylor's estimates also agree with those found in research by Leore, Trent, and Shallow.[47] A complete study of how transit time changes as a result of the amount of traffic using the Ambassador Bridge could be used to develop an analysis of transit time (and delay) as a function of traffic. A detailed discrete event simulation could also help answer this question. Lacking either of these, the research team decided on a rather conservative function with which to estimate delay.

Assuming that our calculations of capacity of the Ambassador Bridge system of 315 trucks per hour moving into the U.S. from Canada is correct, the delay is approximately 90 minutes when demand is approximately ten percent or more of the Bridge's capacity. Based on this repeat evidence, we estimate that transit time increases by thirty minutes when demand is five percent in excess of capacity and by sixty minutes when demand is ten percent in excess of capacity. For each addition increment of demand that is an additional five percent in excess of capacity, delay increases by thirty minutes. We assume that every truck using the Ambassador Bridge is delayed during an hour where demand exceeds capacity. This linear representation of the delay function should be very conservative for very high levels of demand, since delay times increase non-linearly with increasing congestion. At very high levels of demand in excess of capacity, speed of traffic will drop. When speed drops enough, then capacity itself will be reduced,[48] thus further increasing delay. This model appears to accurately model delay as we now see it today and as it was in 2000 on the Ambassador Bridge.

In the long run, drivers and firms will make adjustments to supply chains to avoid a regularly congested border crossing such as the Ambassador Bridge will become in the future[49]. Rail could also be used to take traffic off the Ambassador Bridge or the Blue Water Bridge or both. Unfortunately, most of the alternatives also have significant problems; economically they are all "second best" alternatives to efficient infrastructure spanning the Detroit River.

Diversion to the Blue Water Bridge looks attractive on paper because the Blue Water Bridge has six lanes, compared with the four on the Ambassador Bridge, and can carry trucks in all or most lanes. However, like the Ambassador Bridge system, the Blue Water Bridge system has serious bottlenecks. Truck traffic moving from Canada to the U.S. must move from the right hand lane on the Canadian side to the left lane on the U.S. side to enter Customs booths for commercial vehicles.[50] Currently, only five primary commercial booths exist and the space for secondary commercial inspection is limited for U.S. Customs.[51] Commercial traffic that is cleared by

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[46] Bi-National Study, "Existing and Future Travel Demand Study," Working Paper Executive Summary; pg. 105 using pre Sept 11, 2001 data.

[47] Leore, Bob, Mireille Trent, and Tony Shallow. (2002) "Using Truck Tractor Logs to Estimate Travel Times At Canada-U.S. Border Crossings in Southern Ontario." Report for Policy Group of Transport Canada., pg. 13. Average tachograph time was 34 minutes, while tachograph buffer time was 116 minutes.

[48] Transportation Research Board. *Highway Capacity Manual* (1994). Washington, DC: National Academies Press, pg. 2-29. The effect can also be shown be estimating truck length in relation to speed.

[49] Although the Ambassador Bridge is already congested, we expect that the situation will worsen significantly in the future.

[50] Bi-National Study, "Existing and Future Travel Demand Study," Working Paper Executive Summary; pg. 103

[51] Bi-National Study, "Existing and Future Travel Demand Study," Working Paper Executive Summary; pg. 103

primary Customs inspection must negotiate an S-curve before merging back with automobile traffic bound for I-94 and I-69.[52] Given this awkward layout, it does not appear that the Blue Water Bridge system has adequate capacity to increase commercial traffic dramatically. These problems are similar to the ones discussed above with reference to the Ambassador Bridge.

Increased use of rail either through services such as CPR Expressway or carload traffic could also reduce Ambassador Bridge traffic. However, we must assume that such alternatives would increase costs for shippers, given that rail is not the first choice for moves already moving via truck. We have to doubt the ability of railroads to handle dramatic increases in traffic because most railroads do not maintain much excess capacity. For these reasons, the research team doubts that while a three-hour delay cap – which sets a rather arbitrary ceiling on costs – is realistic; it probably is too low. It does provide a reasonable lower bound for cost, however, and might represent what would happen if problems with crossing the border led to a substantial decrease in manufacturing that depends on cross-border traffic.

IV. The Issue of Border-Crossing Cost

What is the cost of this capacity crisis in dollars and cents?

Reliable and comprehensive data are hard to find on Ambassador Bridge system delays. Data seem to be collected mostly on delays within the border clearance operation rather than on actual queues, measured from the time the truck driver comes to a stop on the public highway on his way to the border. On the U.S. side, border crossing volumes and border crossing delays may push trucks out onto Porter Street and even out onto Interstates 96 and 75, the two main highways funneling traffic into the Ambassador Bridge system.

On the Canadian side, most traffic follows Huron Church Road, as discussed above. This traffic currently begins to back up by 9 a.m. on business days (especially Monday through Thursday) and the backups generally continue throughout the day, clearing only after 9 p.m. Reports on backup length and time-in-queue are anecdotal, with some local radio stations broadcasting estimates regularly. Reportedly, truck traffic backs up to E.C. Row Expressway regularly, and may extend to Talbot Road and beyond under certain circumstances.

The best published measurements we have found were developed by Taylor, Robideaux, and Jackson in the report to three U.S. government transportation agencies in 2003, cited above. This report includes a detailed breakdown of time delays and costs generally across the entire U.S.-Canadian border. Delays include primary and secondary processing, and the report uses the Canada Customs Border Delay Archive Database to document primary delays. The report we obtained does not include measures of time distributions, however; the reported measures are averages only. The report also includes results from a survey Taylor et al. conducted with motor carrier executives, who typically report that they budget two hours for a border crossing. While some carriers and shippers budget far more time (four to six hours are reported) because their freight is so time-sensitive, most seem relatively comfortable with the two hour time window.

[52] Bi-National Study, "Existing and Future Travel Demand Study," Working Paper Executive Summary; pg. 103

The Canada Customs Database reports that the average primary delay in queue at the Ambassador Bridge is 28.82 minutes. The gap between this average delay (only measured once every three hours during busy times and not weighted by the number of trucks crossing in each period) and Taylor's survey of carrier executives, however, reveals that carriers actually budget more than four times as much time as Canada Customs reports to be the average delay.

Methodology

Detailed economic analysis of these crossings, which is necessary to understand the vital role of border-crossing capacity for commercial vehicles, can best be presented using an incremental approach. We define the economic consequences of not building new capacity as the loss in projected Gross Regional Product (GRP) due to the failure to build adequate border crossing infrastructure. The GRP is the value added in the production of goods and services, and the regional analog of Gross State Product (GSP) at the state level and Gross Domestic Product (GDP) for the entire United States; both of these are well-known "value added" concepts.

Insufficient infrastructure capacity, analogous to hardening of the arteries, restricts the flow of raw materials and manufactured goods to companies in southeastern Michigan and southwest Ontario, preventing them from producing the goods and services they would otherwise produce if we provided them with robust transportation capacity. This foregone production represents a long-term loss in value added in the absence of adequate border-crossing capacity.

For the purposes of this analysis, southeastern Michigan includes the three Metropolitan Statistical Areas (MSAs) – Ann Arbor, Detroit, and Flint – as well as the ten counties located there: Genesee, Lapeer, Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne. Southwest Ontario is the region extending from London to Windsor, including Sarnia.

For the purposes of this analysis, the research team has focused its efforts on the manufacturing sector, which is by far the largest user of truck transportation across the Ambassador Bridge. We have not assumed that production of services in the Telecommunications, Communications, Public Utilities, Retail/Wholesale, Finance/Insurance/Real Estate, and Services Sectors would be affected by the lack of new capacity. Services that may be delivered electronically also will not be affected, unless the lack of crossing capacity restricts the supply of cross-border labor[53].

Replicate the Bi-National Study

The first task was to reproduce the Bi-National study so that we could be sure our analysis would use that as our starting point and as a baseline for our analysis. The research team therefore first replicated the results of the Bi-National Study, especially the forecast contained in the Existing and Future Travel Demand Working Paper, in a spreadsheet-based model that would enable us to perform impact assessments and evaluate commodity flows and trips under alternative future growth scenarios. The research team and the Detroit River Tunnel Partnership agreed at the start of the study that the results of the Bi-National Study would serve as a reference point, and also

[53] We do not expect this because the Ambassador Bridge and Detroit-Windsor Tunnel provide adequate capacity for automobile traffic.

the set of baseline forecasts for evaluating the impacts of Detroit River Tunnel Partnership Jobs Tunnel. The resulting model reproduces, at a greater level of detail, the forecasts contained in Section 5.6 "Goods Movement Demand Forecasts," starting on page 164 of the Existing and Future Travel Demand document. We first recreated the results contained in Exhibits 5.20 through 5.29 of the Existing and Future Travel Demand study. Most importantly, these results were replicated very closely in a completely integrated model in which commodity-specific growth rates, truck and rail trips, commodity values, and commodity volumes were simultaneously estimated for 2000, 2010, 2020, and 2030. The approach used in deriving the detailed forecasts was a top-down one in which commodity values were first allocated to crossings by direction, and then assumptions on value per trip and weight per trip were used to derive estimates of the weight of the commodity flow and the number of trips.

Once the overall results of the Bi-National Study were replicated, the following levels of detail were added to our model:

- Commodity flow values and amounts were derived by mode (truck and rail), by direction (U.S. to Canada and Canada to U.S.) and by the six commodity types used in the Bi-National Study (e.g., animal/plant, auto, forest, machinery/electronics, metal, and other) for each of the current crossings, excluding the Detroit/Windsor tunnel.

- Truck and rail trips by crossing, by direction, and by commodity type were estimated for each of the existing crossings, ensuring that the detailed flows and trips when summed closely equaled the totals in the Existing and Future Travel Demand document. These estimates were based on the value per shipment and weight per shipment data, by commodity type, contained in the Bi-National Study.

- The detailed commodity flow and trip forecasts were prepared for both the "No-Build" scenario – defined to consist of the existing crossings, excluding the Detroit/Windsor Tunnel – and for the "Build" scenario, which consisted of the existing crossings plus the Detroit River Tunnel Partnership Jobs Tunnel Project.

- The finished model is a tool that enables the research team to vary such parameters as commodity specific growth rates, the allocation of a single commodity type across the different crossings, and the directional split for a given commodity at a single crossing and then derive revised estimates of truck and rail trips. From the finished model, we created two sets of projections:

  - Detailed Commodity Flows for the "No-Build" scenario, containing forecasts of commodity flow values, weights, and trips by crossing, by direction, by year and by mode on the existing crossings.

  - Detailed Commodity Flows for the "Build" scenario, containing forecasts of commodity flow values, weights, and trips by crossing, by direction, by year and by mode assuming that the Detroit River Tunnel Partnership Jobs Tunnel is built. The same commodity growth rates, commodity flow values and tonnages for the "No-Build" scenario were used, but were then allocated to the larger number of crossing.

Detailed Truck Trip Forecasts

The total number of forecast truck trips by direction for each of the four crossings under the "No-Build" scenario (e.g., Ambassador Bridge, U.S. to Canada; Ambassador Bridge, Canada to U.S.; Blue Water Bridge, U.S. to Canada; and Blue Water Bridge, Canada to the U.S.) were then allocated by day of the week and by hour of the day so that total annual forecast trips were distributed across all 8,760 hours of the year. This analysis was performed for 2000, 2010, 2020, and 2030 and took into account that January 1st of each of these years started on a different day of the week. The Detroit River Tunnel Partnership provided data for fiscal year 2002 on the distribution of truck trips by day of the week, and Exhibit 2.30 of the Existing and Future Travel Demand was used to distribute truck trips by day of the week by hour and by direction. The detailed trips forecasts were needed to estimate delay costs. Once the truck trips were distributed and summed to appropriate control totals, functions were added to determine the number of trips that would occur during hours when the lane capacities of the crossing would be exceeded, and also to estimate delay times.

Delay Cost

The research team used the detailed truck forecasts discussed above to estimate delay costs that would occur on each of four crossing directions based on differing assumptions for:

- Truck operating cost per hour and minute
- Average and maximum delay times, including the ability to cap delay times
- Lane capacities, including the ability to vary them by direction for the both the Ambassador Bridge and the Blue Water Bridge in each of the four forecast years.

After conducting a literature review to determine the estimates used in reputable analyses of delay cost, we decided to use a low cost estimate of US$2.62 per minute and a high cost of US$3.49 per minute. These were based on costs calculated by the U.S. Department of Transportation Federal Highway Administration (FHWA) from a 1995 study estimating a low of US$144 per hour up to US$192 per hour.[54] The costs were converted from 1995 dollars to 2000 dollars using the values in the GDP deflator as contained in Global Insight's August 2003 U.S. macroeconomic forecast. The consumer price index was not used since it is a measure of price increases for a consumer market basket of goods and would not be appropriate for trucking costs. The 1995 US$144 per hour cost became US$2.62 per minute in 2000 current dollars, while the US$192 figure became US$3.49 per minute in current 2000 dollars. Finally, the low and high truck costs in 2000 were escalated to 2010, 2020, and 2030 using the annual growth rate in the GDP deflator from Global Insight's August 2003 long-term U.S. macroeconomic forecast, which turned out to be 2.94% per year.

