The Canadian Automotive Market

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Executive summary

The automotive sector is Canada's largest manufacturing sector, accounting for 12% of its manufacturing GDP and 25% of its manufacturing trade. The principal objective of this study is to calculate the impact of changes in Canada's trade policy on the automotive sector. The study is organized in five sections: the first identifies current and future trends in the industry; the second contains an econometric model to analyse the market effects of four trade policy scenarios on automobile production; the third identifies the impact of trade policy on foreign direct investment; the fourth contains an analysis of the market effects of trade policy changes on the aftermarket auto parts sector; and the last section of the study discusses the future direction of the automotive industry.

Current and Future Trends in the Industry

Despite record sales in North America over the past few years, the long-term trend for the automotive industry is weighted towards higher growth rates in less developed economies, particularly China, Korea, Mexico, Brazil, India and Thailand. While global production increased by a factor of six between 1950 and 2004, combined production in Canada and the United States less than doubled over the same time period. Even though Canadian exports of finished vehicles remain very strong, a

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concern is the reliance on the U.S. market. From a policy perspective, there is little Canada can do about this. The export potential for vehicles produced in Canada is effectively driven by the type of vehicles foreign-owned manufacturers decide to produce in their Canadian assembly plants.

The larger growth area for the Canadian automotive industry in recent decades has been in parts and components which, by 2002, had reached 66% of total automotive employment, up from 55% in 1991. Exports of automotive parts, while also very concentrated on the United States, are slightly more diversified than is the case for vehicles.

Market Analysis: Automobile Production

The Model

The econometric analysis of the impact of trade policy on the vehicle assembly sector was conducted in three steps. First, a nested logit model was used to estimate demand at the vehicle level based on seven nests. This model selection results in higher elasticities of substitution between models in the same segment than across segments. Second, the demand model was used to calculate a number of quantities that influence the effect of policy changes including: (i) own and cross-price elasticities for each model with respect to all other models in the market; (ii) unobserved vehicle quality, from the point of view of the consumer; and (iii) the marginal costs for each vehicle that are consistent with the estimated price elasticities of demand and the observed prices. To calculate the elasticities and marginal costs, it is assumed that firms are playing a Bertrand price-setting game (i.e., a specific form of game theory) in differentiated products. Third, using the estimated demand parameters, price-elasticities and marginal costs, simulations of market equilibrium are conducted to examine the impact of elimination of Canada's 6.1% import tariff on non-NAFTA vehicles.

There are four trade policy changes simulated using this model: (i) an FTA with South Korea; (ii) an FTA with Japan; (iii) an FTA with the European Union (E.U.); and (iv) unilateral abolition of the Canadian tariff on imported vehicles. An FTA is assumed to include the elimination of tariffs on imports from the partner country.

An FTA with Korea: The results of the model's application to elimination of tariffs with Korea is a decrease in average prices, an increase in average mark-ups for Korean firms and a slight decrease for foreign firms, and an increase in aggregate vehicle sales. In the end, Korean imports are estimated to increase by 9.72%, while all other foreign suppliers lose. As well, production in Canada declines by 0.53%.

An FTA with Japan: While the analysis of an FTA with Japan is similar to that of an FTA with Korea, one notable difference is that, due to compositional effects, i.e., sales shifting upmarket as prices decrease, the average sales-weighted Japanese price ends up higher with an FTA. Another is that the largest effect of this FTA would be a 3.14% decrease in imports from the E.U. because they compete with Japan-made cars in all luxury segments. In the end, Japanese imports are estimated to increase by 15.11%, while production in Canada falls by 0.94%.

An FTA with the E.U.: Due to the higher demand elasticities of the median European car in every segment, an FTA with the E.U. brings even stronger compositional effects than an FTA with Japan. In this scenario, the average price is estimated to increase as the generally expensive European vehicles gain market share. The increase in imports from the E.U. is estimated at 28.32%, while Canadian production is estimated to decrease by 0.74%.

Unilateral Tariff Elimination: Under unilateral tariff elimination by Canada, Canadian production is estimated to decline by 8,668 units annually (2.16%). While this is not nearly enough to noticeably impact assembly plant capacity decisions, no doubt employment would be affected, including in supplier plants, and some workers would face transition costs. In addition, while Korea, Japan and the E.U. all benefit under this scenario, the import gains go disproportionately to the E.U., which sees its imports increase by almost 24.53% versus only 7.68% for Korea.

As demonstrated in the following table, there are increases in consumer surplus that would accrue in each of the above scenarios. However, overall domestic welfare is estimated to decrease marginally in each case. This is mainly due to the large decreases in government tariff revenues.

	FTA with:			Unilateral Tariff Elimination
	Korea	Japan	E.U.	
Aggregate effects on:				
Price (average)	-0.35%	-0.27%	0.95%	0.30%
Demand	0.25%	0.53%	0.45%	1.22%
Canadian production[1]	-0.53%	-0.94%	-0.74%	-2.16%
Imports	0.52%	1.04%	0.86%	2.37%
Consumer surplus	0.28%	0.60%	0.51%	1.37%
Tariff revenue	-21.83%	-44.84%	-36.62%	-100.00%
Domestic welfare	-0.04%	-0.04%	-0.02%	-0.08%

[1.] refers only to Canadian production of vehicles sold in Canada

Foreign Direct Investment

While a tariff on final vehicle imports provides incentives for foreign firms to establish local production capacity to avoid the tariff, current tariff levels are sufficiently low and the overcapacity in the market sufficiently large such that no significant investment impact would be expected from any of the scenarios analysed in section two. In addition, the probability that any firm will expand assembly capacity in North America beyond the currently announced plans is relatively small. In terms of potential expansion of Canadian exports of finished vehicles, this is also small. Large export volumes from Canada to the rest of the world also seems an unlikely proposition, in part due to likely increases in exports from low wage countries, only a marginal phenomenon for the moment.

Market Analysis: Aftermarket Auto Parts

In order to assess the impact of trade policy changes on the more diverse parts and components sector, a number of methodologies are used to estimate demand and supply elasticities. Simulations are then conducted to examine the impact on Canadian exports in the event of FTAs with China, South Korea and the E.U. The estimated changes in Canadian exports of automotive parts range from 10.4% to 22.2% for an FTA with China; 8.4% to 11.6% for an FTA with South Korea; and 3.4% to 7.9% for an FTA with the E.U. in view of the fact that current trade protection for the parts sector in Canada is very low. If giving up the limited protection that exists would result in lower overseas trade barriers (which tend to be higher), the net effect would likely be positive.

Future Directions and Concluding Comments

There are many factors that are likely to affect the future direction of the automotive industry in Canada, including: the types of fuels that cars will be using; whether current trends towards keeping manufacturing close to the location of the final customer remain constant; future sales volumes in North America; the location of research and development; and government policy. However, among the limited areas where government intervention may have an effect on the automotive sector, intervention in the area of trade policy is likely to have a more limited net effect on welfare than alternatives such as investment, research and development, and infrastructure support.

The study concludes that changes to Canada's trade policy would have a minimal net impact on Canada as a whole. In particular, while elimination of Canada’s automotive tariff may have a modest impact on Canadian production, these losses are expected to be offset by consumer gains.

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1. Current and future trends

This section analyzes and documents current trends in global production and trade in the auto industry, examines Canada's position (competitiveness and technology leadership) in the global and North American auto markets, and identifies emerging trends and issues in the industry that require policy-makers' attention.

1.1 Canada's automobile industry

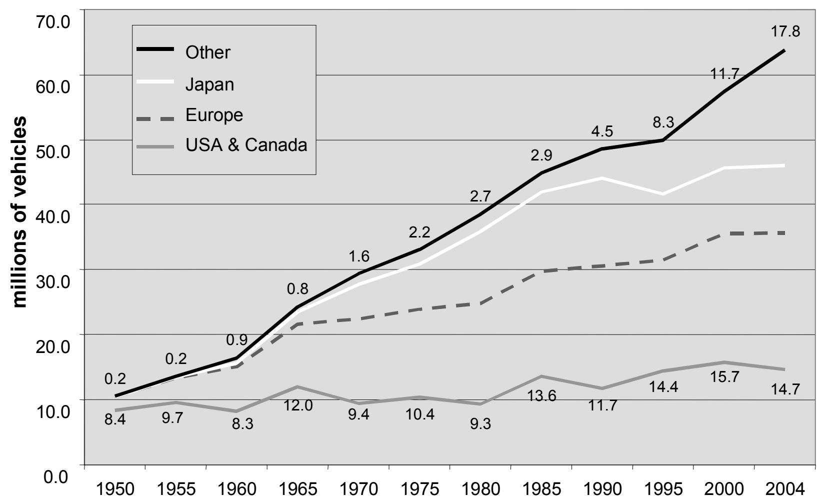
1.1.1 Current situation

Even though the automotive industry in North America is going from one bumper sales year to the next, the long-term trend for the industry is weighted towards higher growth rates in less developed economies. Figure 1A plots the cumulative global production of cars and light trucks, split by region. While global production increased by a factor of six between 1950 and 2004, combined production in Canada and the United States less than doubled over the same time period: average production between 1990 and 2000 was approximately 50% higher than between 1950 and 1960. In 2004, the last year of data in Figure 1.1A, production in Canada and the United States stood at 14.7 million vehicles, approximately the same as the average for the latter half of the 1990s and approximately equal to the combined output of all non-traditional producers (the rest of the world minus North America, Europe, and Japan).