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[54] Small, Kenneth A., Robert Noland, Xuehao Chu, and David Lewis. 1999. National Cooperative Highway Research Program Report 431; *Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation*; Washington, DC: National Academy Press, pg. 36. See also Maring, Gary and Bruce Lambert, *The Freight Analysis Framework: Status and Future Directions,* Federal Highway Administration, Office of Freight Management and Operations, October 3, 2002, 35. See also ICF Consulting, "Economic Effects of Transportation: The Freight Story." January, 2002, pg. 16.

Total delay costs were then estimated for each of the four years in current dollars using the above escalation rate and then the costs were interpolated for intervening years. Next the total lump-sum present value of the future delay costs was estimated for the year 2000 using a discount rate of 6.454% based on the long-term (20 years or more) bond interest rates that prevailed in early September 2003. Finally, the discount rate was used to annualize the total present value costs in 2000 over the 30-year period.

Interruption Costs

Sound Science, Inc. originally was contracted to perform macroeconomic analysis assessing the value to the regional economy of building the Detroit River Tunnel Partnership Jobs Tunnel Project. During the course of this analysis we became aware of the risk of interruption of service on the current single infrastructure element providing truck access between Detroit and Windsor, the Ambassador Bridge. We released a report on September 5, 2003, which we include as Appendix A of this report.

The purpose of the interruption analysis was to estimate the net loss in value added that could occur in southeast Michigan and Ontario if production had to be stopped in key manufacturing sectors in these two regions (e.g., motor vehicle manufacturing, auto parts, machinery, electronics) because of an extended stoppage in the flow of commodities between the U.S. and Canada in the Port Huron/Sarnia to Detroit/Windsor corridor. As this analysis was being prepared the blackout of August 14, 2003 occurred, causing an immediate halt in production at automobile assembly and parts plants throughout southeast Michigan and Ontario, and more importantly, showing the magnitude of the economic losses that can occur when production in important industries is halted. The research team recognized the individual plants will still be able to continue production for some time after an interruption begins, depending on the amount of inventory they have on hand, and on how dependent they are on commodities flows moving across the border. We also realized that once productive activities resume after an interruption ends, that some portion of the output foregone during the interruption would be made up.

To estimate interruption costs we obtained estimates on the amount of value-added produced annually, and per hour and per day, in the potentially affected economic sectors in southeast Michigan and Ontario. Because of the relatively small size of the London and Windsor economies, and since the Canadian plants that would be potentially affected by an interruption, especially auto assembly and parts plants, are located along Highway 401 from Windsor to east of Toronto, we estimated interruption costs for the Province of Ontario. Value-added was chosen as the metric since it is the regional and provincial analog of GDP at the U.S. and Canadian levels. The research team used Global Insight's Business Demographics Model, and our economic forecasts for the Province of Ontario and for the three MSAs that comprise southeast Michigan, and data obtained by Statistics Canada to estimate value added at the detailed SIC code level in Michigan and at the detailed NAICs code in Canada.

We next identified the manufacturing sectors whose production could be potentially affected by a prolonged disruption based on the commodity flow forecasts by type of commodity contained in the Bi-National Study. We restricted our analysis primarily to the manufacturing sector to avoid double counting and because businesses in services, trade, and Finance/Insurance/Real Estate sectors are much less likely to have to cease operations in the short-run if commodity flows between the U.S. and Canada are halted. Once we had identified potentially affected sectors, we made the conservative decision to use only those sectors in which productive activities would clearly be affected by an interruption. We estimated the net loss in GDP that could occur under interruptions of different lengths, while also varying the amount of foregone production that is permanently lost due to the length of disruption. For example, for very short disruptions on the order of several hours, most plants will have enough inventory on site to maintain production, while for much longer interruptions approaching a month, affected businesses will have the time to make alternative transportation arrangements. Finally, the research team estimated the value of the net loss in GRP in southeast Michigan, and GDP in Ontario using different lengths of outages and varying assumptions of net losses in foregone output by sector; for the latter assumptions the research team relied to some extent on the interviews we conducted in July 2003.

IV. Inventory Costs

We calculate increased inventory cost from delays in the following manner. First we assume that firms will either have trucks leave early or will hold safety stock to counteract delays. The increased inventory cost of having trucks leave early is measured as the average amount of inventory in-transit[55] times some inventory carrying cost factor[56] which is similar to an interest rate. The increased cost of holding safety stock is measured as the maximum delay in hours, times average hourly value of goods moved across the Ambassador Bridge.[57] The resulting product represents the value of inventory held as safety stock and is multiplied by the holding cost factor to determine the cost of holding the inventory. Firms are assumed to have trucks leave sooner if delays are under four hours and to hold safety stock if delays are four hours or more.[58] The following table shows the cost of delays in increased inventory costs.

Table 6: Inventory Cost (US$)

	2000	**2010**	**2020**	**2030**
Ambassador Bridge, U.S. to Canada	$ 0	$2,897,708	$16,393,909	$43,492,364
Ambassador Bridge, Canada to U.S.	$2,562,424	$5,091,409	$21,130,068	$60,245,423
Total Ambassador Bridge	**$2,562,424**	**$7,989,116**	**$37,523,977**	**$103,737,787**

[55] Calculated as maximum delay for the year in hours divided by hours worked per year assuming 7 day weeks and 24 hour days

[56] We use 20% which exceeds the cost of capital, but includes other factors such as risk cost and/or opportunity cost

[57] This is measured as annual value of goods moved for auto, machinery/electronics, and other divided by 52 to get weekly value. This number is multiplied by 17% which is the average weekday value moved as a percent of total weekly volume. This product is then divided by daily production hours assume to be sixteen or two ten hour shifts.

[58] We use four hours because with delays of over four hours, it is very doubtful that trucks could make round trips dependably within the hours-of-service law.

The numbers above are deceptively small. While the cost of holding additional inventory caused by delays to automotive traffic using the Ambassador Bridge are small, the effects of holding additional inventory are more serious. Quantifying these effects is outside the scope of this study. However it is possible to describe what these effects might be and how they might affect future automotive production. The effects can be seen in several areas:

- Inability to store additional inventory due to lack of racks for holding parts
- Inability of plants to store additional inventory efficiently
- Inability to completely plan for all contingencies
- Difficulty of planning increased due to longer lead-times
- Detrimental effect of holding more inventory on continuous improvement

Many automotive parts are stored in special racks to prevent them from being damaged while they are being transported. These racks have substantial cost and are produced in limited numbers at the beginning or the production year. If the supply chain is altered to increase inventory of these parts, either new racks will have to be made or the supply chain will be unable to increase safety stock to control for reduced transit time reliability. To the extent that delays increase quickly, automotive producers will have difficulty keeping matching the number of racks to the amount of inventory in the system.

Japanese plants and newer North American plants have substantially less room for holding safety stock than older North American plants. For this reason, automotive producers may be unable to hold larger amounts of safety stock efficiently. As a solution, parts suppliers may have to establish JIT warehouses next to plants they supply to decouple the movement of parts across the border from their delivery to assembly plants.

While our analysis plans for know effects of increasing truck movement across the Ambassador Bridge, it does not plan for special events. Given the increasing congestion that we see at the Ambassador Bridge, the ability of the Bridge system to recover from extraordinary events will be severely compromised. This suggests that the frequency of abnormal events is also likely to increase, reducing the ability of automotive plants to avoid stockouts of and disruptions to production.

The longer lead-times that we are predicting for the future Ambassador Bridge crossings will also have the effect of increasing lead-time for the entire production planning process. The ability to shorten lead-times for design, production planning and production provides competitive advantage to producers by shortening the cash-to-cash cycle and by decreasing the time to market. The projected delays for the Detroit-Windsor border crossing can do nothing but disadvantage plants that rely on parts that cross the border.

Finally, there are other tactical reasons that plants desire to hold less inventory. *Kaizen* or continuous improvement labels inventory as an enabler of production inefficiency. Many producers reduce inventory, not only to reduce cost of inventory itself, but to force employees to deal with inefficiencies in production. Inventory can hide waste from poor scheduling, machine breakdowns, quality problems, line imbalances, long setup times and other causes.[59] When inventory is limited, then employees have strong incentive not just to fix problems that occur, but also to prevent them from reoccurring.

For these reasons, in the long-run plants with unreliable supply chains will be at a disadvantage compared with plants with reliable supply chains. Given this situation and the current over-capacity in the North American automotive production, it can be expected that plants with substantial disadvantages will be phased out over time. Because the critical mass of automotive production and parts production are on the U.S. side of the border, problems with reliability of the border crossing between U.S. and Canada will likely result in the eventual closure of many plants in Canada. While the timing of this event is difficult to quantify, it could happen in less than a decade given the four-year cycles under which plants are renewed.

Impacts on the Auto Sector in Southeast Michigan

One of the anticipated benefits from the construction of the Jobs Tunnel is that the reduction in delay costs and times will lower transportation costs between southeast Michigan and southwest Ontario, and between the two regions and other parts of the U.S. and Canada, such that existing industries and individual plants now located there will be more likely to remain open. In other words, it is has been suggested that the presence of the Jobs Tunnel will enhance the competitive transportation cost advantage of southeast Michigan and southwest Ontario, both in terms of Just-In-Time (JIT) inventory shipments between the two regions, especially in the important transportation equipment sector, and in terms of inter-regional commodity flows, so that future growth rates of production and employment in key economic sectors will be higher than they would otherwise be. Economic development benefits, in the form of higher future levels of output and employment, could be generated by either higher, positive growth rates, or by lower rates of decline.

It is very difficult to predict how the major industries present in southeast Michigan and southwest Ontario, particularly in the auto manufacturing and auto parts sectors, will respond to a decrease in transportation costs. A detailed survey of decision-makers in the potentially benefiting industry sectors, designed to quantify how they would respond to lower delay costs and times, was beyond the scope of this study. In addition, there are several factors, other than transportation costs, that affect the cost of production in the two regions, and those will determine likelihood of existing plants remaining open. One way to determine the potential significance of a reduction in transportation costs is to determine the share transportation costs in the current total cost of production in key industries. The research team obtained production function information from the 1987 and 1997 Benchmark Input/Output Accounts, published by the Bureau of Economic Analysis, specifically the Use Table, that presents percent share of all the factor inputs used in manufacturing motor vehicles and auto parts.[60] This analysis showed that truck transportation and total transportation inputs accounted for 1.24% and 2.23% of the

[59] Kiyoshi Suzaki; 1987 *The New Manufacturing Challenge: Techniques for Continuous Improvement;* The Free Press; New York, New York; pg. 17

[60] U.S. Department of Commerce, Bureau of Economic Analysis, 2002. Industry Economic Accounts, "Benchmark Input-Output Accounts of the United States 1997." The Use Table - Use of Commodities by Industries Before Redefinition. http://www.bea.doc.gov/bea/industry/iotables/prod/table_list.cfm?anon=222

total producer cost of passenger vehicles in 1997; interestingly these figures were down from 1.62% and 2.59% in 1987. This suggests that transportation costs may be a relatively minor factor in influencing cost of producing a motor vehicle in the U.S. compared to other cost factors such as wages and salaries, benefits paid to workers, energy costs, and other costs. However, a dollar saved has the same positive effect on the bottom line – and on an individual plant's cost of production – as does a dollar reduction in labor and benefit costs, energy, local property taxes, and other costs.

The research team estimated the magnitude of economic benefits that could occur in southeast Michigan if the Jobs Tunnel is built by comparing our baseline long-term economic forecast for the transportation equipment sector with the higher rate of decline that could result in this sector if the Jobs Tunnel is not built. Since Global Insight's economic forecasts are market-driven, they implicitly assume that the market will provide the infrastructure needed to accommodate the forecast growth; in other words our baseline economic forecast for southeast Michigan assumes that infrastructure like the Jobs Tunnel is built. We estimated the future changes in the levels of regional economic activity, such as employment, income, and value added, that would occur if the future rate of decline in employment in southeast Michigan's transportation equipment sector were 25% lower and 50% lower than in Global Insight's Spring 2003 long-term forecast for southeast Michigan. These two lower levels of growth were based our long-term employment forecast for the U.S. transportation equipment sector, prepared in the fall of 2003. The trend, or the most likely scenario, forecasts that U.S. employment in the transportation equipment sector will decline at an average annual rate of -0.69% between 2003 and 2028, while the corresponding value in our low or pessimistic forecast is –0.91%, which is 32% lower than the trend growth rate. We decided to bracket the 32% difference by using growth rate declines of 25% and 50%.

We used both the IMPLAN Input/Output (I/O) model for southeast Michigan, and our State of Michigan forecast model, to estimate the future changes in regional economic activity that would result under the two assumptions of lower future employment growth in the transportation equipment sector. We simulated the change in final demand in our Michigan forecast model by decreasing future employment levels in the transportation equipment sector based on the lower growth rate assumptions, and recorded the incremental differences in regional activity in 2010, 2020, and 2030. We used the IMPLAN output model to estimate the current multiplier impacts of an employment reduction in the transportation equipment sector. The results of the two models were then combined to derive the lower future levels of economic activity in southeast Michigan that would result from lower than forecast growth in the transportation equipment sector.

VI. The Cost of Delay

Based on commodity flow data for shipments between the U.S. and Canada in the Port Huron/Sarnia to Detroit/Windsor corridor the research team identified the economic sectors – all in the manufacturing sector – where production activities were most likely to be eventually affected by lack of capacity.

The Impact on Motor Carriers and Freight Transportation Costs

The value of freight transportation delayed includes both the cost to the trucking company and the cost to the shippers and consignees.[61] A report developed for the National Cooperative Highway Research Program, published by the National Academy of Sciences, finds that the total cost of highway delays to motor carriers is very high. Developed using a survey of motor carrier executives, the report determines that the cost varies from US$144.22 to US$192.83 per hour.[62] This means that in 1995 (the year the data were collected), delays cost carriers between US$2.40 and US$3.21 per minute.

Using our estimate of the system capacity of 395 trucks per hour going from the U.S. to Canada and 315 trucks per hour going from Canada to the U.S., we find that while no U.S.-to-Canada trucks were delayed purely due to Bridge system capacity in 2000, approximately 348,658 Canada-to-U.S. commercial motor freight crossings were delayed just due to Ambassador Bridge system capacity issues in 2000, or 10% of all truck crossings on the Ambassador Bridge. In 2000, delays on Canada-to-U.S. truck crossings began as early as 7 a.m. and continued until approximately 6 p.m. After September 11, 2001, however, the delays on the Canadian side became substantially longer than those on the U.S. side, due to heightened security in addition to traffic flow.

By 2010**,** even with the lane capacity on the Ambassador Bridge from Canada to the U.S. increased to 395 truck trips per hour, approximately 965,400 truck trips will exceed the hourly capacity constraints – almost 69% them on the Canadian side. By 2010 approximately 22.6% of all truck trips on the Ambassador Bridge will exceed the hourly capacities. The number of trips exceeding capacity is forecast to rise to almost 2.58 million by 2020, accounting for 46.4% of all truck trips across the Ambassador Bridge without added crossing infrastructure. Finally, if nothing is done, by 2030 almost 69% of truck trips on the Ambassador Bridge would exceed the hourly lane capacities.

Traffic projections indicate that these delays are concentrated on Monday through Thursday, so the research team calculated projected hourly delays based on these four days. We estimate that in 2010, two trucks per hour will be delayed going from the U.S.-to-Canada at 9 a.m., peaking by 2 p.m. at 19 trucks per hour. As expected, delays from Canada to the U.S. will begin after 8 a.m., and by 9 a.m. about 88 trucks will be delayed, peaking at 2 p.m. with some 134 trucks delayed during that hour on the average workday. Assuming a conservative average length of 60 feet per truck plus 20 additional feet in front and 20 feet behind the average truck and consistent with an observation by Taylor and his colleagues,[63] 53 trucks lined up would stretch one mile. The 10 a.m. backup due to the Ambassador Bridge system alone will average one and two-thirds

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[61] A delay is defined as the period of time that begins when the truck stops somewhere in a queue to get across the bridge and into customs. The source of delay makes no difference to the trucker who is delayed.

[62] Small, Kenneth A., Robert Noland, Xuehao Chu, and David Lewis. 1999. National Cooperative Highway Research Program Report 431; *Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation*; Washington, DC: National Academy Press, pg. 36.

[63] John C. Taylor, Douglas R. Robideaux, and George C. Jackson. "The U.S.-Canada Border: Cost Impacts, Causes, and Short to Long Term Management Options." Report to the Michigan Department of Transportation, the U.S. Department of Transportation, and the New York State Department of Transportation May 21, 2003, pg. 24.

miles long. Backups also are cumulative, so that the backup at 10 a.m. must be added to the additional backup developed during that hour, and at 11 a.m. the backup will be 187 trucks, or more than three and one-half miles long.

If nothing is done to add capacity by 2020, and truck traffic continues to increase, this over-capacity problem becomes nearly gridlocked. We estimate that 3,058,500 truck trips in 2020 in both directions would exceed the lane capacities, accounting for 55% of forecast truck trips. We estimate also that 597,606 Canada-to-U.S. truck trips will be delayed, or more than 20% of all trips. The backups will extend far into Canada and onto U.S. interstate highways, and investment decisions will be affected. Manufacturers and distributors will begin to make strategic relocation decisions that will damage the long-term economic health of this region.

The cost of these delays is quite high. Assuming the estimate cited above of between US$157.20 and US$209.40 per hour for delay cost (in 2000 US$), we have calculated a substantial cost – and inefficiency – for this particular link in the cross-border North American motor freight transportation system[64]. Tables 7 and 8 take this calculation out thirty years; based on the Canada Customs delay data and the TRB published estimates of the cost of truck delay time. We base the cost estimates solely on the conservative Canada Customs average delay data.

The results are striking. Using the Canada Customs delay times for 2001 (admittedly a year after 2000 but more realistic into the future given the unanticipated border delay complications that arose in 2001), we estimate the cost of delay in 2000 at between US$135.6 million and US$180.6 million for the Canada-to-U.S. truck trips alone. The total cost to carriers was between US$150.2 million and US$200.1 million, which must be reflected in unnecessarily high freight rates for cross-border transportation. By 2010 – only about six years from now – the cost to trucking companies (and the cost to shippers whose goods they carry) will have risen to between US$248.7 million and US$331.3 million, most of it incurred in shipping goods to the U.S. These increased costs must be passed on to consumers, and higher prices for Canadian goods likely will lead to reduced demand, lowering both production and employment. By 2020 delay costs will have reached the range of about half a billion U.S. dollars.

[64] Maring, Gary and Bruce Lambert, *The Freight Analysis Framework: Status and Future Directions,* Federal Highway Administration, Office of Freight Management and Operations, October 3, 2002, 35. See also ICF Consulting, "Economic Effects of Transportation: The Freight Story." January, 2002, pg. 16.

Table 7. Ambassador Bridge Delay Times[65] – Low Truck Cost[66] $2.62 per minute (2000 US$)

	Delay[67]	Cap.[68]	Delay Costs by Year				Present Value	
			2000	2010	2020	2030	Total	Annualized
U.S. to Canada	3.3	395	$14,660,000	$23,650,000	$41,700,000	$75,220,000	$365,990,000	$27,890,000
Canada to U.S.	28.8	315	$135,560,000	$225,080,000	$386,300,000	$710,630,000	$3,430,660,000	$261,460,000
Total			**$150,220,000**	**$248,730,000**	**$428,000,000**	**$785,850,000**	**$3,796,650,000**	**$289,350,000**

Table 8. Ambassador Bridge Delay Times – High Truck Cost $3.49 per minute (2000 US$)

	Delay	Cap	Delay Costs by Year				Present Value	
			2000	2010	2020	2030	Total	Annualized
U.S. to Canada	3.3	395	$19,530,000	$31,500,000	$55,550,000	$100,200,000	$487,530,000	$37,160,000
Canada to U.S.	28.8	315	$180,570,000	$299,820,000	$514,580,000	$946,600,000	$4,569,850,000	$348,280,000
Total			**$200,100,000**	**$331,320,000**	**$570,130,000**	**$1,046,800,000**	**$5,057,380,000**	**$385,440,000**

The unpredictability of border delays is a bigger problem yet. Carriers and drivers the research team interviewed, as well as those interviewed by the Taylor team, indicate that border delays can be extremely unpredictable. Not only do carriers suffer the reduction in cycle times reported by Taylor and his colleagues, the typical carrier must build into its schedule a two hour time window or allowance for unexpected border crossing delays. These unexpected delays can be the result of security alerts, collisions or breakdowns on the Ambassador Bridge or its access lanes, closures of customs booths for any reason, or simply unanticipated heavy traffic flow. When a system is as close to capacity as the Ambassador Bridge system – at least from Canada to the U.S. – it does not take a great stimulus to create a substantial queue.

Tables 9 through 14 estimate the cost of this buffer time in net present value and annualized cost. These estimates follow Taylor's research that indicates that between 40% and 60% of all trucks crossing the border build in this buffer, and we further assume that between 35% and 45% of this extra budgeted time is not recoverable. We do not know if carriers build in this delay buffer going both ways or just to Canada, or whether the budgeted delay might vary one direction or the other, because Taylor et al. imply that carriers that build in this buffer do so regardless of direction. This calculation therefore reflects the cost to motor carriers and the business logistics bill that shippers and customers must pay as part of their freight rates.

The estimated delay cost includes the cost of two hours of delay per trip for the fraction of carriers estimated to build in this buffer time, less the fraction of non-recoverable cost. We carry

65 Canada Customs, *Border Delay Archive Database for Commercial and Personal Travel North and Southbound*, November, 2001 – August, 2002.

66 Small et al., op cit., pg. 36. See also Taylor et. al., op cit.

67 Delay expressed in minutes

68 Capacity expressed in trucks per hour

this delay cost out from 2000 through 2030, and provide both total and annualized cost. The total cost is the sum of cost in each reported year and all years in between. The annualized cost, in "net present value," is the annual levelized cost of delay throughout this period, if paid out in equal installments.

The following three scenarios provide alternative estimates, depending on varying infrastructure and logistics strategy assumptions.

Scenario 1

The first two scenarios represent worst-case scenarios. In both, the delay function remains uncapped on the assumption that drivers will continue to wait in line for the Ambassador Bridge, rather than seek alternative methods of getting freight across the border. The first scenario also assumes that no infrastructure improvements of any kind are made during the period up to 2030, including the Jobs Tunnel, other bridges in the immediate region, and the planned Gateway improvements.

Table 9. Scenario One A
Lower Bound for Truck Delay Cost: Truck Trips Exceeding Bridge Capacity

Assumption: No new border-crossing infrastructure built (including Gateway)
Truck Cost/minute: $2.62 per minute (2000 US$)
Delay Times: (30 minutes * % of trucks/hr. > capacity)/. 05
Limit on Delay Times: None
Truck Trips Affected: All trips during hours when forecast trips exceed capacity
Capacity Limits in truck trips her hour

	Delay Costs by Year				*Present Value*	
	2000	**2010**	**2020**	**2030**	**Total**	**Annualized**
U.S. to Canada	$0	$582,273,962	$777,981,033	$4,313,859,787	$6,758,784,126	$515,104,433
Canada to U.S.	$37,096,823	$1,843,471,277	$2,466,458,518	$9,759,564,790	$21,221,020,120	$1,617,308,872
Totals	**$37,096,823**	**$2,425,745,240**	**$3,244,439,551**	**$14,073,424,577**	**$27,979,804,245**	**$2,132,413,305**

Capacity:

U.S. to Canada	395	395	395	395		
Canada to U.S.	315	315	315	315		

Table 10. Scenario One B
Higher Bound for Truck Delay Cost: Truck Trips Exceeding Bridge Capacity

Assumption: No new border-crossing infrastructure built (including Gateway)
Truck Cost/minute: $3.49 per minute (2000 US$)
Delay Times: (30 minutes * % of trucks/hr. > capacity)/. 05
Limit on Delay Times: None
Truck Trips Affected: All trips during hours when forecast trips exceed capacity
Capacity Limits in truck trips her hour

	Delay Costs by Year				*Present Value*	
	2000	**2010**	**2020**	**2030**	**Total**	**Annualized**
U.S. to Canada	$0	$775,624,477	$1,036,318,247	$5,746,324,678	$9,001,930,749	$686,060,443
Canada to U.S.	$49,415,234	$2,455,616,320	$3,285,473,369	$13,000,336,304	$28,267,694,740	$2,154,354,185
Totals	**$49,415,234**	**$3,231,240,796**	**$4,321,791,616**	**$18,746,660,982**	**$37,269,625,489**	**$2,840,414,628**

Capacity

U.S. to Canada	395	395	395	395		
Canada to U.S.	315	315	315	315		

Scenario 2

The second scenario assumes the Gateway is built but no additional crossing capacity is added. In Scenario 2, we assume the Gateway improvements to the U.S. side are made by 2010 and capacity of the Ambassador Bridge system moving from Canada to the U.S. rises to 395 trucks per hour. We also assume no new crossing capacity.