The same production statistics for each region are plotted in Figure 1.1B as a fraction of global output. The declining relative importance of Canada and the United States is put in stark perspective. While these two countries accounted for almost 80% of world output in 1950, this declined to 24% in 1980. The subsequent establishment of North American assembly plants by foreign producers stabilized, even increased slightly for a while, the North American share of world output, which currently stands at 23%[1].

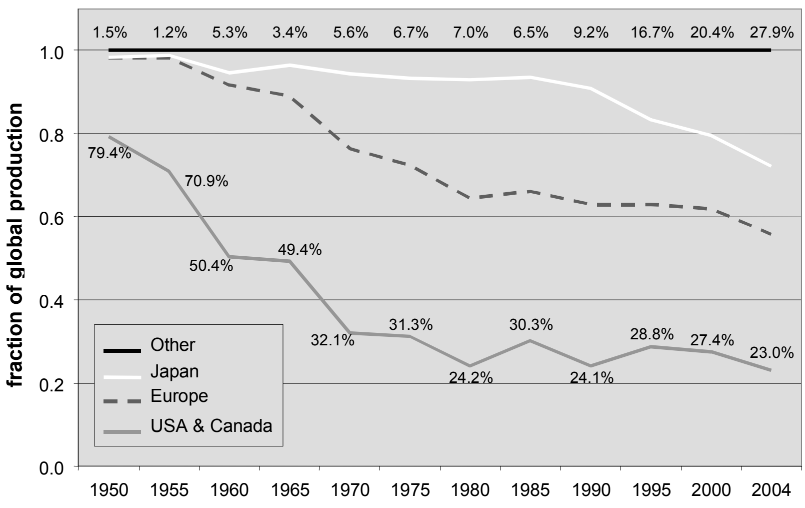
[1] Note that the higher average value of vehicles produced in North America gives the region a higher relative weight in value terms.

Figure 1.1A: Light vehicle production by region (million vehicles)



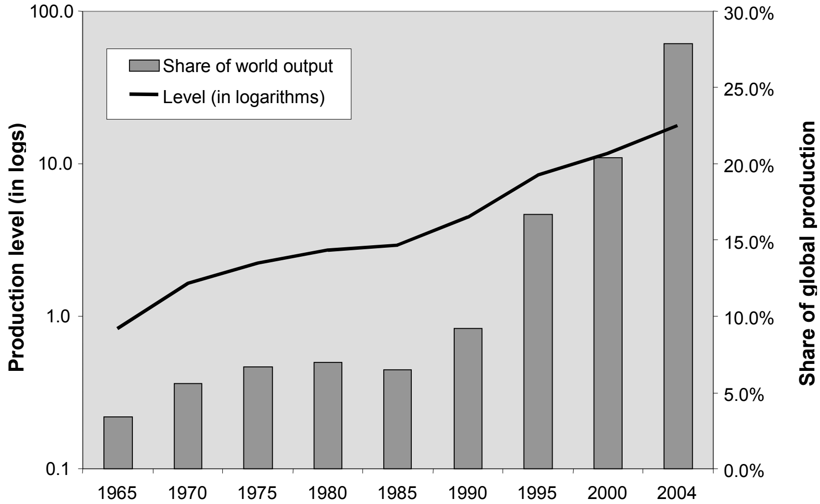
Source: Ward's World Motor Vehicle Data Book (2005)

Figure 1.1B: Light vehicle production by region
(fraction of worldwide total)



Source: Ward's World Motor Vehicle Data Book (2005)

Figure 1.1C: Light vehicle production by non-traditional producers (countries)



Source: Ward's World Motor Vehicle Data Book (2005)

In the first 15 years after World War II, the fastest growth took place in Europe, which quickly doubled its share in world production. Subsequently, its relative importance declined somewhat, but the decline was cushioned by the more recent rise of Eastern Europe as a lower-cost manufacturing base.

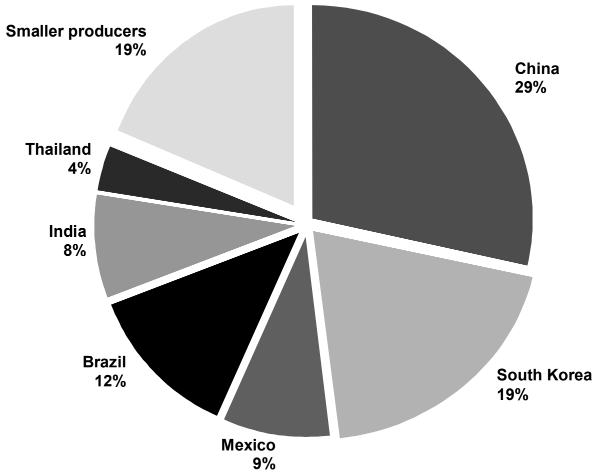
Over the next 20 years, from 1965 to 1985, Japan increased its share of world production of light vehicles from 3% to 29%. In contrast with the North American and European experience, Japan's production increase was largely export driven. Import tariffs and quotas in Europe and voluntary export restrictions in the United States led Japanese producers to open up assembly plants in all their major export markets, lowering the share of Japan in world production to approximately 17% recently. The spectacular appreciation of the yen was an additional incentive for Japanese firms to establish production capacity overseas.

Finally, in the last seventeen years, most of the output growth was in non-traditional car producing countries. While the first three regions saw their combined output fluctuate between 42 and 46 million vehicles with no noticeable trend, production in the rest of the world increased from 2.9 million vehicles in 1985 to 17.8m in 2004. This represents a six-fold increase in output over 19 years or a sustained annual growth rate of more than 10%. As a result, these countries produced more than one quarter of all vehicles worldwide in 2004, and this fraction has increased further in the last two years. To illustrate the importance of the output increase in these countries, Figure 1.1C plots their production level in logarithms (left scale) and their share in world output (right scale) over the last 39 years. Output growth in these countries has been remarkably constant at a very high level. All indications are that this trend will continue in the near future.

The composition of the group of "other countries" is illustrated in Figure 1.2, where the percentages indicate the share of production of each country in the group in 2004. The six most important producers are China, South Korea, Mexico, Brazil, India, and Thailand. In the last 3 years, the importance of China, and to lesser extent India, has increased further. Smaller producers are all countries producing less than 350,000 vehicles per year. One notable fact is that net exporters dominate the group of "other countries". All of the six countries depicted have higher production than domestic sales. Among the smaller producers, only Argentina is an important net exporter. Furthermore, with the exception of Brazil, the largest producers are also the countries with the fastest output growth. Given the high scale economies in vehicle production, it is no surprise that production is relatively concentrated even among emerging countries.

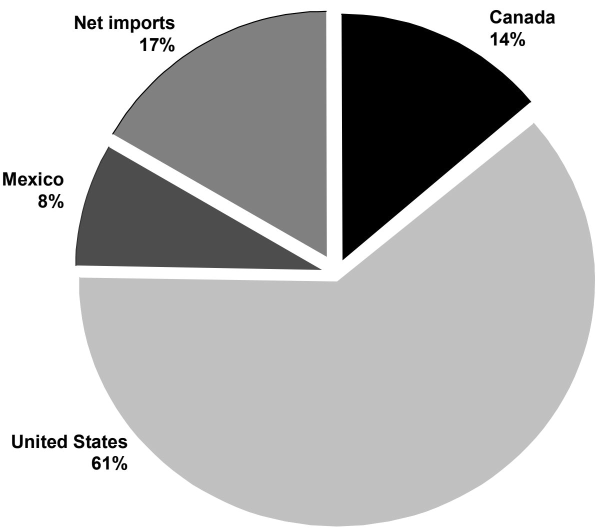
Focusing on the North American market, total sales in 2002 stood just under 20 million vehicles, at 19,487,556. The origin of the vehicles is depicted in Figure 1.3. While the United States accounts for almost 87% of North American sales, only 61% of vehicles are produced in that country. Foreign imports are the second most important source and Canadian production is slightly lower. Mexican production is the least important source, accounting for less than 8% of North American sales, but is growing rapidly. Almost half of all vehicles assembled in Mexico are exported and this fraction is increasing.

Figure 1.2: Composition of the group of 'other countries' (fraction in the group's output in 2004 is indicated)



Source: Ward's World Motor Vehicle Data Book (2005)

Figure 1.3: Origin of vehicles sold in North America (2004)



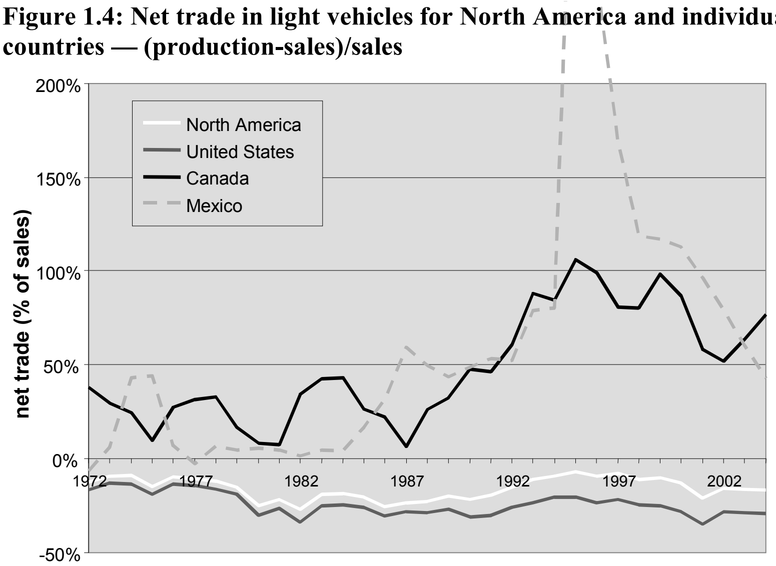
Source: Ward's Automotive Yearbook (2005)

The evolution of international trade on the North American content is also instructive. As a region, North America is running a trade deficit in vehicles that is relatively stable over time. In Figure 1.4, this is depicted by the white line. From 1972 to 2002, imports of finished vehicles fluctuated between 4.6 million units (in 1986) to a low of 1.1 million (in 1995). Net imports as a fraction of sales fluctuated between 10% and 20% in most years. North American exports are relatively unimportant and fluctuations in imports determine the trade balance almost completely. Imports started to decline in the mid-1980s when foreign producers opened their first assembly plants on the continent. In 1982, the year Honda opened its first U.S. plant, 27% of all vehicles sold in North America were imported. This declined to a mere 6.9% in 1995, after which it started to increase again, in line with the rising U.S. trade deficit for the entire economy.

The pattern for the continent as a whole is driven by the United States, which runs an even larger deficit than the region. In Figure 1.4, the blue line for the United States lies everywhere below the white line for North America. The mirror image is trade surpluses by Canada and Mexico. After the establishment of the Autopact in 1965, the Canadian industry integrated completely with the U.S. industry. Between 1972 and 1988, the trade surplus fluctuated between 7% and 43% of Canadian sales, which corresponds to an average net export of 320,000 vehicles, the vast majority to the United States. After the establishment of the Free Trade Agreement with the United States (in 1988) Canadian exports surged, even surpassing domestic sales in 1995 with the expansions of the Honda and Toyota plants coming on steam. Since then, Canadian exports have returned to normal levels, which are still 50% of domestic sales or almost 1 million vehicles.

Closures of assembly facilities in Bromont by Hyundai (1993), in Halifax by Volvo (1998), in Ste. Therese by General Motors (2002), the Pilette Road plant in Windsor by Daimler-Chrysler (2003), and the Ontario Truck plant in Oakville by Ford (2004) reduced Canadian production subsequently. The recently announced closure of the Oshawa 2 plant (2007) and the elimination of the third shift in the Oshawa 1 plant (2006), both by General Motors, will reduce production capacity more than the newly announced assembly plant that Toyota will build in Woodstock (2007). However, it should be noted that increased production at existing plants is likely to lead to stable production levels, as forecasted by CSM.

Figure 1.4: Net trade in light vehicles for North America and individual countries — (production-sales)/sales



Source: Own calculations based on Ward's Automotive Yearbook (various years) and Ward's World Motor Vehicle Data Book (2005)

Mexico has done particularly well, even before the North American Free Trade Agreement took effect in 1996. Its exports grew from less than half a million vehicles when NAFTA was negotiated to over one million vehicles by 2000. This export growth is in sharp contrast with domestic sales which collapsed in 1995-96 (hence the sharp increase in Figure 4), but which have returned to the trend growth path since. Mexican sales increased by 5% per year on average over the last 25 years, only slowing to 3.6% in the last 10 years.

While the Canadian automotive industry has performed well in terms of final vehicle production, the growth rate in components has been even more remarkable. This shows up most clearly in the employment figures for the final assembly sector versus the parts and components sector. Table 1.1 has the employment numbers for the two sub-sectors in 1991 and 2002. The employment share of parts and components in the automotive total grew from 55% in 1991 to 66% in 2002. In Section 1.2, on the vertical organization of the industry, we will discuss the parts sector in greater detail.

Table 1.1: Manufacturing employment in the Canadian automobile industry

	Employment	
	1991	**2002**
Vehicle assembly	53,300	51,000
Parts and Components	65,400	98,100

Source: Industry Canada

Thus far we have discussed the Canadian automobile industry by itself and in relation to the rest of the worldwide automotive industry. It is worthwhile to stress its importance for Canadian manufacturing. Industry Canada estimates that the entire industry employs more than half a million employees in Canada: 171,002 people in automotive assembly and component manufacturing, and another 333,529 in distribution and aftermarket sales and service. Manufacturing is clustered in central Canada, in the heart of the North American auto industry, while distribution is spread across the country. It is Canada's largest manufacturing sector, accounting for 12% of the sector's GDP and 25% of manufacturing trade[2]. In 2003, Canada had an overall automotive trade surplus of $4.6 billion on flows totalling $159.1 billion. Total industry shipments stood at $69.3 billion in vehicles and $31.4 billion in parts in 2003. Production, especially in the final assembly sector, but to a lesser extent also in parts, is concentrated in South-western Ontario.

[2] Industry Canada, *Canada's Automotive Industry 2004*, http://strategis.ic.gc.ca/epic/internet/inauto.-auto.nsf/en/am01722e.html

1.1.2 Future outlook

Even though Canadian exports of finished vehicles are very strong, a concern is the reliance on the U.S. market. Figure 1.5 illustrates that the vast majority of Canadian vehicle exports (HS code 8703) are destined for the United States. The graph on the left illustrates how dominant the U.S. market is, accounting for more than 98% of Canadian exports. Imports, on the other hands, are less concentrated as Japanese, Korean, and Mexican imports have grown from 26% in 1998 to almost 40% in 2004. The graph on the right illustrates the same export numbers, normalizing the 1998 levels to 1. Exports to other countries, the white line, increased noticeably, although from a very low base.

From a policy perspective, there is little Canada can do about this. The export potential for vehicles produced in Canada is entirely driven by the type of vehicles the (foreign-owned) producers decide to allocate to their Canadian assembly plants. In this respect, it is very encouraging that several Canadian plants have received the world mandate for the vehicle(s) they are assembling, meaning that no other plant produces the same vehicle.

Exports of automotive parts (HS code 8708), while also very concentrated on the United States, tend to be slightly more diversified. Throughout the 1998-2004 period, the share of Canadian parts exports going to the United States was constant around 91%. Total parts exports grew substantially over this period and exports to other countries outpaced U.S.-bound exports (see the right graph in Figure 1.6).

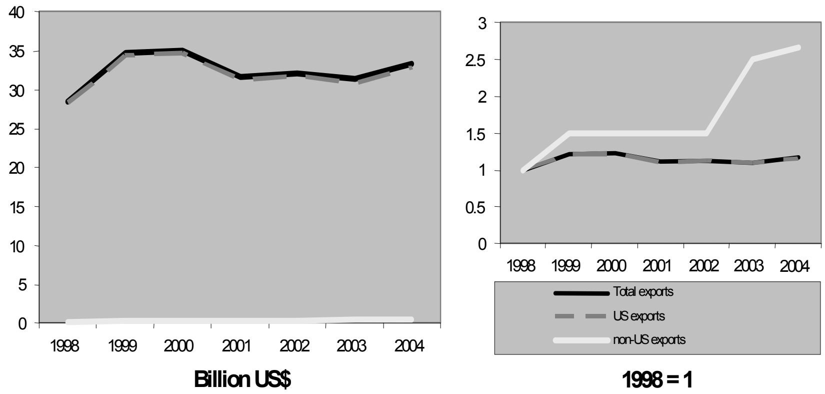
In 2004, exports of parts to non-U.S. destinations were worth US$896 million, almost twice the value of vehicle exports outside the United States. Moreover, while Canada had a large and growing trade deficit in vehicles with the rest of the world (excluding the United States), its trade deficit in parts declined from US$1,090m in 1998 to US$800m in 2003, although it recently jumped back up to $1,028m (in 2004).

Even for parts, the United States is by far the most important partner and the concentration of Canadian exports is increasing over time. Table 1.2 indicates that, even though the share of parts exported to the U.S. declined only marginally from 92.5% in 1993 to 91.6% in 2004, the share of the other important export destinations increased noticeably. The five most important export destinations now account for 99.2% of Canadian parts exports. The increase is most visible for exports going to other countries (excluding the U.S.). Compared with the production statistics in Section 1.1.1, Canadian parts exports are clearly more concentrated than worldwide production. In particular, exports to Europe and Japan are much lower than expected.

The ongoing FTA negotiations with Korea could result in a more favourable import regime for Canadian parts and vehicles and increase Canadian exports to that part of the world. The recently started trade talks with Japan would work towards the same goal in Japan and the Free Trade Area of the Americas could increase Canadian exports to Latin America as well. Given the low level of trade protection, at least in terms of import tariffs, only moderate effects are expected from these initiatives. The concentration in the industry means that individual firm decisions are likely to determine the trade flows and balances. For example, as long as GM was exporting body panels to its Buick plant in China, Canada was running a large trade surplus with China. The end of these exports in 2004 instantly almost halved Canada's exports to China[3]. In terms of trade policies, all changes are in the right direction, we just expect them to be of second-order importance.