Table 11. Scenario Two A
Lower Bound for Truck Delay Cost: Truck Trips Exceeding Bridge Capacity

Assumption: Gateway built but no new border-crossing lanes; no Jobs Tunnel
Truck Cost/minute: $2.62 per minute (2000 US$)
Delay Times = (30 minutes * % of trucks/hr. > capacity)/. 05
Limit on Delay Times: None
Truck Trips Affected: All trips during hours when forecast trips exceed capacity
Capacity Limits in truck trips her hour

	Delay Costs by Year				*Present Value*	
	2000	**2010**	**2020**	**2030**	**Total**	**Annualized**
U.S. to Canada	$0	$582,273,962	$777,981,033	$4,313,859,787	$6,758,784,126	$515,104,433
Canada to U.S.	$37,096,823	$829,705,608	$1,108,576,491	$5,817,600,195	$10,750,662,164	$819,335,791
Totals	**$37,096,823**	**$1,411,979,570**	**$1,886,557,525**	**$10,131,459,981**	**$17,509,446,290**	**$1,334,440,223**

Capacity:

U.S. to Canada	395	395	395	395		
Canada to U.S.	315	395	395	395		

Table 12. Scenario Two B
Upper Bound for Truck Delay Cost: Truck Trips Exceeding Bridge Capacity

Assumption: Gateway built but no new border-crossing lanes; no Jobs Tunnel
Truck Cost/minute: $3.49 per minute (2000 US$)
Delay Times: (30 minutes * % of trucks/hr. > capacity)/. 05
Limit on Delay Times: None
Truck Trips Affected: All trips during hours when forecast trips exceed capacity
Capacity Limits in truck trips her hour

	Delay Costs by Year				*Present Value*	
	2000	**2010**	**2020**	**2030**	**Total**	**Annualized**
U.S. to Canada	$0	$775,624,477	$1,036,318,247	$5,746,324,678	$9,001,930,749	$686,060,443
Canada to U.S.	$49,415,234	$1,105,218,539	$1,476,691,586	$7,749,398,733	$14,320,538,531	$1,091,405,309
Totals	**$49,415,234**	**$1,880,843,016**	**$2,513,009,833**	**$13,495,723,410**	**$23,322,469,281**	**$1,777,465,752**
Capacity:						
U.S. to Canada	395	395	395	395		
Canada to U.S.	315	395	395	395		

Scenario 3

In Scenario 3, the research team relaxed the assumption that all trucks wait to use the Ambassador Bridge. We cap the maximum delay of every truck at 180 minutes and assume that drivers who anticipate a delay of more than three hours reroute to the Blue Water Bridge. We chose three hours because this is about the delay that trucks might encounter if they diverted to an uncongested Blue Water Bridge before waiting in a substantial backup at the Ambassador Bridge; if the Blue Water Bridge (or other bridges in the Buffalo-Niagara Falls area) becomes congested, adjust estimates upward accordingly. The team expects congestion to increase at the Blue Water Bridge, however.

Table 13. Scenario Three A
Lower Bound for Truck Delay Cost: Truck Trips Exceeding Bridge Capacity

Assumptions: No new truck lanes and truckers divert to Blue Water
Truck Cost/minute: $2.62 per minute (2000 US$)
Delay Times: (30 minutes * % of trucks/hr. > capacity)/. 05
Limit on Delay Times: 180 minutes
Truck Trips Affected: All trips during hours when forecast trips exceed capacity
Capacity Limits in truck trips her hour

	Delay Costs by Year				*Present Value*	
	2000	**2010**	**2020**	**2030**	**Total**	**Annualized**
U.S. to Canada	$0	$575,931,334	$769,506,595	$2,461,707,472	$5,549,837,090	$422,967,450
Canada to U.S.	$37,096,823	$762,052,915	$1,018,185,172	$2,960,596,542	$8,387,011,542	$639,195,859
Totals	**$37,096,823**	**$1,337,984,250**	**$1,787,691,768**	**$5,422,304,014**	**$13,936,848,632**	**$1,062,163,309**

Capacity:

U.S. to Canada	395	395	395	395		
Canada to U.S.	315	395	395	395		

Table 14. Scenario Three B
Upper Bound for Truck Delay Cost: Truck Trips Exceeding Bridge Capacity

Assumptions: No new truck lanes and truckers divert to Blue Water
Truck Cost/minute: $3.49 per minute (2000 US$)
Delay Times: (30 minutes * % of trucks/hr. > capacity)/. 05
Limit on Delay Times: 180 minutes
Truck Trips Affected: All trips during hours when forecast trips exceed capacity
Capacity Limits in truck trips her hour

	Delay Costs by Year				*Present Value*	
	2000	**2010**	**2020**	**2030**	**Total**	**Annualized**
U.S. to Canada	$0	$767,175,708	$1,025,029,778	$3,279,144,685	$7,391,550,820	$563,329,220
Canada to U.S.	$49,415,234	$1,015,101,021	$1,356,284,828	$3,943,695,394	$11,172,011,557	$851,447,919
Totals	**$49,415,234**	**$1,782,276,729**	**$2,381,314,606**	**$7,222,840,080**	**$18,563,562,377**	**$1,414,777,139**

Capacity:

U.S. to Canada	395	395	395	395		
Canada to U.S.	315	395	395	395		

Again, the cost of actual delay is substantial, but the cost of budgeted buffer time is staggering. In 2000, budgeted border delay time was between US$37.1 million and US$49.4 million. If no new capacity is built and the Gateway is not built (worst case scenario) and if we do not artificially cap waiting time, by 2010 this cost will rise to between US$2.5 billion and US$3.2 billion, putting a tremendous strain on U.S.-Canadian trade in general and automobile production in particular. Since a large fraction of auto industry manufacturing consists of parts provided by auto industry suppliers, the cost of automotive components will rise and make Detroit-based automotive production less competitive and increasing the cost of Canadian production dramatically. Were we to delay constructing additional capacity, the total present value cost of transportation delays will be between US$27.98 billion and US$37.27 billion between 2000 and 2030. On an annual basis over this period, the additional transportation costs absorbed by all sectors of the U.S. and Canadian economies that rely on trucking services would range between US$2.132 billion and US$2.84 billion. Global Insight estimates that annualized gross output per worker in the U.S. economy between 2000 and 2030 will be approximately US$236,200 per worker, so that if the increase in annual transportation costs were absorbed entirely by the U.S. economy and resulted in a direct loss in output, employment could be reduced by between 9,000 and 12,000 jobs.

Scenario 2 assumes that the Gateway project is built but the stalemate over new border-crossing capacity has resulted in no Jobs Tunnel. By 2010, the annual cost is between US$1.4 billion and US$1.9 billion. By 2030 the annual cost rises to between US$10.1 billion and US$13.5 billion with a total cost of between US$17.5 billion and US$23.3 billion.

In our most conservative estimate, Scenario 3, in which the Gateway is built but no crossing capacity is built, and capping the delay at three hours on the assumption that trucks will divert costlessly to other border crossings, we find that by 2030 the annual cost still rises to between US$5.4 billion to US$7.2 billion per year. Again, this estimate uses the extremely conservative and somewhat implausible expectation that the Blue Water Bridge does not become more congested due to a secular increase in truck traffic and increased trade, as well as the systematic diversion of trucks from the Ambassador Bridge. It sets a hard lower bound estimate, which itself is extraordinarily costly.

VII. The Impact on the Southeast Michigan Regional Economy

Manufacturing has been declining in the United States for decades, and this is no surprise either to academic observers or to ordinary working people. In fact, while manufacturing accounted for nearly 30% of all jobs in the U.S. in 1950, a steady decline in manufacturing which began in 1950 continues today, with slightly less than 15% of all jobs now in manufacturing.[69] Since manufacturing jobs – especially in automotive production – provide greater benefits to workers in this region, it is important that regional policy to support the kind of infrastructure that will support the manufacturing sector.

Global Insight forecasts that employment in the U.S. transportation equipment sector (including both auto parts and original equipment auto manufacturers) will decline at an annual rate of 0.69% over the next 25 years. By comparison, Global Insight's Fall 2003 forecast predicts employment in the State of Michigan's transportation equipment sector will decline at an annual rate of 1.2% over the next 25 years, a decline of almost 71,400 jobs, just due to increasing productivity, pressure from international trade, and market competition within a saturated market. This forecast assumes that public officials will ensure that adequate transportation capacity is available to support this expansion. As we have shown, this very assumption currently is "on the table" with the debate over construction of new cross-border links. If the Jobs Tunnel is not built, the negative effects will be substantial. If the Jobs Tunnel is built – and built as soon as possible – the region will be able to retain as many jobs as possible, maintaining the estimates that are predicted in the current baseline, because we estimate that between 9,000 and 12,000 jobs will be retained due to the economic activity created by the Jobs Tunnel.

[69] See for example Herzenberg, Stephen A., John A. Alic, and Howard Wial. *New Rules for a New Economy: Employment and Opportunity in Postindustrial America*. Ithaca, NY: Cornell University Press, 1998, pg. 3.

Table 15. Regional Economic Impacts in Southeast Michigan of Further Declines in the Transportation Equipment Sector
Scenario 1: Growth in Employment is 25% Lower than Baseline

Change In:	**Forecast Year**		
	2010	**2020**	**2030**
Trans. Equip. Employment	(500)	(8,000)	(12,777)
% Change from Baseline Forecast	-0.3%	-5.5%	-10.4%
Total Employment	(1,592)	(25,468)	(40,677)
% Change from Baseline Forecast	-0.1%	-0.9%	-1.4%
Total Personal Income*	-$163.51	-$3,449.30	-$1,315.52
% Change from Baseline Forecast	-0.06%	-0.78%	-0.17%
Decline in Trans. Equip. Gross Output*	-$314.5	-$6,850.6	-$15,278.3
% Change from Baseline	-0.30%	-5.53%	-10.41%
Decline in Total Gross Metro Product*	**-$246.1**	**-$5,761.9**	**-$13,083.8**
% Change from Baseline	**-0.09%**	**-1.27%**	**-1.80%**

*In millions of US$

Table 16. Regional Economic Impacts in Southeast Michigan of Further Declines in the Transportation Equipment Sector
Scenario 2: Growth in Employment is 50% Lower than Baseline

Change In:	**Forecast Year**		
	2010	**2020**	**2030**
Trans. Equipment Employment	-4,600	-17,800	-27,778
% Change from Baseline Forecast	-2.8%	-12.3%	-22.6%
Total Employment	-14,591	-56,984	-91,239
% Change from Baseline Forecast	-0.6%	-2.1%	-3.2%
Total Personal Income*	-$1,496.26	-$7,762.47	-$17,016.74
% Change from Baseline Forecast	-0.57%	-1.76%	-2.20%
Decline in Trans. Equip. Gross Output*	-$2,893.0	-$15,242.6	-$33,215.0
% Change from Baseline	-2.80%	-12.30%	-22.62%
Decline in total Gross Metro Product*	**-$2,258.8**	**-$12,873.8**	**-$29,168.3**
% Change from Baseline	**-0.81%**	**-2.83%**	**-4.01%**

*In millions of US$

Economic Impacts of a Change in the Future Growth Trend of Ontario's Transportation Equipment Sector

Ontario's manufacturing industries – especially the transportation equipment sector that is concentrated from Toronto west along Highway 401 to Windsor – are under intense competitive pressure both within the NAFTA trade area, and from foreign auto manufacturers. At present the goods producing sector of the economy (e.g., Agriculture, Mining, Construction, and Manufacturing) in both Canada and the U.S. has little pricing power, due to extremely strong price competition and low commodity prices. As a result, profit and cost margins have been squeezed, causing producers to look for cost savings anywhere they can find them.

The net effect of the Jobs Tunnel on the transportation equipment industry in southwestern Ontario and southeastern Michigan would be to reduce the share of production costs used to obtain transportation services. In other words, automobile manufacturers and parts suppliers need to reduce the percent of producer's price for a manufactured good (i.e., the price received by the producer of an automobile or an auto part at the factory gate) by reducing the share of final production cost allocated for transportation inputs. The primary issue is whether the reduction in transportation costs due to the Jobs Tunnel, including the increase in supply chain efficiency, would be large enough to confer a competitive advantage on the manufacturing industries present in southwest Ontario and southeast Michigan – especially the important transportation equipment sector – so they would have higher future economic growth rates than would otherwise be the case. Similarly, it may also be the case that the construction of the Jobs Tunnel, and the accompanying network benefits, would slow the forecast rate of decline in these manufacturing sectors.

In order to estimate the economic benefits, in the form of higher future growth rates or smaller rates of decline in key industries that could accrue to Ontario and to southwest Ontario when the Jobs Tunnel is built we first must understand the importance of the potentially affected sectors to the Provincial and southwest Ontario economies. For example, in 2002, according to Statistics Canada, the manufacturing sector accounted for 18.5% of total Ontario employment, with the transportation equipment sector alone accounting for 3.9% of total employment with a total of 239,100 jobs. Similarly, in the same year the manufacturing sector accounted for 20.4% of Ontario's real GDP (1997$ in basic prices), with the transportation equipment sector producing 4.7% of real Provincial GDP.

The manufacturing sector is even more important to the economy of the southwest Ontario region near Windsor. For example, according to Statistics Canada, in 2002 the manufacturing sector accounted for 30.8% of total labor force employment in Windsor – a total of 48,900 jobs, while in London the manufacturing accounted for 16.9% of total labor force employment of 36,200 jobs.

In order to obtain a better idea of the importance of transportation equipment sector, Global Insight obtained detailed labor force employment data by three-digit North American Industrial Classification System (NAICS) manufacturing code for the economic areas located in southwest Ontario. This sector had 42.7% of total manufacturing sector employment in 2002 in the London Economic area, and 47.4% of total manufacturing sector employment in the Windsor/Sarnia economic area, accounting for a total of 65,100 jobs in the transportation equipment sector in these two areas. In other words, while 12.7% of Ontario's total manufacturing employment (labor force series) is located in the London and Windsor/Sarnia economic areas; approximately 27.2% of the Province's employment in the transportation equipment sector is concentrated in these two areas.

As the above data make clear, even a modest change in the future growth trend in manufacturing employment in Ontario, especially in the transportation equipment sector, would have significant economic effects on the provincial economy, with effects being concentrated in London, Windsor, and Sarnia. If the Jobs Tunnel is built and improves the predicted and future growth trends in transportation equipment manufacturing, the proportion of the Ontario-wide economic impacts that would occur in the London and Windsor/Sarnia economic areas would be at least equal to their shares of total employment noted above, and likely higher due to the well-established backward linkages of local businesses that provide goods and services used in the production of autos and auto equipment.

In sum, we would expect the Province-wide employment, output, and income multiplier effects of a change in production in the transportation equipment sector to be moderately higher than those presented above for southeast Michigan, since the Ontario economy is more than 1.5 times larger. However in contrast to southeast Michigan where the economic impacts would be distributed throughout the region, the economic effects in Ontario would be disproportionately concentrated in the London, Sarnia, and Windsor areas. We conclude that somewhere between 1/4th and 1/3rd of the changes in economic activity (i.e., employment, income, output, value added, etc.) at the Provincial level would occur in these three areas, depending on the specific auto plants that are affected.

With automotive production so key to this region, every dollar added to the cost of a car will tend to reduce the market for North American automobiles. Table 17 shows that delay costs add nearly US$200 to the cost of a new car in the first ten years of delay. As the cost increases dramatically during each decade of delay, this added cost will be an onerous burden for the auto industry to bear.

Table 17. Delay Cost Impacts on Vehicles Produced in Southeast Michigan & Ontario (US$) [70]

	2000	2010
Delay Costs Ambassador Bridge, Auto shipments, both directions	$ 15,172,058	$ 532,687,831
Units Produced - Autos & Light Commercial Vehicles		
SOUTHEAST Michigan	3,598,261	3,613,591
Canada	2,919,801	2,913,484
Total, Cars & LCVs	6,518,062	6,527,075
Additional Mfg. Cost per Vehicle Produced in Ontario & Southeast Michigan		
If total delay costs affect all cars & LCVs	$ 2.33	$ 81.61
	2000	**2010**
Average Sales Price of New Car (I.e., purchaser price)	$ 29,698	$ 39,912
Average Producers Price	$ 23,625	$ 31,751
Truck Transportation cost if Jobs Tunnel is built	$ 318	$ 427
Truck Transportation Costs if Jobs Tunnel is *not* built	$ 318	$ 508
New Producer Price	$ 23,628	$ 31,832
New Purchaser Price	$ 29,701	$ 40,015
% Increase in Producer Price	NA	0.257%
% Increase in Purchaser Price	NA	0.257%

[70] Estimate limited to 2010 because the Global Insight automobile industry forecast extends only to 2008. Expect similar but large effects in future years as delay times increase in the absence of new infrastructure. Average price of new 2003 cars is US$28,587, which was obtained from www.edmunds.com, June 2003. Because of manufacturers' incentives, the average price of a new car in 2003 was less than that of the average car sold in 2000. Average sales price in 2000 is calculated based on the change in the consumer price index for new automobiles; the index was lower in 2003 than in 2000.

VIII. Economic Benefits from Construction

We estimated the temporary economic impacts during construction in southeastern Michigan using the IMPLAN input/output (I/O) model for the region. We used the capital cost estimates provided by Detroit River Tunnel Partnership, determined the share that would be spent annually in the United States, converted the cost estimates to U.S. dollars, and then performed impact analysis for each year of the construction period. Using the IMPLAN model the research team estimated the total changes in regional economic activity (e.g., output, employment, value added, and labor income) in southeastern Michigan during the five-year construction period.

Methodology of Construction Analysis

The research team estimated the economic impacts that would be produced in southeast Michigan using the IMPLAN input/output (I/O) model for southeast Michigan, which as noted elsewhere consisted of the Ann Arbor, Detroit, and Flint MSAs. The Detroit River Tunnel Partnership provided the research team with information on the total estimated capital cost of the project, in Canadian dollars, including spending by year over the five-year construction period, and the percent shares of construction expenditures in the U.S. and Canada. Since the construction spending would be distributed over a five-year period, Global Insight ran five different simulations of the I/O model to estimate the changes in economic activity in southeast Michigan that would be generated by each year's construction expenditures. We assumed that the final demand change in the IMPLAN model would be in sector 51 – Highway Construction. In order to conduct the analysis, and correctly use the IMPLAN model, the research team converted the cost information provided by the Detroit River Tunnel Partnership to U.S. dollars using the exchange rates that prevailed during the first week of August 2003, then converted the 2003 current dollar estimates to 1999 dollars to align with the base year of the IMPLAN coefficients, and then translated the resulting output back to 2003 current dollars.

At the time this analysis was prepared, an IMPLAN model for Ontario was not yet available, although one is being prepared, so a directly comparable construction impact analysis could not performed for Ontario, let alone for the London and Windsor Census Metropolitan Areas (CMAs). Therefore, in order to get an idea of the potential multiplier effects of a construction project in Ontario, the research team evaluated two other approaches: 1) use Global Insight's econometric model for Ontario to assess the multiplier effects of the construction project, as well as the impacts of declining production in the automobile sector; and 2) estimate economic base employment multipliers for both Ontario and the London and Windsor CMAs. Our review indicated that the Canadian forecast model was not detailed enough to assess fully the impacts of highway construction projects, and the economic base employment analysis yielded an employment multiplier of between 2.5 and 3.0, higher than the 1.78 employment multiplier indicated by the IMPLAN analysis for a highway construction project in southeast Michigan.

We also compared the size and structure of the Ontario economy to the southeast Michigan economy, reasoning that the economic multiplier effects of a construction project in Ontario would be at least as high as in southeast Michigan due to the larger size and diversity of the Ontario economy. The uncertain part of the Ontario analysis was the spatial distribution of the direct, indirect, and induced economic impacts. While most of the Canadian construction workers could likely be obtained from London and Windsor, the small size of the economies of these two CMAs relative to the southeast Michigan and Ontario economies meant that there would more leakage of direct effects out of these cities, so that some of the construction workers would likely come from outside the two cities, but still reside within daily commuting distance; and also that some of the specialized goods and services needed during construction would be purchased in other parts of Ontario.

Based on these evaluations, and the fact that the Ontario economy was considerably larger than that of southeast Michigan, the research team made the conservative assumption that the construction project multiplier effects in Ontario would be the same as in southeast Michigan, although they probably would be higher. The multipliers for employment, output, value added, and labor income derived from the southeast Michigan analysis were then applied to the projected direct construction expenditures in Canada by year to derive the construction economic impacts in Ontario.

Finally, the operational effects of the completed tunnel were estimated using the IMPLAN model using information provided by the Detroit River Tunnel Partnership on the number and wages of permanent workers that hired to work at the completed tunnels, along the annual purchases of goods and services needed to operate and maintain them.

Economic Impact of Jobs Tunnel Construction

The maximum employment impact occurs in Year 3 when a total of 547 full time jobs would be created in southeast Michigan from direct construction expenditures of about US$43 million (Table 18). This increase includes the direct employment effect – the construction workers hired for the project – and the additional employment generated by both the indirect effect – the purchases of construction supplies and materials at local businesses, and the induced effect: expenditures of disposable income by the newly hired workers at local businesses.

Since only about 37% of the construction capital costs will be spent inside the United States, and since Windsor's economic structure is similar to that of Detroit's, we expect the economic impacts in Windsor during the construction phase will be proportionately greater – with total employment increasing during Year 4 by about 900 jobs (Table 21), giving a total employment increase on both sides of the border of 1427 jobs. By way of comparison, Detroit River Tunnel Partnership's data indicate total United States construction expenditures of US$156 million (CN$218.4 million).

Capital Cost

The direct economic impacts of the construction of the Detroit River Tunnel Partnership Jobs Tunnel would include hiring construction workers and the purchase of non-labor goods and services in southeastern Michigan and southwestern Ontario. The temporary increases in economic activity within these two regions during the construction phase will be the sum of: 1) the direct economic effects – hiring construction workers and purchasing non-labor goods and services; 2) indirect effects – the additional demands for goods and services from the businesses in the regions produced by the companies hired to build the tunnels; and 3) induced effects – the increases in employment and income generated by the expenditure of disposable income of the newly-hired construction workers. The size of the temporary increases in economic activity in the two regions during construction and operation will depend on the proportion of direct expenditures that take place within them. Once the Jobs Tunnel begins operating, the direct, indirect and induced economic effects would be permanent.

The Detroit River Tunnel Partnership provided the research team with an estimate of the total capital cost of the project, including expenditures to be made in the U.S. and in Canada, and expenditures by quarter. At the time this analysis was performed in August 2003 the estimated capital cost of the tunnel was $585 million in current 2003 Canadian dollars (Tables 19 and 22), or $419 million in U.S. dollars (Tables 18 and 21).[71] Detroit River Tunnel Partnership estimates that approximately 37% of the total construction cost expenditures will be in the U.S. and 63% in Canada, translating into a total U.S. expenditure of US$156.5 million and total Canadian expenditures of US$262.5 million.

Construction Phase Economic Impacts in Southeast Michigan

Global Insight first estimated the construction-phase economic impacts in southeast Michigan using the following steps:

- Determined the annual total expenditures in the U.S. during the five-year construction period in current 2003 U.S. dollars based on the project quarterly cash flows as estimated by the Detroit River Tunnel Partnership.

- Estimated the total changes in economic activity in southeast Michigan during each year of construction using the IMPLAN input/output (I/O) model for southeast Michigan.

The IMPLAN I/O model was used to assess the impacts because its high level of sectoral detail enabled the construction expenditures to be put into the correct final demand sector; and because the IMPLAN software allows the estimation of an I/O model that is specific to the economic structure of southeast Michigan. Since the total purchases of labor and non-labor inputs will occur over a five-year period, Global Insight performed seven runs of the I/O model, one for each year of construction phase, and allocated the probable purchases of both labor and non-labor inputs to each year based on the labor schedule prepared by the Detroit River Tunnel Partnership. The impacts are stated in current 2003 dollars, with the gross domestic product deflator used to convert results from the IMPLAN model's base year of 1999 to current 2003 dollars. Given the size of the southeast Michigan economy, virtually all of the labor and material inputs required for the U.S. portion of the tunnel should be available with the region. For example, in August 2003, total construction and mining employment in the 3 MSAs that comprise southeast Michigan (i.e., Ann Arbor, Detroit, and Flint) were 117,100 workers, more than sufficient to meet the demands of the project.

The results of our analysis are presented in the table below.

[71] The exchange rate between the U.S. and Canadian dollars has been falling since the middle of the summer of 2003, so the cost estimates in U.S. dollars have risen It is difficult to predict how these exchange rates will vary over the project period and we have not tried to do so.

Table 18. Annual Construction-Phase Economic Impacts in Southeast Michigan (2003 US$)

Year	Expenditure	Output	Value Added	Labor Income	Employment
Year 1	$13,186,667	$20,203,193	$10,176,655	$7,691,097	168
Year 2	$42,708,280	$65,433,029	$32,959,609	$24,909,519	543
Year 3	$42,998,256	$65,877,305	$33,173,736	$25,078,649	547
Year 4	$41,958,220	$64,283,874	$32,380,761	$24,472,049	534
Year 5	$15,672,002	$24,010,955	$12,094,683	$9,140,664	199
Totals	**$156,523,425**	**$239,808,355**	**$120,785,444**	**$91,291,979**	**1,991**

Global Insight estimates the following annual economic impacts in southeast Michigan during the construction period:

- Between 168 and 547 full-time annual jobs will be created, dependent upon the level of construction activity in any given year.
- Total output will rise by between US$20.20 million and US$65.88 million annually, while the annual increase in value added will range between US$10.18 million and US$32.38 million (Table 18).
- Total labor income (consisting of wages & salaries, and income to sole proprietors) will increase by between US$7.69 million and US$25.08 million annually (Table 18).

The total employment increase presented above of 1,991 means that a total of 1,991 person years of new employment would be generated in southeast Michigan during the five year construction phase; annualized this translates an average of 398 additional full-time jobs during the construction phase. The overall temporary increase in economic activity in southeast Michigan would consist primarily of high paying jobs because of the skills required for this complex construction.

The construction impacts in Canadian dollars are presented below.

Table 19. Annual Construction-Phase Economic Impacts in Southeast Michigan (2003 CN$)

Year	Expenditure	Output	Value Added	Labor Income	Employment
Year 1	$ 18,403,312	$ 28,195,575	$ 14,202,540	$ 10,733,695	168
Year 2	$ 59,603,675	$ 91,318,335	$ 45,998,430	$ 34,763,725	543
Year 3	$ 60,008,367	$ 91,938,367	$ 46,297,266	$ 34,999,763	547
Year 4	$ 58,556,892	$ 89,714,575	$ 45,190,590	$ 34,153,192	534
Year 5	$ 21,871,847	$ 33,509,689	$ 16,879,339	$ 12,756,710	199
Totals	**$ 218,444,093**	**$ 334,676,541**	**$ 168,568,165**	**$ 127,407,085**	**1,991**

Activities during the construction-phase of a large project such as the Detroit River Tunnel Partnership Jobs Tunnel require significant expenditures for services such as engineering and design, public outreach and information programs, permitting, and other analysis prior to the time that actual construction activities begin. The Detroit River Tunnel Partnership has already made considerable expenditures in the region that have begun to generate federal, state and local tax revenues. Once construction begins, in year two the pace of annual expenditures will pick up considerably as shown in Table 19, along with the generation of tax revenues. During the construction phase a variety of federal, state, and local tax revenues will be generated; at the state level the most significant of these will be sales taxes, personal income taxes, and corporate income taxes. These tax revenues estimates as produced by the IMPLAN model are presented below, with the major state tax revenue broken out separately.