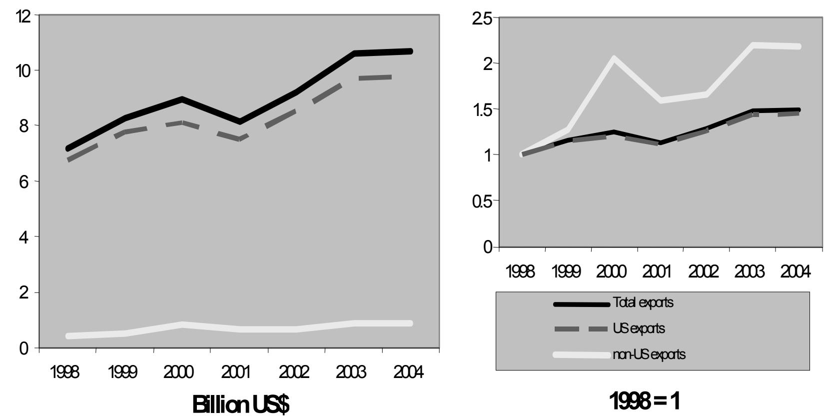
[3] The Asia Pacific Foundation of Canada, (2005) "The East Asian Automobile Industry: Opportunity or Threat?"

Figure 1.5: Canadian exports of finished vehicles (billion US$ left, 1998=1 right)



Source: U.N. Comtrade data set (online)

Figure 1.6: Canadian exports of automotive parts and components (US$ left, 1998=1 right)



Source: U.N. Comtrade data set (online)

Table 1.2: Origin and destination of trade in parts and components (fraction of total)

	Imports			Exports	
	1993	**2003**		**1993**	**2003**
USA	0.857	0.875	USA	0.925	0.916
Share of trade excluding the U.S.			**Share of trade excluding the U.S.**		
Japan	0.451	0.427	China	0.196	0.562
Mexico	0.300	0.257	Mexico	0.208	0.213
E.U.	0.177	0.165	E.U.	0.119	0.092
China	0.002	0.054	Japan	0.085	0.039
Korea	0.033	0.030	Latin America	0.060	0.037
Latin America	0.018	0.026	Australia	0.194	0.019
Eastern Europe	0.001	0.012	Eastern Europe	0.022	0.015
India	0.001	0.007	Other Asia	0.022	0.007
Australia	0.014	0.006	Korea	0.005	0.004
Thailand	0.001	0.006	Thailand	0.000	0.002
Other Asia	0.000	0.005	India	0.001	0.000
Rest of the world	0.007	0.041	Rest of the world	0.090	0.009
Top 5 (overall)	**0.994**	**0.988**	**Top 5 (overall)**	**0.979**	**0.992**
Top 4 (non-US)	**0.961**	**0.903**	**Top 4 (non-US)**	**0.717**	**0.906**

Source: U.N. Comtrade data set (online)

Mexico, the second most important trading partner for Canada in 1993, is now surpassed by China, where more than half of all Canadian (non-US) parts exports were heading in 2003. The large increase of exports to China, where the domestic automotive industry is expanding rapidly, seems particularly vulnerable. For example, Magna International, by far the most important Canadian parts exporter, is increasing its production capacity in Asia. These trends are already reflected in the huge relative fall-off of Australia and the rest of Asia as an export destination for Canadian parts. In contrast, the most rapidly increasing assembly regions of the world, except for China, i.e. Eastern Europe, Korea, Thailand, and India, are not yet important trading partners for Canada.

On the import side, on the other hand, the growth of the automobile industry in developing countries is already making a small impact. The share of Canada's part imports coming from the top 4 countries (excluding the U.S.) decreased from 96.1% to 90.3%. The countries with growing automobile industries figure prominently. China, Eastern Europe, India, and Thailand all post enormous increases, albeit from a low base.

Finally, we take a look at the 10 most important (6 digit HS) products in Canada's exports; Table 1.3 has the list. These account for 93.4% of Canadian parts exports in 2003. The share of the United States is again extremely high and for most products the U.S. import growth is rather high. The right-most columns indicate the export growth of Mexico and China in each of the ten parts. The export levels for each of these parts are relatively low in these countries, but the growth rates are extremely high. Importantly, they tend to be much higher than the growth rate of U.S. import demand.

For the Canadian industry it is extremely important to continuously find new products where it can establish a comparative advantage. For example, in 1998 U.S. imports of "fittings" and "electric lighting" were negligible and currently all Canadian exports of these two products go to the U.S. In 2003, these two products combined accounted for more than 18% of Canadian parts exports to the U.S.

Table 1.3: The 10 most important Canadian automotive component exports in 2003

Top 10 parts (excluding n.e.c.)	Share in Canadian parts exports	Importance of USA		Export growth of	
		Share	Import growth (av. +32%)	Mexico (av. +53%)	China (av. +307%)
Brake system	0.252	0.96	32%	42%	207%
Bumpers	0.165	0.96	18%	158%	121%
Fittings	0.136	1.00		74%	-71%
Wheels	0.126	0.91	79%	157%	554%
Mufflers	0.069	0.99	79%	281%	1835%
Safety glass	0.048	0.87	23%	-6%	225%
Electric lighting	0.046	1.00		199%	264%
Shock absorbers	0.036	0.89	20%	1090%	3066%
Safety belts	0.033	0.73	-44%	14%	4848%
Seats	0.023	0.99	-99.7%	301%	2401%

Source: U.N. Comtrade data set (online)

1.2 Vertical organization of the industry

1.2.1 Current impact

Until the 1960s, the two major firms in the North American industry, GM and Ford, were highly vertically integrated. Chrysler outsourced a larger fraction of its component inputs. The establishment of Japanese-owned assembly plants on the continent, starting in 1982, reversed the trend and independently owned suppliers flourished. Managing a supply chain of several thousand firms proved to be exceedingly complicated and over the last 15 years the industry organized into a tiered supplier network. The final vehicle producers—OEMs—would outsource major components or subassemblies to Tier 1 suppliers, which in turn outsourced several of the components to Tier 2 suppliers, and so on. As a result, the OEMs dramatically reduced the number of suppliers they had to deal with directly, without giving up the benefits of specialization.

1.2.2 Future impact

In recent years this arrangement has started to change again. It is too early to know whether these trends will radically change the organization of the industry, but the following five issues have received a lot of attention recently:

- Suppliers are increasingly involved in the design and development of the parts they produce. One of the main benefits is to cut development time. While twenty years ago, a model had an average product life of 7 years, the main Japanese producers now introduce new versions of the majority of models in their lineup every 4 years. Hyundai is even trying to achieve the same feat every three years. To facilitate this rapid product turnover, R&D is pushed upstream. In 2003, Andrew Brown, Delphi's executive director of engineering, claimed his company was spending US$2 billion in R&D and engineering worldwide, almost 8% of sales: "Most innovations in safety, emissions, and entertainment come from Tier 1 suppliers." In a 2002 study prepared for Accenture by the Center of Automotive Research (CAR) in Michigan, the share of components in the total value generated in the U.S. automobile industry was estimated at 58.3% for 1990, against 24.5% of the value generated by the vehicle producers. This declined to 56% in 2000, but is expected to increase to 63-65% by 2010.
- Cost control by OEMs is increasingly focused on streamlining the supply chain. The process of outsourcing entire modules to Tier 1 suppliers and delegating responsibility for the design and subcontracting has probably gone furthest in interiors and seats. Lear, Johnson Controls, and Intier dominate that industry and handle the design of complete vehicle interiors. Recently, GM announced that it would take more control over its interiors and work directly with smaller suppliers. GM believes it can more effectively control costs and quality by bringing more work in-house. This initiative is just one facet of wide-ranging cost cutting programs in purchasing that all the major auto-

makers have engaged in. GM has just finished a three year program aiming to cut its component costs by 20%. Given that the company's purchasing bill runs at US$86 billion annually, savings can potentially be huge. An important new addition to the program is that in the next two years GM will require all its 250 largest suppliers to have offshore manufacturing capabilities. This is in addition to any price target.

- While assemblers are bringing some tasks back in-house, at the same time the role of Tier 1 suppliers is increasing in some vehicle programs. For niche vehicles or low-volume cars the entire assembly is sometimes turned over to an outside contractor. This practice allows OEMs to assemble vehicles locally without large capital investments or to increase production capacity when their own assembly plants cannot satisfy demand for an unexpectedly successful model. In addition, suppliers are sometimes in charge of building a convertible or stretched vehicle from an existing sedan or adding four-wheel drive. Magna Steyr is a prime example of such a "Tier 0.5 supplier" strategy, with an increasing focus on assembly. Currently it produces the Mercedes-Benz G-class, Jeep Grand Cherokee, and the Chrysler 300C in Europe for DaimlerChrysler and it is the sole assembler for the BMW X3. In the past it also developed and produced convertibles, four-wheel drive, and stretched vehicles for Saab, Volkswagen, Audi, and Mercedes-Benz and it is currently designing the new Stillo for Fiat. Karmann in Europe and ASC in North America are other firms with expertise in this area.
- An alternative to outsourcing the assembly entirely is to bring modulization to the assembly plant. An important trend, especially in Europe and Latin America, is the factory-within-a-factory cooperation between OEMs and suppliers. Within the Nissan assembly plant in Sunderland (U.K.), Karmann installs the folding hardtop roofs on the Micra. Starting in 2006, when the new compact minivan will be introduced, Magna Kansei will install its own cockpit modules and Calsonic Kansei the front-end modules, again operating within the Nissan plant. Similarly, Kuka Group will run the paint, body, and chassis operations of the new Daimler- Chrysler Toledo (OH) assembly

plant, which will open in 2006 and produce the Jeep Wrangler. Kuka and three other suppliers are investing US$300 million in the new plant. Other important projects are DaimlerChrysler's Smart plant in France, its Campo Largo plant in Brazil, Volkswagen plants in Resende, Brazil and Mlada Boleslav, Czech Republic and GM's Blue Macaw plant also in Brazil.