Table 20. Taxes Generated During Construction from U.S. Expenditures (2003 US$)

Year	Total Federal Taxes	Total State and local Taxes	Michigan Personal Income Taxes	Michigan Corporate Income Taxes	Michigan Sales Taxes
Year 1	$ 3,095,300	$ 714,347	$ 198,145	$ 50,813	$ 229,678
Year 2	$ 7,842,100	$ 2,313,590	$ 641,740	$ 169,939	$ 743,870
Year 3	$ 6,297,000	$ 2,329,298	$ 646,097	$ 165,688	$ 748,921
Year 4	$ 4,382,900	$ 2,272,958	$ 630,469	$ 161,681	$ 730,806
Year 5	$ 378,100	$ 848,982	$ 235,489	$ 60,390	$ 272,967
Totals	**$ 21,995,400**	**$ 8,479,176**	**$ 2,351,941**	**$ 608,511**	**$ 2,726,241**

Global Insight confirmed that the Michigan personal income taxes that would be generated are consistent with recent statistics from the Internal Revenue Service concerning average adjusted gross income levels in Michigan, the share of labor income that would be compensation paid to workers, taxable income as a share of adjusted gross income, and on Michigan's current flat tax rate of 4% on taxable personal income.[72]

Construction Phase Economic Impacts in Ontario

As noted in Table 22, approximately US$262.5 (CN$366.55) million in capital cost expenditures are expected to be made in Canada during the five-year construction period.[73] The spatial distribution of the direct, indirect and induced economic effects generated during the construction period in Ontario will be more disbursed than in southeast Michigan because the economy of the London/Windsor/Sarnia region is much smaller than the economy of southeast Michigan. For example, in 2002 total labor force employment in these two census metropolitan areas (CMAs) was 373,300 workers, only 6.2% of total labor force employment in Ontario and only 14.2% of total place of residence employment in southeast Michigan. Total construction employment in the London and Windsor CMAs in 2002 was 18,700 jobs, or 5.3% of Ontario's total construction employment. In addition, no economic model was available for southwest Ontario. For these reasons, construction phase impacts were estimated for the Province of Ontario, recognizing that the direct employment increases (i.e., the hiring of construction workers) and the induced economic effects (i.e., generated by the expenditures of wages by the new construction workers) would be concentrated between London and Windsor. By contrast, the indirect effects (e.g., demands for additional goods and services generated by the companies constructing the tunnels) will be more widely distributed throughout Ontario depending on the locale of the suppliers.

There is no IMPLAN I/O model available for the Province of Ontario, or for southwest Ontario, although at the time this analysis is being prepared (October 2003), we expect an Ontario model will be available shortly. However, a comparison of the size and diversity of the Ontario economy with that of the southeast Michigan economy shows that the former is significantly larger. For example:

- In 2002, Ontario's payroll employment was 5,105,500 workers, while the comparable employment total for southeast Michigan, based on the BLS establishment or payroll employment series, was 2,541,600 workers, just under 50% of Ontario's.

- Total manufacturing (NAICs-based) employment in Ontario in 2002 was 949,000 jobs, which was 18.6% of total employment. This compares with 427,300 manufacturing jobs in southeast Michigan, or 16.8% of total southeast Michigan employment, but only 45% of Ontario's total.

- Based on the payroll employment data series (SEPH) from Statistics Canada, the London and Windsor CMAs in 2002 had a total of 85,100 manufacturing jobs, or 9% of the Ontario total, but 29.2% of their total payroll employment.

[72] Statistics of Income Bulletin, Spring 2002.

[73] Based on exchange rate prevailing during the first week of August, 2003 of $1 = $1.395 Canadian

- Ontario's 2002 Gross Domestic Product was US$309.6 billion; compared to total regional gross product in southeast Michigan of US$194 billion, which was 62.7% of Ontario.[74]

The larger size and diversity of Ontario's economy means that, at a minimum, the economic multiplier effects produced by the construction expenditures in Canada for the Jobs Tunnel will be at least as large as the effects in southeast Michigan, although they will distributed over a larger area region that extends from Toronto to Windsor. Therefore, Global Insight made the conservative assumption that economic multiplier effects would be the same as in southeast Michigan. Based on this assumption, the annual construction impacts that would be produced in Ontario during the construction phase are presented below.

Table 21. Annual Construction-Phase Economic Impacts in Ontario (2003 US$)

Year	Expenditure	Output	Value Added	Labor Income	Employment
Year 1	$ 12,246,100	$ 18,762,157	$ 9,450,784	$ 7,142,513	156
Year 2	$ 59,246,828	$ 90,771,612	$ 45,723,038	$ 34,555,594	753
Year 3	$ 54,761,920	$ 83,900,326	$ 42,249,562	$ 31,939,784	697
Year 4	$ 70,182,721	$ 107,526,420	$ 54,162,687	$ 40,933,934	893
Year 5	$ 66,032,380	$ 101,167,707	$ 50,959,710	$ 38,513,253	838
Totals	**$ 262,469,949**	**$ 402,128,222**	**$ 202,545,779**	**$ 153,085,078**	**3,338**

Global Insight estimates the following annual economic impacts in Ontario during the peak construction period:

- Between 156 and 893 full-time jobs will be created, with the range of the increase based the level of construction activity.
- Total output will rise by between CN$26.18 million and CN$150.06 million annually, while the annual increase in value-added will range between CN$13.19 million and CN$75.59 million.
- Total labor income (consisting of wages & salaries, and income to sole proprietors) will increase by between CN$9.97 million and CN$57.13 million annually.

Note that in comparison to the flow of expenditures in the U.S., peak construction expenditures in Canada would occur in year four. The total employment increase of 3,339 person years (Table 21), when annualized, means an average annual increase in total Ontario employment during construction of 679 full time jobs. The impacts in Canadian dollars are presented below.

[74] U.S. dollars, using 7/1/02 exchange rate of $1 U.S. = $1.52 Canadian.

Table 22. Annual Construction-Phase Economic Impacts in Ontario (2003 CN$)

Year	Expenditure	Output	Value Added	Labor Income	Employment
Year 1	$ 17,090,657	$ 26,184,466	$ 13,189,514	$ 9,968,092	156
Year 2	$ 82,936,082	$ 126,680,861	$ 63,811,071	$ 48,225,787	753
Year 3	$ 76,425,736	$ 117,091,295	$ 58,963,488	$ 44,575,162	697
Year 4	$ 97,947,005	$ 150,063,872	$ 75,589,446	$ 57,127,398	893
Year 5	$ 92,154,789	$ 141,189,652	$ 71,119,371	$ 53,749,096	838
Totals	**$ 366,554,269**	**$ 561,210,147**	**$ 282,672,889**	**$ 213,645,535**	**3,338**

The extent to which the economic impacts produced during construction are concentrated in southwest Ontario near London and Windsor will depend on two main factors: 1) the share of construction workers hired to work on the project that live in these two cities; and 2) the location of both the construction companies hired to build the Jobs Tunnel and the location of their major vendors. Some construction materials will be purchased locally, such as concrete and construction aggregates; while other specialized materials and equipment likely will be bought outside of London and Windsor.

Economic Impacts During Operation

Once the Jobs Tunnel begins operations, it will generate small, but permanent increases in economic activity in southeast Michigan and southwest Ontario. The Detroit River Tunnel Partnership estimates approximately 165 new, full time employees will be needed on the Canadian side for the customs activities required at the Jobs Tunnel, and that they will create 12 to 15 full-time jobs to operate and maintain the Jobs Tunnel. In addition, there will be annual purchases of goods and services from local businesses by the Detroit River Tunnel Partnership needed to operate and maintain the tunnel. The total estimated annual expenditures, including payments of wages and salaries, fringe benefits, and purchases of goods and services needed for O&M activities is estimated to be about US$10.135 million or CN$14.148 million. The direct effects of operating the Jobs Tunnel – payments of wages and salaries to new workers hired to operate and maintain the tunnel, and the purchase of goods and services need for operation and maintenance (O&M) – would generate additional increases in employment, income, and output through the indirect and induced effects as described above.

The IMPLAN I/O model for southeast Michigan was again used to estimate the permanent increases in regional economic activity that would be produced by the annual increases in employment and expenditures described above. Total wages and salaries were adjusted by excluding to exclude employee benefits, since they are not received as income that is then spent locally, and by considering only the disposable portion of the wages and salaries paid. The table below presents the permanent increases in regional economic activity generated by the operation of the Detroit River Tunnel Partnership Jobs Tunnel. The spatial distribution of the impacts will depend on distribution of the spending between the U.S. and Canada. For example, if 80% of the new employees and 80% of the annual expenditures for O&M activities occurs in Canada, then a similar proportion of the increases shown below would occur in Canada and the remainder in the U.S. Similarly, if half of the new employees hired are U.S. residents, and half of the spending occurs in the U.S., then the total changes shown below would be evenly distributed between southeast Michigan and southwest Ontario.

Table 23. Annual Operations-Phase Economic Impact (2003 US$)

	Expenditure	Output	Employment	Value Added	Labor Income
U.S.	$10,135,000	$10,985,000	294	$5,468,600	$8,942,000
CN	$14,148,000	$15,335,100	294	$7,634,000	$12,484,4000

As the table above shows, the economic impacts directly attributable to the operation and maintenance of the Detroit River Tunnel Partnership Jobs Tunnel will be quite small as a percent share of total economic activity in southeast Michigan and southwest Ontario, but in contrast to the construction-phase impacts, the increases in employment, labor income, and indirect effects will be permanent. The employment multiplier would be about 1.65, as the indirect effects from the purchases of goods and services required for O&M activities, and the induced effects from the spending of wages and salaries by the new workers, will be relatively small. The tax revenue impacts in Ontario and Michigan will also be quite small, and they will depend on the shares of the new workers hired from the U.S. and Canada, and on the distribution of the O&M expenses between the two companies.

The above analysis does not include the economic impacts that would be generated by the hiring of new customs workers on the U.S. side, as this number has not been determined. It would be expected that a similar number of jobs comparable to the Canadian jobs noted above would be generated in the U.S.

IX. Conclusion

The Jobs Tunnel is a critical investment in the future economic well-being of the Detroit Windsor region. In this study, we first established that the two regions have grown and prospered as a result of integrated economies, both of which are substantially driven be the automotive industry. This economic integration has occurred over the last 30 years, during which bi-lateral trade grew faster than the GDP, increasing at an annual rate of 11%. The primary physical commercial link between the regions is the Ambassador Bridge, constructed in the 1920s, and this Bridge now carries fully 25% of the value of merchandise between the two nations.

In the intervening decades since the Ambassador Bridge was constructed, economic realities have changed in many ways. The research team carefully analyzed the ways that the region's economic realities have changed, and how that has affected freight flows between the regions. Clearly, with the Ambassador Bridge operating at about 92 percent of commercial truck capacity as calculated by the research team, freight volumes have grown faster than the fixed infrastructure stock to carry these goods. This inadequate border crossing capacity, measured in delayed traffic, hits the bottom line for the trucker, the producer, the consumer, and the public at large. For the trucker, a minute of delay can cost between US$2.62 and US$3.49/minute (in 2000 US$). By 2030 those minutes of delay realistically could cost truckers between US$17.5 billion and US$23.2 billion in present value terms. Those costs for the trucker, in turn must be passed on or shared with producers and consumers. If the Jobs Tunnel is NOT built, the bi-national regional economies are likely to lose out to regions which attract auto production due to low land, labor and transport costs. The overall negative impacts will be substantial on both sides of the border. Citizens could feel the impacts of a diminished job base in the automotive sector, which in turn will deflate total jobs, total income, and total taxes resulting in an overall diminished gross metro product.

The above facts and figures present both challenge and opportunity, but these economic costs can be reversed with the construction of the Jobs Tunnel. Moving ahead with the construction of the Jobs Tunnel can offset projected economic decline and keep good manufacturing jobs in this region longer. There is an immediate economic benefit of a US$419 million (CN$585 construction project, which leverages a significant amount of private capital to build the Jobs Tunnel. On the Michigan side, between 168 and 547 full time jobs will be created during the construction cycle, and in value-added terms the total southeast Michigan impact is US$120.79 million. On the Ontario side, the project creates between 156 and 893 jobs during the construction cycle and the Ontario value-added impacts amount to CN$282.67 (US$202.55) million. Additionally, by building the Jobs Tunnel and adding critical border crossing capacity, the regions will realize the benefits of pushing back or eliminating delay costs thereby preserving and potentially growing the regional economic base. Furthermore, drivers in the Detroit-Windsor region can enjoy the very real increased safety benefits of having a dedicated truck tunnel directly connected to major highways. Finally for national security objectives, we must have resilient and redundant border crossing infrastructure at North America's busiest crossing.