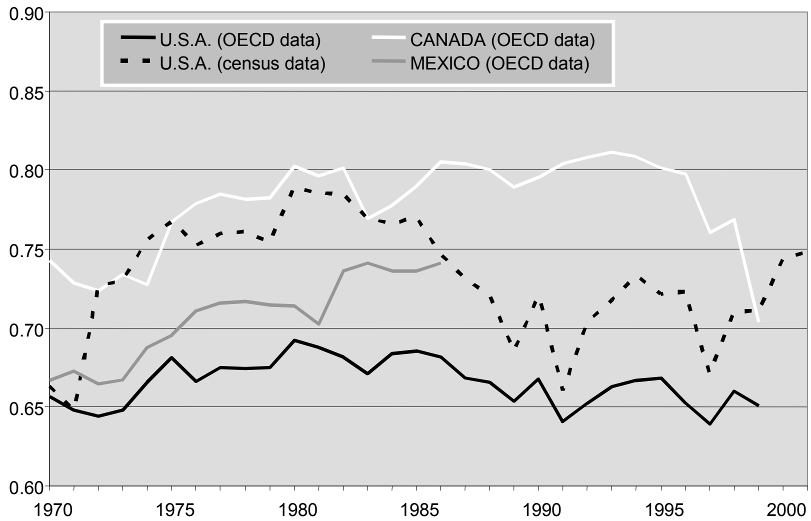
- Finally, the closer integration of OEMs and their suppliers increase the stakes when unexpected things happen, such as the current spike in raw material prices. This has led to a number of bankruptcies and court cases. With several large suppliers, most notably Delphi, Collins & Aikman Corp, Tower Automotive, and Federal-Mogul in Chapter 11 bankruptcy restructuring, the exposure of OEMs to problems at their suppliers is becoming apparent. Without Ford's assistance Visteon would also have had declare bankruptcy. Several of the companies are kept alive by credit from their clients which would suffer from the disruption of their supply chains. Several disputes center around the sharing of increased raw materials costs. While the most successful suppliers, such as Robert Bosch and Valeo, have been able to pass some of the increases in steel prices to their clients, a similar attempt by Lear has landed it in court. Its dispute with DaimlerChrysler affects 12 final assembly plants and is closely watched by the rest of the industry.

1.2.3 Canada's position

The share of intermediate inputs as a fraction of the value of vehicle production is higher in Canada than in the United States. Figure 1.7 uses industry data compiled by the OECD to track the evolution of the material cost/sales ratio for the motor vehicle industry in each of the three North American countries. The Mexican and, especially, the Canadian industries outsource more of their material purchases than the U.S. industry. In Canada, material purchases as a percentage of final sales in the motor vehicle industry even exceeded 80% in the early 1970s, while in the U.S. it peaked at 69%.

From 1971 to 2001, assembly plants in each country initially outsourced more tasks and inputs, but this reversed towards the end of the century. In 2001, the U.S. industry is back where it started, purchasing 60% of its sales value from other industries. The Mexican ratio converged to the U.S., testament of its close integration in recent years. In Canada materials still take up a larger share of sales, which might be related to the important presence of DaimlerChrysler and Magna, two companies that have been instrumental in the push towards modulization of assembly.

Figure 1.7: Share of intermediate inputs in total sales



Source: STAN data set (OECD) and U.S. Bureau of the Census

Table 1.4 contains the most important Canadian firms in the automotive parts and components sector. The importance of Magna International is striking. It is more than 10 times larger than the second Canadian firm, Linamar and 18 times larger than the ABC Group, the Canadian number three. The Canadian share of North American light vehicle production in 2002 was almost 16%, but only 5% of the major component suppliers have Canadian headquarters. In 1999, Faurecia, Decoma, and F&P Manufacturing still were operating regional headquarters in Canada, but by 2002 their Canadian affiliates did not report as separate suppliers anymore.

Recently, wage pressures on the industry have increased. The large incentives offered by the OEMs to boost sales have been accompanied by increased cost cutting efforts. Outsourcing components to Asia, especially to China, is a first manifestation of this trend. The difficulty of Delphi and Visteon, formerly owned by GM and Ford, to maintain high wages is a second manifestation. The 2003 wage negotiations between the UAW and Delphi introduced dual wage profiles at the largest North American supplier, allowing the firm to pay newly hired workers less than insiders. Finally, given that suppliers tend to be smaller firms than OEMs, the wage gradient by firm size influences the relative competitiveness of different countries in attracting suppliers. Statistics in Table 1.5 indicate that, even though the average salary in the automotive industry was significantly lower in Canada than in the U.S., this is reversed for the smallest firms. U.S. firms that employ less than 20 employees paid an average salary of C$30,940 in 1995, while Canadian firms of similar size paid C$36,300.

Table 1.4: Canadian top suppliers (NA rank)

	1993 (top 100)		1999 (top 150)		2002 (top 150)	
	sales	**NA rank**	**sales**	**NA rank**	**sales**	**NA rank**
Magna Int.	2,450	7	5,760	6	7,650	5
Linamar Corp.			687	54	712	56
AG Simpson			407	91	245	129
Multimatic			356	107	342	110
ABC Group			323	110	423	94
Meridian Tech.			306	117	207	147
FAG Autom.					210	145
Fabricated St. P.	160	71				
Faurecia			586	64	HQ in France	33 (parent)
Decoma Int.			496	80	HQ in US	45 (parent 2000)
F&P Mfg			291	125	HQ in US	84 (parent)

Source: Automotive News

Table 1.5: Wage gradient by employment category in the motor vehicle industry (1995)

Employees:	1-19	20-99	100-499	499+	Industry average
Canada	0.75	0.71	0.81	1.1	C$48,400
USA	0.55	0.64	0.68	1.06	C$56,250 (US$41,000)

Note: Average salary (including benefits) for firms in different size-categories (measured by employment) as a fraction of the average salary for the industry.

Source: OECD

Of course, comparisons like this are highly sensitive to the exchange rate of the moment. The enormous appreciation of the Canadian dollar since 2002 has further eroded the competitiveness of Canadian suppliers.

While the automobile industry spends enormous sums on R&D, to a large extent this bypasses the Canadian industry. The vast majority of innovation is done at company headquarters, which are only rarely in Canada. Table 1.6 lists the location of the headquarters of the top 150 (top 100 in 1993) suppliers in the North American automobile industry. While 9 of the largest firms were headquartered in Canada as recent as 1999, this declined to only 7 in 2002. Only two companies improved their rank. At the same time, Mexican and European firms increased their presence. In contrast, the importance of Michigan is striking. In 2002 it was home to 82 of the top 150 suppliers, a full 55%. Within Michigan, firms are concentrated in Detroit, Troy, and Auburn Hills, where GM, Ford, Chrysler, and Delphi have their headquarters. As the OEMs have disintegrated vertically, geographic proximity has become a substitute for ownership ties to smooth commercial interactions.

Table 1.6: Location of top supplier headquarters (to the NA industry)

	1993 top 100	1999 top 150 (100)	2002 top 150 (100)
Canadian	2	9 (5)	7 (3)
Mexican	0	2 (1)	3 (3)
European	0	2 (2)	4 (3)
Michigan	51	72 (51)	82 (52)
Detroit-Troy-Auburn Hills	24	32	33
Other Midwest[1]	24	36	30
Southern U.S.[2]	8	17	16

Notes:
[1] OH, IN, IL, and PA;
[2] AL, FL, KY, MO, MS, NC, SC, TN, and TX

Source: Automotive News

1.3 Flexible production

1.3.1 Current impact

In the automobile industry, flexibility is the new buzzword in manufacturing. Increased competition has led manufacturers to increase the number of products they offer for sale. Traditionally, each assembly plant produced a single model or a few similar ones. The explosion in models for sale made it prohibitively expensive to continue this practice. As a result plants are being forced to assemble several models on the same assembly line, which has important consequences for production and trade.

A first effect is that the exploitation of flexibility often goes together with diminished emphasis on realizing scale economies. While the average plant size has been decreasing gradually over the last 30 years, as the industry made the transition from mass to lean production, the recent decrease is more pronounced[4]. New plants announced in North America have often been in the 100,000 unit range, although subsequent capacity

[4] For detailed information on this, see Van Biesebroeck (2006), "Productivity Dynamics with Technology Choice: An Application to Automobile Assembly," *Review of Economic Studies,* 70(1), pp. 167-98.

additions have made the difference with existing plants smaller. China, where most of the recent capacity additions have taken place, has an average plant size of approximately 50,000 vehicles[5]. The minimum efficient scale of an automobile assembly plant seems to be falling.

It is hard to know whether it is the cause or the effect of the manufacturing flexibility, but the number of models for sale has increased dramatically in recent years. Table 1.7 illustrates this trend over the last 30 years. Models for sale in the United States increased from 133 in 1974 to 282 in 2004. The growth has been much more pronounced in light trucks than passenger cars, and in the former category it does not seem to have topped out. The trends for the number of models sold and produced in North American are by and large similar.

Table 1.7: Number of car and truck models sold and produced in North America (1974-2004)

	1974	**1984**	**1994**	**2004**
Models for sale in U.S.	133	195	238	282
Cars	96	140	164	167
Light trucks	37	55	74	115
Models for sale in NA	185	228	273	320
Models produced in NA	90	125	139	165

Source: Ward's Automotive Yearbooks and Ward's Infobank (2004)

One way to increase product variety is to sell mechanically similar cars under different nameplates. Models that share a platform can be made to differ mainly in appearance, standard features, and trim level, while it is straightforward to develop and assemble them together. All firms have mastered such a 'platform stretching' strategy, even though they do not all use it to the same extent. The number of platforms in production has increased notably less than the number of models[6].

[5] The substantial involvement of provincial governments in China, aimed towards attracting automotive investment to their province, makes it not unlikely that production in China is taking place below efficient scale.

[6] For details, see Van Biesebroeck (2006), "Complementarities in Automobile Production," *Journal of Applied Econometrics*, forthcoming.

A by-product of the increased variety is the emergence of new market segments and different sources of differentiation. Imported vehicles are no longer either small, reliable and cheap or high quality, luxurious sport sedans. Given the multidimensional product competition, the nationality of the owning firm is becoming an ever smaller factor to explain a vehicle's attractiveness. From the consumer's point of view, the difference between vehicles produced by domestic or foreign producers is becoming smaller. Their product lines overlap almost completely and there is no single characteristic on which domestic and foreign vehicles differ consistently.

1.3.2 Future impact

Smaller, nimbler plants could be operated at a higher rate of capacity utilization. Recent research of CAR in Michigan indicated that, in the latest economic downturn, capacity utilization in the industry hardly declined, even though profits were dragged down by lower prices. It is suggested that the break-even point in capacity utilization has increased substantially over time. Trade can be a contributing factor to make sure factories operate as close to full scale as possible. Previously, plants had to be dedicated to a single model and capacity utilization fluctuated with the popularity of that model. The ability to produce a wide variety of models in a single plant allows firms to tailor production more closely to demand. Especially for foreign producers, flexibility allows firms to rely less on imports and produce more domestically, operating their North American plants closer to full capacity.

The average plant size in countries with more recently built assembly plants is certainly lower than in the United States or Canada. Even in Mexico, average capacity is 140,000 vehicles relative to 200,000 further north. In China especially, many smaller plants are being built. To some extent this merely represents cautious entry in an uncertain market or by new firms, but also more established plants by Western multinationals tend to be smaller. It is not implausible that Canadian plants will also become smaller in the future.

1.3.3 Canada's position

As mentioned, in the long run it is not impossible that greater flexibility will lead to lower imports even without new capacity additions. For example, Honda claims all its assembly plants can produce its entire model range with a relatively low productivity penalty. When the firm initially established a manufacturing presence in the United States it was only natural to produce first only its best selling vehicles, the Civic and Accord. Now that it operates several plants across the continent, flexibility will allow the firm to shift production to the vehicles most in demand and avoid having idle capacity in North America, while importing different models from overseas. However, for this to be a reality, the entire supply chain has to become equally nimble. Different vehicles require different components and the suppliers have not yet matched the OEMs' flexibility.

Even though Japanese plants in the United States were the first to be flexible, the technology is now spreading through the industry. In Canada, Honda claims to be able to assemble almost its entire line-up in each plant. Its Alliston plant in Ontario has produced a wide range of vehicles in the last decade. The Ford plant in Oakville is currently undergoing a $1 billion investment project to make it one of its most flexible facilities. The DaimlerChrysler plant in Windsor assembles three models derived from two different platforms, which is the ultimate in flexibility. Finally, also Toyota has manufactured a wide range of models in Canada, including the first Lexus being produced outside of Japan.

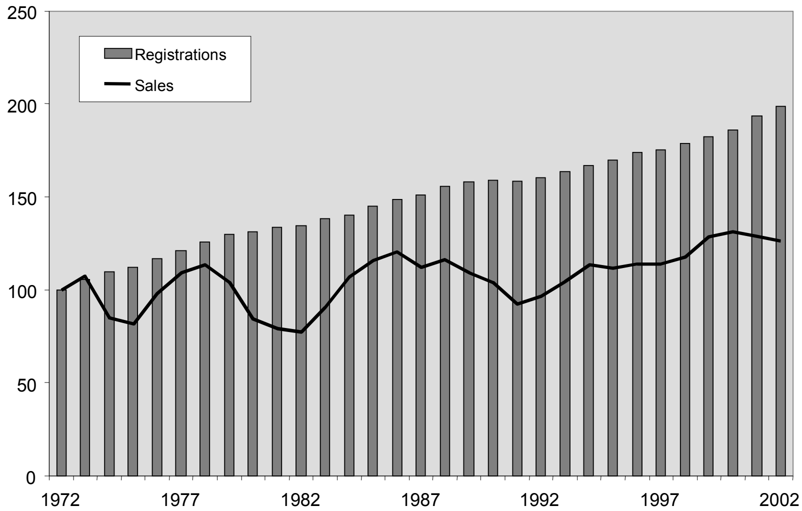
1.4 Stock of vehicles

1.4.1 Current impact

The North American light vehicle market recently has had a string of record sales years. At the same time the average expected lifetime of a vehicle in Canada has risen from 7.7 years or 154,000 km in 1970 to 11.6 years or 227,000 km today. As a result, new sales outnumber the number of vehicles that are scrapped, increasing the number of vehicles on the road. Figure

1.8A shows for the United States sales and registrations from 1972 to 2002, both normalized at 100 in the first year. Clearly, the combination of increased durability with record sales has increased the number of registrations ever higher. In 2002, almost 236 million vehicles were registered in the United States.

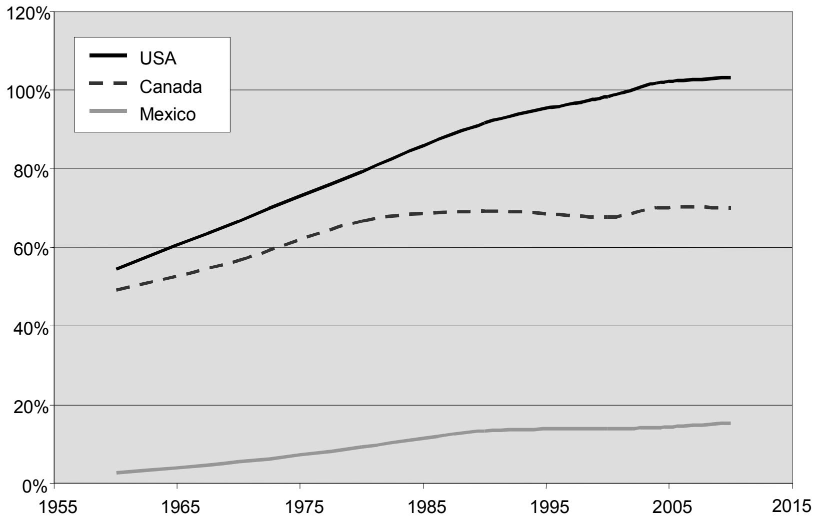
Figure 1.8A: Vehicle sales and registrations in the United States (1972 = 100)



Source: Ward's Automotive Yearbook (various years)

To put the increasing stock of vehicles in perspective, Figure 1.8B plots registrations as a fraction of the population of driving age. For the United States this increased from 55% in 1960 to 102% in 2004. The growth in this ratio is projected to decelerate and only reach 103% by 2010, but that will only happen if sales of new vehicles drop far below current levels. The ratio is lower in Canada, but one cannot automatically infer that the potential demand is larger. Canadians are not as rich as Americans, on average, and more likely to live in cities, which lowers demand for vehicles. By 1990, there were 0.69 vehicles per person of driving age and this has remained virtually unchanged in the last 15 years, only reaching 0.70 in 2004. Growth opportunities in Mexico are much larger. The current vehicle penetration rate is much lower and still increasing, although only very slowly, because population growth is relatively high.

Figure 1.8B: Total vehicle registrations per driving age population



Source: Ward's Automotive Yearbook (various years)

On the demand side quality is becoming a less important factor as well. This is not really surprising as there are decreasing marginal returns to everything. The large quality improvements by GM over the 1990s have not provided the anticipated sales boom. The stellar quality record of GM's Oshawa 2 plant did not prevent an announcement of its prospective closure. The quality record of Buick hardly translates in higher sales. In the 2004 Vehicle Dependability Study by J.D. Power which looks at longer term (3 year out) defects, Buick was the second most reliable brand in North America, only topped by Lexus. GM brands with average number of defects below the industry average include Buick, Cadillac, Chevrolet, GMC, Saab, and Saturn. Only Pontiac and the discontinued Oldsmobile perform more poorly than average, but this has not prevented GM's market share from slumping continuously. Similarly, Hyundai passed Toyota in the initial quality survey (after 3 months of ownership), but it still sells its cars at a discount relative to its Japanese competitors.