Indeed, the world and the region have changed dramatically since the Ambassador Bridge was constructed. The Detroit River Tunnel Partnership Jobs Tunnel is a 21st century response to a 21st century global economy, and a 21st century security imperative. The sooner the construction begins, the sooner the region will be poised to compete and grow.

Appendix

Regional and National Economic Analysis of Delay and Delay-Related Costs at the Detroit-Windsor Crossings

Economic Effects of Interruption of Capacity on the Ambassador Bridge

REGIONAL AND NATIONAL ECONOMIC ANALYSIS OF DELAY AND DELAY-RELATED COSTS AT THE DETROIT-WINDSOR CROSSINGS

Economic Effects of Interruption of Capacity on the Ambassador Bridge

Report produced for:

THE JOBS TUNNEL™
DETROIT RIVER TUNNEL PARTNERSHIP

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Introduction

We have been contracted by the Detroit River Tunnel Partnership to study the economic effects of the proposed Jobs Tunnel project on the regions most strongly affected by this potential project: metropolitan Detroit (southwest Michigan) and southwest Ontario (especially Windsor), and Michigan and Ontario. In the course of this research we have become concerned about the possible macroeconomic effect of any interruption of service on the Ambassador Bridge. This concern was validated by the blackout that began on August 14, 2003.

In 2001, the total value of surface trade between the United States and Canada reached US$346.6 billion. The Ambassador Bridge, the Detroit-Windsor Tunnel, and the Blue Water Bridge accounted for 42% of this value (US$147.5 billion)[1]. The Ambassador Bridge alone carried approximately 25% of the value of the merchandise trade between the two nations[2]. Approximately 76% of the value of goods transported between southeast Michigan and southwest Ontario is carried on commercial trucks, demonstrating the importance of these border crossings to both the United States and Canada[3]. There is no doubt that the border crossings in the Detroit-Windsor area are of critical economic importance, and in the post 9-11 world we have learned that these crossings have significant national security implications as well.

Problem Definition

Detailed economic analysis of these crossings, which is necessary to understand the vital role of border-crossing capacity for commercial vehicles, can best be presented using an incremental approach. The economic impact estimation analysis involves consideration of loss to the regional economy measured as the net decline in Gross Regional Product (GRP) – or the value added by production in the region – resulting from loss of production when time-sensitive goods are not able to move across the border in the reliable manner necessary to support supply chains. GRP is the regional counterpart to the nation's Gross Domestic Product (GDP).

Redundancy and the risk of service interruption in commercial vehicle capacity at the border must be addressed analytically. The key trade arteries connecting Detroit and Windsor currently depend on a border crossing infrastructure that is seven decades old. Given the significance of these trade routes, citizens and policy-makers in both countries must evaluate the costs of delays and disruptions in the road network, ranging from major incidents involving infrastructure damage to necessary closures for maintenance, and then address these issues clearly and effectively. The risk of regional and national economic harm is not inconsequential.

Over the past thirty years, bilateral trade in goods and services between the U.S. and Canada has grown faster than GDP, increasing at an annual rate of 11 percent[4], yet no new physical

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[1] "Transportation Problems and Opportunities Report," Bi-National Study, November 2002, pg. 11, Table 2.1. Source of data from the US Department of Transportation, Bureau of Transportation Statistics.

[2] Associated Press. *Transport Topics*. June 23, 2003, pg. 25.

[3] "Transportation Problems and Opportunities Report," Bi-National Study, November 2002, pg. 12. See also Bi-National Study; page S-2, "Existing and Future Travel Demand Study," Working Paper Executive Summary.

[4] Bi-National Study. "Transportation Problems and Opportunities Report," November 2002, pg. 12.

infrastructure has been built to accommodate the growing level of traffic. The level of binational commerce is not likely to abate; rather, Global Insight forecasts it will increase by approximately two and one half times in the next twenty years, with the trade in goods increasing at an annual rate of 5 percent.[5] This is an increase from US$346 billion in 2001 to approximately US$866.5 billion in 2021 in current dollars.

The Bi-National Study determined that since 1995, the value of freight crossings by truck and by railcar have grown at average annual rates of 5.2 and 6.6 percent, respectively. Trucks are now one-fifth of all vehicle crossings at Detroit-Windsor and Port Huron and the volume continues to grow. This suggests that trucks are the mode of choice to accommodate the Just-In-Time (JIT) delivery practices of modern manufacturing in general and the automotive industry in particular.

From an economic perspective, the addition of new truck crossing capacity is fundamental to sustaining the projected trade levels and the economic vitality of the two regions. From an international security perspective, an even a more compelling case can be made for adding secure and redundant border-crossing capacity such as the dedicated truck lanes proposed by the Detroit River Tunnel Partnership.

Disruption Effects

This analysis focuses on the very real risk that the Ambassador Bridge could be taken out of service for some period of time. While the Bridge Company has done an excellent job protecting this infrastructure, no security system is perfect and unforeseen events do occur. Immediately following the terrorist attacks of September 11, 2001, the Ambassador Bridge suffered extraordinary delays of about 12 hours for all commercial traffic for a period of several days, producing immediate and well-documented impacts in the finely-tuned supply chain.[6] *Time* reported the shut down of auto assembly lines from Flint, Michigan to Hermosillo, Mexico as a result.[7] More recently, the August 14, 2003 power outages also halted or delayed traffic for several hours. The resulting impact on the auto industry in southeastern Michigan and southwestern Ontario was sudden and severe, with back ups of up to four miles at the Ambassador Bridge. According to a Reuters report in the *Detroit Free Press*, more than 50 auto assembly plants operated by General Motors, Ford, and DaimlerChrysler in Michigan, New York, Ohio, and Ontario were shut down due to the blackout[8].

While this particular effect was not confined to Ambassador Bridge traffic, the event has caused analysts to consider the effects of a localized shutdown as well. It no longer is unimaginable that major segments of a transportations system can be shut down completely. While all border crossings were affected by these events, we can anticipate scenarios in which physical damage or threats shut down one crossing, causing substantial freight and passenger tie ups associated with a sudden disruption of service and necessary re-routing of freight. Citizens of both Canada and

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[5] Global Insight, Inc., World Trade Service Forecast, 2nd Quarter, 2003.
[6] U.S. Customs Commissioner Robert C. Bonner, speech before the Canadian Association of Importers and Exporters, 10/22/2002.
www.customs.ustreas.gov/xp/cgov/newsroom/commissioner/speeches_statements/oct222002.xml.
[7] Shannon, Elaine, "9/11: One Year Later 'The Inspector'" *Time,* Sept. 9, 2002.
[8] Reuters Newswire. "Power Outage Pulls Plug on Auto Industry." *Detroit Free Press*, Aug. 15, 2003.

the United States now fully understand how choke points in the transportation system can become more than just physical barriers to trade; border crossings have become security vulnerabilities, and are the lynchpin to economic prosperity. This issue of economic security can manifest itself at national, regional and local levels, having personal consequences for every individual in the region, and indeed on the economy of both the United States and Canada.

Disagreeable as it may be to explore the security risks related to a closure of the Ambassador Bridge, it is prudent to do so and in the public interest to analyze the economic repercussions of a threatened or real closure of the Bridge, and to identify the economic costs related to such a sudden disruption. Recent events assure us that not only is another bridge closure possible, it also is probable.

The Economic Cost of Infrastructure Disruption

We define the economic consequences of a disruption as the loss in the Gross Regional Product due to the interruption event. The GRP is the value added in the production of goods and services, and the regional analog of Gross State Product (GSP) at the state level and Gross Domestic Product (GDP) for the entire United States; both of these are well-known "value added" concepts. The basic premise is that an interruption of the flow of raw materials and manufactured goods to companies in southeastern Michigan temporarily prevents them from producing their goods and services. This foregone production represents a potential loss in value added if it cannot be made up at a later time. The eventual net loss in output depends on the share of the foregone production that occurs during the period when truck movements are stopped, offset by the production that is made up at a later time when shipments are renewed.

For the purposes of this analysis, southeastern Michigan is defined to include the three Metropolitan Statistical Areas (MSAs) – Ann Arbor, Detroit, and Flint – as well as the ten counties located there: Genesee, Lapeer, Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne.

In this analysis we estimate the extent to which production is temporarily halted in various economic sectors when flows of six commodity classes stop crossing the Ambassador Bridge. To carry out these estimates, we have examined the likelihood that individual sectors would suffer a reduction or stoppage in production. We have been careful to focus on those sectors where the cessation of commodity flows that are essential inputs into other production processes would cause the stoppage of those other production processes if the flows were disrupted at the border. For example, since auto parts and components flow freely across the border between suppliers and Original Equipment Manufacturers (OEMs), it is clear that if the shipments in the automotive supply sector stop, production in the automotive production sector will eventually stop; similarly, interruption in the flow of newsprint would halt the production of newspapers and magazines. The crucial part of any analysis of the net economic effects of a temporary shutdown – whether it is due to a power outage, dockworker's strike or management lockout, snowstorm, or a 9/11-type event – is the share of the foregone output and sales that is not made up at a later time.

We have been careful to take into account existing inventories on site that companies will have available in the short run to keep producing until the crossings are reopened and trucks begin to flow, so that net loss of output will be less than the potential loss of output. The ability to make up foregone output due to the disruption varies by economic sector based on the types and characteristics of the inputs used in the production process, and by duration of the disruption. For example, those sectors using perishable inputs, such as for food production, will not be able to make up foregone output, while the auto producers may be able to schedule extras shifts when the bridge reopens. While service sector operations – such as the tourist, entertainment, and gaming industries – would not be able to recover much of their lost sales, they are not as dependent in the short-run on the maintenance of cross-border flows of raw materials and manufactured components as are the region's automobile plants that rely heavily on JIT inventory supply systems. For a short disruption, the affected economic sectors are more likely to have enough inventory to maintain production until shipments resume, while for a long disruption they can make alternative transportation arrangements, although likely at a higher cost, or find new suppliers. However, for an in between disruption lasting a week or two, these businesses are more likely to run out of inventory, yet not have enough time to make alternative arrangements. In addition, interruptions of this type often appear to be indeterminate during the period of interruption, forcing businesses to guess about when the bridge might open again, producing an uncertainty cost.

For the purposes of this analysis, we assume conservatively that foregone output occurs only in a manufacturing sector that produces a good. We have not assumed that production of services in the Telecommunications, Communications, Public Utilities, Retail/Wholesale, Finance/Insurance/Real Estate, and Services Sectors stop when the border crossing is shut down. For example, just because the flow of automotive components is halted when the crossing shuts down, it does not mean that auto dealers have to shut down because they still will have an inventory of unsold cars. Over the long run the auto dealers might shut down if the production of autos is reduced, but in the short run they will not. Services that may be delivered electronically also will not stop, though those dependent on unavailable goods or those dependent on unavailable labor may stop. Trucking services will suffer variable effects; initially they will be tied up in traffic waiting to cross or be committed to a routing that is closed. They may then postpone service, hoping that traffic flow will resume, and later take circuitous routes across the limited number of other bridges elsewhere in the region, with a substantial productivity loss. Based on our conservative approach, our judgment is that the net economic losses presented in the tables below probably is on the low side.

We identified affected economic sectors at the 3-digit Standard Industrial Classification (SIC) code level for precision and to prevent over estimation of potential losses. For example, production would likely not stop in all of SIC 37 – Transportation Equipment, just because the crossings are shut down. This sector consists not only of SIC 371 – Motor Vehicles and Equipment, which clearly would be affected by a disruption, but also includes other sectors such as SIC 372 – Air Craft and Parts, SIC 373 – Ship Building, and SIC 374 – Railroad Equipment, all which are less likely to be affected by a disruption.

Disruption Scenarios Considered

In order to reveal the potential costs that closure of the Bridge presents, this report examines potential closures/disruptions of varying lengths of time ranging from:

Four hour disruption
Two day disruption
One week disruption
Two week disruption

Our objective in selecting this range of disruption scenarios was to consider the likely range of potential economic impacts, from short disruptions which are long enough to begin causing production levels to stop (i.e., JIT inventory flows between the region's auto plant are stopped) to disruptions long enough that the affected businesses would be able to make alternative arrangements and begin to increase production levels.

Results

Our analysis of these scenarios demonstrates that the economic impacts from such disruptions, especially longer ones lasting several days or more, could be substantial depending on three major factors:

- The proportion of an economic sector's total productive capacity in southeast Michigan and southwest Ontario that is affected by a disruption (i.e., the proportion of all auto plants affected by a stop in Detroit-Windsor cross-border truck movements).
- The proportion of production that is foregone during the disruption period that cannot be made up at a later time. In other words, while productive activities may be stopped due to a disruption, creating the potential for significant economic losses, the net loss to the region in terms of a decline in GMP or GDP is likely to be less if the foregone output can be made up. In theory, only in a sector operating at full capacity would forego production equal the net loss in value added.
- The extent to which motor carriers may take alternative routes between the U.S. and Canada. This effect is conditioned on the distance traveled along the alternative route and the extent to which the other existing border crossings (primarily the Blue Water Bridge between Port Huron and Sarnia, the Niagra Falls Bridge between St. Catherine's and Niagra Falls, and the Peace Bridge at Buffalo) are pushed beyond capacity due to this rerouting of freight traffic. Pushed well beyond current capacity, and potentially affected by heightened security alerts, these crossings may experience quite extraordinary delays.