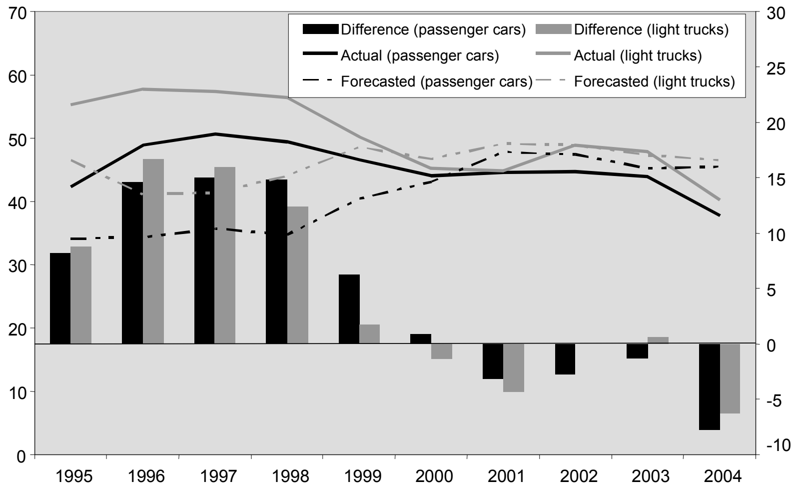
1.4.2 Future impact

Automobiles are durable goods and sales predictions are obviously affected by the stock of vehicles in the economy. The preceding analysis points to weaker sales in years ahead. At a micro level, the industry got a taste of what is to come when sales of the Big Three collapsed in the fall of 2005 after a summer where "employee discount plans" spectacularly increased sales. At an economy-wide level, the bumper sales years of the last half decade will most likely translate into lower sales years ahead. For example, Automotive News predicted 2006 sales to be 4% below the 2005 level for the U.S. at 16.5 million units. Ward's predictions were similar and they expect further declines in 2006 if GM and Ford hold firm on their commitment not to boost fleet sales[7]. Moreover, the mix of vehicles is also shifting towards more economical and smaller cars. For Canada, EDC Economics predicts exports of vehicles to decline by 3% in 2006 and 5% more in 2007, reflecting softening demand in the U.S.

At the same time the fleet is aging. As people owning a second hand vehicle are less likely to trade it in for a new car, future demand for new vehicles might fall off even more rapidly than the registration statistics suggest. Currently, the group of cars 1–5 years old is larger than the group of 10+ year old vehicles, and this is expected to remain true for another 3 years. Later, the group of very old vehicles will become the largest. As vehicle durability is maintained or even rises in the future, the owners of very old vehicles will have very little incentive to replace their vehicles. The solid lines in Figure 1.9 indicate that the resale value of four year old passenger cars and light trucks has decreased almost continuously over time.

[7] The economic outlook of the government's Consensus Revenue Estimating Conference by the Administration, House Fiscal Agency, and Senate Fiscal Agency as agreed to at the January 12, 2006 meetings was slightly more optimistic forecasting 16.7 light vehicle sales in 2006 and 16.8 in 2007.

Figure 1.9: Predicted and actual resale values of 48 month old vehicles (Canada)



Source: DesRosiers "Industry Overview 2004" (2004)

In the past, firms promoted leasing to entice customers to trade in vehicles more quickly. In Canada, leasing peaked in 1997 at 46.8% of all new car registrations. In the following years, rising income levels made car ownership more affordable and leasing rates declined to only 28.1% in 2003. This suggests there is scope for growth by pushing leasing over buying. However, increased durability of vehicles has pushed up predicted resale price of off-lease vehicles, the dotted lines in Figure 1.9, making leasing very advantageous to consumers.

By 2004, lessors had predicted much higher resale value for their fleets than actually realized, resulting in negative off-lease values for their customers (the bars in Figure 1.9). This made it exceedingly disadvantageous for the lessees to take possession of their leased vehicles at the end of the contract, depressing recent resale values even further. Future lease contracts are expected to become more expensive as lessors take into account lower projected resale values. Less leasing could lead to slower vehicle turnover and lower sales of new vehicles.

Exporting excess supply of second hand vehicles to less developed economies is a viable alternative that E.U. countries are actively taking advantage off. Canadian exports of used vehicles rose from around 15,000 in 1994-96 to more than 200,000 in 2001-02. The recent increase in the exchange rate has choked this trade. In the future, trading second hand vehicles with Mexico or other countries in Latin America could be an option that would benefit the Canadian industry. To stimulate the local automotive industry several countries, notably Brazil, have made trade in used vehicles very difficult. It is common practice for countries, even those with no domestic automobile industry, to charge higher import tariffs on second hand than new vehicles (often for emissions or safety reasons). The Free Trade Area of the Americas could prove very beneficial in this regard. Facilitating exports of second hand vehicles to the south would benefit the domestic industry.

1.4.3 Canada's position

What makes the previously described situation precarious for Canada is that the North American industry is plagued by overcapacity. For the industry, total excess capacity is estimated at approximately 0.5 to 1 million units, but this combines larger excess capacity at some firms, most notably GM and Ford, and a projected capacity shortage at other firms, notably Honda and Toyota. Over the last several years, the Big Three American firms have taken capacity from the market, while transplants are building new plants and this process is likely to continue. Canada has benefited from this as Toyota, Honda, and Suzuki (in a joint venture with GM) now operate plants in Ontario. The recently announced closure of the GM plant in Oshawa and the elimination of one shift in another plant will be partly compensated for by the new plant Toyota will build in Woodstock, Ontario, close by its current Cambridge complex.

The reductions in capacity far outstrip the additions. Including the GM announcement, 6 assembly plants will have been closed in Canada between 1993 and 2007, while only Honda and Toyota (in two locations) have substantially increased production capacity. Ford is expected to announce the closure of at least four assembly plants in North America early in 2006. While the large investment in a flexible production system for the

Oakville plant bodes well for its future, the future of the St. Thomas plant is more uncertain.

Over the longer term, the industry is only viable if production capacity matches demand. If future sales in North America will be lower than today, more closures will be inevitable.

1.5 New technologies

1.5.1 Current impact

The primary new technology in automobile production is the flexible plant, discussed earlier. Important evolutions in vehicle technology are taking place in powertrains. In Europe, fuel efficient diesel engines are outselling gasoline cars. Direct injection has vastly improved mileage and lowered emissions. In addition, diesel engines tend to last at least 25% longer than gasoline engines. The catalysts in the cleanest diesel powered vehicles require sulfur-free fuel, which will only be available in North America in 2006.

In North America, the preferred way to achieve similar fuel efficiency is through hybrids. A battery pack is added to the vehicle, which is charged by a smaller combustion engine and by power-recycling technologies when the vehicle brakes. In stop-and-go traffic an electric engine provides (additional) acceleration power, while the gasoline powered combustion engine can function at optimal operating speed. On the highway, gas mileage in the two most popular hybrids, Toyota Prius and Honda Civic (4.2 and 4.3 l/100km), is comparable to the Volkswagen diesels in the Golf or Beetle (4.6 l/100km); in city driving the hybrids deliver superior mileage.

The second important trend in vehicles is the growing importance of electronics. This was clearly illustrated in 2004 when Robert Bosch became the largest component supplier in the world, and Siemens VDO was the fastest growing of the top suppliers. Both firms specialize in electronics. Visteon and Delphi, the two largest North American suppliers, are rapidly increasing their electronics division, which for Delphi is already responsible for more than 20% of revenue. Not only are the electronics-intensive firms growing most rapidly, they also spend a lot on R&D. Siemens VDO, Hella, and the electronics division of Visteon report spending 9% of sales on R&D; Bosch is not far behind at 7.1%. This is well above the industry average of 4%.

1.5.2 Future impact

The future of drivetrain technology is likely to be the fuel cell, as the “hydro economy” develops. Each major automobile manufacturer is involved in developing fuel cell vehicles, which is certain to represent a much more dramatic shift for the industry. The outlook and especially the timing are highly uncertain, but Canadian industry is very active in this field. Ballard Power, headquartered in Vancouver, is considered to be one of the world leaders in fuel cell technology. It is already a supplier to the automobile industry and thus well placed for the future. Other Canadian companies active in the development of fuel cell technology for vehicles are Astris Energy, Cellex Power, and Zongshen Pem Powersystems.

While fuel cells are important for the long-term future, electronics will matter greatly in the years to come. For North American suppliers, the top three concerns are to (1) broaden their client base to include transplants, (2) get compensated for raw material price increases, and (3) expand in electronics. The first and third items are identified as the most import growth opportunities for domestic suppliers. It is estimated that the electronics content in the average vehicle will increase from US$2,250 in 2000 to US$3,850 by 2010. In addition, OEMs expect that by 2010 50% of all R&D—a large fraction of this in electronics—will be carried out by suppliers.

Finally, the importance of the Internet is also felt in this industry. On the consumer side, in Canada as in the United States, new vehicles have to be sold by dealerships. As a result, online purchasing has never taken off, even though the second hand car market has taken advantage of the Internet to organize classified ads, but also for transactions. A result of the wealth of information accessible on the Internet is the increased bargaining power of customers, at the dealers’ expense. Profit margins in dealerships have declined noticeably in recent years. The "employee pricing" schemes that the Big Three ran in the U.S. and Canada over the summer of 2005 could have a lasting effect as consumers were particularly attracted to the no-haggling buying process.

On the B2B side of the market, the demise of the cooperative online auction website Covisint has left each company organizing much of its own purchasing again. For Canadian suppliers to OEMs as well as for the Canadian aftermarket it is especially important to follow developments in the United States. E-commerce applications are subject to network effects and getting locked into an incompatible standard can be very costly. At the same time, timely and accurate communications can provide large productivity gains and Canadian firms do not want to come late to this technology.

1.5.3 Canada's position

No Canadian assembly plant produces hybrids, and this is likely to remain so until Ford brings the hybrid versions of the Edge to Oakville, which is currently projected to happen only in 2010. While most Civics sold in North America are produced in Alliston, Ontario, hybrids are imported from Suzuka, Japan. The Honda Accord is also only produced with gasoline engines in Marysville, OH, while hybrids are imported from Sayama, Japan. Similarly, the Lexus RX 330 is produced in Cambridge, Ontario and Kyushu, Japan, but the Japanese plant is the only one that produces the hybrid version (400h). Even GM has chosen to launch production of its Chevrolet Silverado hybrid pickup truck in Fort Wayne, IN, even though the Oshawa plant is the lead plant for the vehicle. Ford produces its Escape hybrid alongside the regular Escapes in Kansas City, MO and Avon Lake, OH[8].