As the duration of disrupted trade flows increases from four hours to two days, the impact on the Detroit metropolitan region grows rapidly from US$10.31 million to over US$64.92 million in a net loss of GRP as shown below in Table 1. At two weeks, the disruption, despite the inevitable steps to mitigate the situation would cause a net economic loss of about US$857.44 million in southeastern Michigan's GRP. The net economic loss to the auto industry is US$597.4 million during such a two-week disruption.

Table 1:
Net Loss in SE Michigan Gross Regional Product (US Dollars, SIC Basis) by Major Commodity Flow Class in 2003

	Length of Disruption			
Commodity Class	**4 hours**	**2 days**	**1 week**	**2 weeks**
Animal/Plant	$ 160,000	$ 1,890,000	$ 10,870,000	$ 27,710,000
Forest	$ 240,000	$ 3,540,000	$ 16,100,000	$ 36,450,000
Metal	$ 850,000	$ 5,080,000	$ 21,180,000	$ 67,780,000
Machinery/Electronics	$ 880,000	$ 5,250,000	$ 21,890,000	$ 70,030,000
Autos	$ 7,470,000	$44,800,000	$186,690,000	$597,400,000
Other	$ 730,000	$ 4,340,000	$ 19,210,000	$ 58,060,000
Total	**$10,310,000**	**$64,920,000**	**$275,950,000**	**$857,440,000**

The net loss of GRP in southeast Michigan would decline somewhat after 2 weeks because after several weeks affected businesses would begin to obtain raw materials and components from other suppliers, and they would also begin using other transport modes and routes to receive raw materials and components. However, it is important to note that the affected businesses would incur substantially higher costs if the new suppliers have higher prices. Since we would expect that manufacturers currently are making the most efficient choices, these adaptations will be less efficient economically. We further expect that the alternate transportation modes would be much more expensive and the routes much longer, raising costs further. The extent to which these additional costs are passed along to buyers will depend on the pricing power of the sellers; under current competitive market conditions we expect the affected businesses would be unable to pass much of the additional costs to their customers, thus lowering their profitability substantially and putting greater pressure on product and service suppliers to reduce their prices.

It is appropriate also to note that the actual net losses in GRP in southeast Michigan from a disruption would vary considerably around the figures presented above in Table 1 because we do not know for certain the share of foregone production in each economic sector that would be made up eventually. Similarly, the amount of time that each economic sector would be able to maintain production using on-site inventories before having to reduce output will also vary. Since the automotive sector already is so competitive globally, these drastically higher regional costs would make it even more difficult for them to remain here, risking the loss of more good manufacturing jobs.

In preparing the above estimates of the likely net loss in southeast Michigan's GRP, and the estimates presented below for Ontario, the authors have made the following assumptions:

- Based on commodity flow data for shipments between the U.S. and Canada in the Sarnia to Detroit/Windsor corridor we identified the economic sectors – all in the manufacturing sector – where production activities were most likely to be eventually affected by a disruption.
- We estimated the share of foregone output in each economic sector for each disruption period that would eventually be made up. Our assumptions were generally conservative in that we assumed that no output losses would occur until at least a four-hour disruption, and that except in rare cases (i.e., perishable commodities) that most, but not all, foregone output would be made up.

- We assumed that the maximum impact would occur for a disruption of two weeks. For a shorter disruption some businesses would still be able to maintain production using on-site inventories and supplies. For longer disruptions of a month or more businesses would begin to obtain supplies and raw materials from alternative suppliers and via other transportation modes and routes, thus increasing production levels, though at higher costs.
- We assumed that once the disruption ends, businesses would attempt to recover as much of the foregone production as possible by increasing production rates by extending existing shifts and scheduling additional shifts as necessary. The increase in overtime payments would also increase production costs in the short run.

Looking to Canadian impacts, Table 2 presents estimates for net losses in gross domestic product (GDP) in Ontario from the same disruption scenarios analyzed above.

Table 2:
Net Loss in Ontario Gross Domestic Product (US Dollars, NAICS Basis) by Major Commodity Flow Class in 2003

	Length of Interruption			
Commodity Class	**4 hours**	**2 days**	**1 week**	**2 weeks**
Animal/Plant	$1,010,000	$ 8,370,000	$ 41,080,000	$127,360,000
Forest	$ 700,000	$18,880,000	$ 42,660,000	$ 99,360,000
Metal	$ 990,000	$11,930,000	$ 49,700,000	$159,050,000
Machinery/Electronics	$1,120,000	$13,820,000	$ 58,730,000	$193,460,000
Autos	$ 580,000	$ 6,910,000	$ 28,810,000	$ 92,180,000
Other	$ 660,000	$ 5,540,000	$ 20,410,000	$104,950,000
Total	**$5,060,000**	**$65,450,000**	**$241,390,000**	**$776,350,000**

Table 2A:
Net Loss in Ontario Gross Domestic Product (Canadian Dollars, NAICS Basis) by Major Commodity Flow Class in 2003

	Length of Interruption			
Commodity Class	***4 hours***	***2 days***	***1 week***	***2 weeks***
Animal Plant	$1,400,971	$11,610,027	$ 56,982,068	$ 176,661,056
Forest	$ 970,970	$26,188,448	$ 59,173,686	$ 137,822,256
Metal	$1,373,229	$16,548,103	$ 68,938,870	$ 220,618,255
Machinery Electronics	$1,553,552	$19,169,722	$ 81,464,383	$ 268,348,366
Autos	$ 804,518	$ 9,584,861	$ 39,962,351	$ 127,862,878
Other	$ 915,486	$ 7,684,534	$ 28,310,711	$ 145,576,145
Total	**$7,018,726**	**$90,785,695**	**$334,832,069**	**$1,076,875,085**

As shown above, the net loss in Ontario's GDP would range from a low of US$5.06 million for a four-hour outage up to US$776.35 million for a two-week outage. Once again, we forecast that after 2 weeks the affected sectors in Ontario would increase production levels by purchasing from new suppliers, and by using new transport modes and routes. While production will recover, it will do so at substantially higher cost

The numbers in Tables 1 and 2 are comparable in that they both are based on value added measures – Gross Domestic Product in Ontario and Regional Gross Product in southeast Michigan. However, the figures in Table 1 for southeast Michigan use SIC codes to classify the underlying data – estimates of Gross State Product (GSP) from the Bureau of Economic Analysis are still based on SIC codes, and will not be released in NAICS form until May 2004. By contrast, the Ontario GDP information, which served as the basis for the figures in Table 2 that we obtained from Statistics Canada were estimated on a NAICS basis. In practical terms, the change from SIC to NAICS on the manufacturing sector decreased employment in this sector by about 6.5%; the decline in value added produced by the manufacturing sector would be similar in size. The data in Table 2 were converted from Canadian dollars to U.S. dollars using the currency exchange rate that prevailed on September 3, 2003, 1.3871 Canadian to U.S. dollars.

In addition, we can estimate the effect on the southeast Michigan region because the data for the region are precise enough to allow us to make the calculations. Ontario data are less precise regionally, forcing us to make the estimate province wide. We do know that 291,700 workers are employed in London and Windsor, representing 5.7% of Ontario employment. Manufacturing is concentrated heavily in this region, however, as 85,100 workers are in the manufacturing sector, which is 9% of Ontario manufacturing employment overall. Any shutdown in manufacturing would have an enormous impact on Windsor and London, however, because 29.2% of all employment in and around those cities is in the manufacturing sector, more than three times the concentration of manufacturing jobs throughout the province. While Ontario's economy is more than 50% larger than the economy of southeastern Michigan[9], the impact will be higher and the effects more focused proportionally in southwestern Ontario.

Although these two sets of numbers cannot be combined, strictly speaking, because of slightly different data sources, for purposes of illustration we have done so in Table 3. This gives us an idea of the overall size of this kind of an event and the combined regional effect.

Table 3: Combined Net Loss in SE Michigan Gross Regional Product (US Dollars, SIC Basis) and Net Loss in Ontario Gross Domestic Product (US Dollars, NAICS Basis) by Major Commodity Flow Class in 2003

Length of Disruption

Commodity Class	*4 hours*	*2 days*	*1 week*	*2 weeks*
Anima/ Plant	$ 1,170,000	$ 10,260,000	$ 51,950,000	$ 155,070,000
Forest	$ 940,000	$ 22,420,000	$ 58,760,000	$ 135,810,000
Metal	$ 1,840,000	$ 17,010,000	$ 70,880,000	$ 226,830,000
Machinery/Electronics	$ 2,000,000	$ 19,070,000	$ 80,620,000	$ 263,490,000
Autos	$ 8,050,000	$ 51,710,000	$215,500,000	$ 689,580,000
Other	$ 1,390,000	$ 9,880,000	$ 39,620,000	$ 163,010,000
Total	**$15,370,000**	**$130,370,000**	**$517,340,000**	**$1,633,790,000**

[9] In US Dollars, southeast Michigan's GMP in 2002 was $194 billion and Ontario's GDP was $309.6 billion.

Table 3A: Combined Net Loss in SE Michigan Gross Regional Product (Canadian Dollars, SIC Basis) and Net Loss in Ontario Gross Domestic Product (Canadian Dollars, NAICS Basis) by Major Commodity Flow Class in 2003

	Length of Disruption			
Commodity Class	***4 hours***	***2 days***	***1 week***	***2 weeks***
Animal Plant	$ 1,622,907	$ 14,231,646	$ 72,059,845	$ 215,097,597
Forest	$ 1,303,874	$ 31,098,782	$ 81,505,996	$ 188,382,051
Metal	$ 2,552,264	$ 23,594,571	$ 98,317,648	$ 314,635,893
Machinery Electronics	$ 2,774,200	$ 26,451,997	$111,828,002	$ 365,486,979
Autos	$11,166,155	$ 71,726,941	$298,920,050	$ 956,516,418
Other	$ 1,928,069	$ 13,704,548	$ 54,956,902	$ 226,111,171
Total	**$21,319,727**	**$180,836,227**	**$717,602,314**	**$2,266,230,109**

The figures in Tables 1 and 2 suggest that the net economic effects in both Ontario – especially southwestern Ontario – and southeast Michigan from a disruption in truck flows over the Ambassador Bridge would be similar in magnitude (in terms of both net and proportional losses in RGP/GDP) when exchanges rates and differences in the SIC and NAICS definition of the manufacturing sector are taken into consideration. When we consider the similarity between the structures of the economies of southeast Michigan and southwest Ontario, especially given the importance of the auto sector and related durable manufacturing sector (e.g., industrial machinery, primary and fabricated metal products, glass, and electronic components and accessories), this result makes sense; the production functions would be quite similar. It further indicates the close connection between the economies of these two regions, and the extent to which they are dependent on each other for the efficient movement of commodities back and forth.

Summary Comments

It is clear that the economic effects of a sudden disruption of service on the Ambassador Bridge are complex and present difficult issues of economic interdependency. To some extent, shipment patterns can be adjusted to react to a short-term disruption.

For scenarios with interruptions of two weeks and over, however, manufacturing firms and the automotive industry will take steps to avoid the use of the Ambassador Bridge. Examples would include moving time-sensitive parts by air express or switching to intermodal shipments of finished vehicles using railroad terminals closer to Port Huron and using the Blue Water Bridge as much as possible. The truck traffic that would be disadvantaged the most would be local Detroit-to-Windsor traffic, which must divert to other border-crossing strategies.

We can say for certain that Windsor manufacturing will be economically disadvantaged by longer interruptions. Assembly plants in Windsor and possibly Chatham will be cut off from efficient shipment of U.S. parts and will suffer substantial harm. Assuming some degree of overcapacity in the North American auto industry, the future of automobile assembly plants between Windsor and London would be threatened by long-lasting interruptions in service on the Ambassador Bridge. Likewise, automotive parts plants between Windsor and London would find it difficult to compete against plants that had more reliable supply chains. The loss of a reliable truck border crossing between Windsor and Detroit would likely result in the eventual loss of automotive jobs in Windsor and in the corridor stretching between Windsor towards London.

This analysis conservatively estimates a cost to the region of more than US$1.6 billion if the bridge closes for two weeks for any reason. This cost would directly damage the manufacturing industries on which metropolitan Detroit and southwest Ontario rely, and make them reconsider their cross-border operations. While the scenarios tested here are unlikely, we now know that unlikely events do happen, and redundancy is one way to ensure that the economic dislocation is minimal. Measured against the approximately US$450 million the tunnel would cost – built mostly with private funds and supporting its cost with user tolls – and the case becomes clear. The gamble simply is not worth it.