The current popularity of hybrids, also in Canada, is very strong. In 2005, the Honda Civic hybrid was chosen as the family sedan of the year by Consumer's Report while the Toyota Prius took top honours as the Car of the Year. Waiting lists

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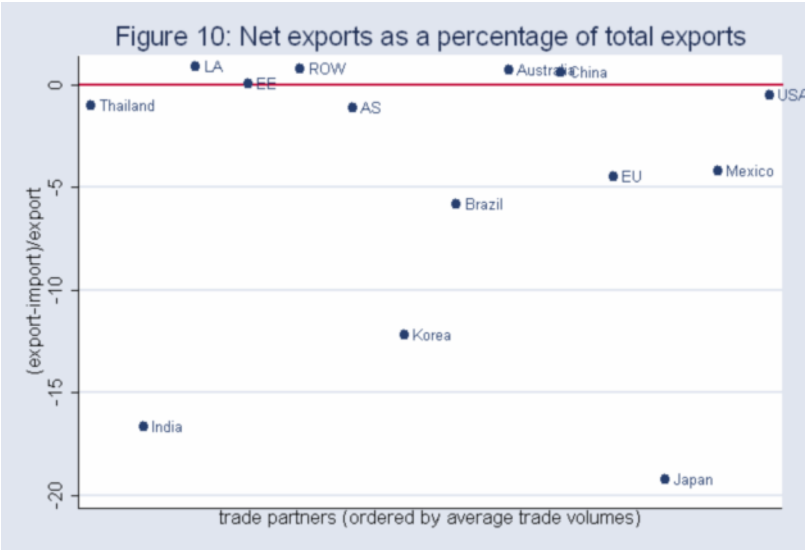
[8] It should be noted that GM does produce E85 vehicles in Canada, such as the Monte Carlo, Impala and the Silverado.

for the Prius are still running over half a year. North American sales in 2003, for all hybrids combined, were only 40,000, but are expected to reach 177,000 in 2005. A total of 28 models—18 trucks and 10 cars—are expected to offer hybrid powertrain options in 2008. Thus far, all of this is bypassing the Canadian industry.

It is unlikely that the new diesel technology will ever be as popular as the hybrids, but the Canadian industry is again not very involved. Two of North America's largest engine plants are in Canada. Ford's Windsor plant has a capacity of approximately 600,000 engines, mostly V6's, but its future capacity utilization will depend on Ford's future restructuring plans. GM's St. Catherines plant used to be even larger, but high fuel prices have put the demand for V8 engines in doubt. Cylinder deactivation technology, such as that in the Impala, allows for substantial fuel savings and have proven to be popular. No diesels or hybrids are made in Canada.

Of the top Canadian suppliers, Magna has a sizeable electronics division, and also the ABC Group, Canada's third largest supplier, is heavily involved in electronics. All other large Canadian suppliers, Linamar, Multimatic, A.G.S. Automotive Systems, Meridian Technologies, and FAG Automotive, tend to have their comparative advantage in mechanics. Advanced technologies are equally important here, but the value added share of the vehicle is clearly shifting towards electronics.

Finally, we list the trading partners and products that Canada is running a trade surplus with in automotive components. Figure 1.10 illustrates that Canada is running a trade deficit with all its primary trading partners in components. The deficit is especially large with Japan, where Canada is importing 20 times as much as it is exporting. With several of the fast growing automobile producing countries, such as Brazil, South Korea, India and Thailand, Canada is also running a deficit. China is the one positive note, but the rapid expansion of the Chinese automotive industry combined with a deepening of its domestic supply chain puts much of those Canadian exports in doubt for the near future.



Source: Own calculations based on U.N. Comtrade data set (online)

Figure 1.11 illustrates the size of Canadian trade deficits per component, where components are ranked according to the importance of the E.U. in U.S. and Japanese imports. This ranking is intended to capture the extent to which a component can be considered high tech. The vertical axis represents the trade surplus or deficit: (exports-imports)/exports. The good news is that 90% of Canadian exports are components for which the E.U.'s importance as a source of imports into the other advanced economies is higher than the E.U.'s median importance. The largest circles, which represent the size of Canada's exports, are to the right. This indicates that Canada is specializing in goods in which Europe is a successful exporter to the U.S. and Japan, presumably "high tech" goods. It is also clear that Canada's exports are highly concentrated. There are only two goods for which Canada is running a sizeable trade surplus, the two largest circles above the zero line. These are non-electrically powered work trucks (the left-most dot) and bumpers, the largest positive observations more or less in the centre. In all electronics, Canada is running a trade deficit.

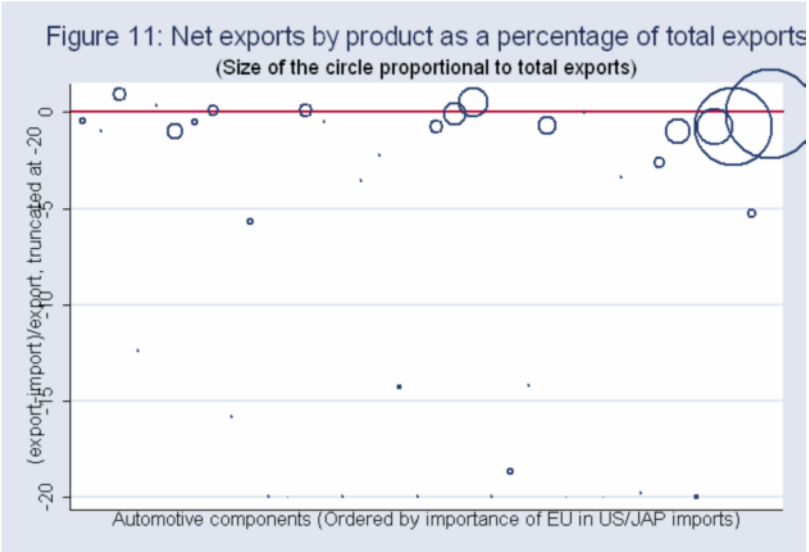


Figure 11: Net exports by product as a percentage of total exports
(Size of the circle proportional to total exports)

Source: Own calculations based on U.N. Comtrade data set (online)

2. Market analysis: automobiles and light trucks (with Frank Verboven)[9]

This section estimates the potential impact of eliminating MFN tariffs on new vehicles on the production, employment, consumption, and trade of new vehicles in Canada (both short and long-run effect) using cost-benefit and regression analyses (such as estimating the price and substitution elasticity, taking into account quality and reliability differences) with disaggregation by vehicle type to the extent possible. The estimation will be undertaken under two scenarios:

a) Unilateral elimination of Canadian tariffs on new vehicles;
b) Elimination of tariffs on new vehicles in the following five FTA contexts: Canada-South Korea, Canada-E.U., Canada-Japan, Canada-China, and Canada-Mercosur (each of the five separately).

The expected effect of eliminating the 6.1% tariff on final vehicles can be broken down into the following components:

Effect	**=**	**Benefit – Cost**	
	=	**Lower price for consumers**	**(1)**
		+ higher sales of vehicles	**(2)**
		+ tariff concessions by trade partners	**(3)**
		– lost tariff revenue	**(4)**
		– lost FDI	**(5)**
		– lower domestic production	**(6)**

Items number 1, 2, 4, and 6 will be addressed in this section[10].

Item number 5 is the subject of the next section.

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[9] All analysis in Section 2 is joint with Professor Frank Verboven from the Catholic University of Louvain in Belgium.

[10] Note that this analysis is limited to final assembly. If Canadian parts are disproportionately oriented towards Canadian vehicle production, the lost production domestically will have a multiplier effect on the parts sector. Given that we do not have any data on this exposure, we merely note this point, but do not come up with an estimate of the effect.

Properly discussing item number 3 would go beyond the automotive industry. We will include some comments about the possible export effects of trade concessions of trade partners on final vehicles in the current section, but reciprocity in the automobile industry is only one of several possibilities.

Throughout, we will have to compare dollar values that represent gains and losses for different groups to obtain an aggregate effect for Canada. When an effect has a non-obvious distributional effect, it will be noted.

The way we will obtain estimates for the quantities outlined above is by estimating a discrete choice model of vehicle choice in the Canadian automobile market. This follows in a recent tradition of using oligopolistic models of competition in differentiated products to study the actual market equilibrium and to conduct counterfactual analysis. The crucial objective is to get an estimate of the primitives of the model, most crucially the demand parameters, but potentially also the parameters that govern the marginal cost function. With estimates for those functions in hand, one can conduct counterfactual simulations how the market equilibrium is expected to change if, for example, a trade policy is changed. The main benefit of such an approach is that we allow all market participants, even those only indirectly affected by the policy change, to update their strategies and we calculate a new Nash equilibrium for the industry. This way one obtains a consistent estimate of the trade policy effect only keeping the primitives constant, not the observed strategies. It leads to an analysis that is robust to the Lucas-critique, which has plagued earlier counterfactual analyses.

We will proceed in three steps. First, in Section 2.1, we formulate and estimate a discrete choice model of vehicle demand. Given the time constraints for this project we estimate a nested logit model using aggregate market shares and model characteristics, including price, at the vehicle-level. In a more elaborate analysis one could allow random coefficients on some of the characteristics, especially price, and add assumptions on the shape of the marginal cost function to estimate a supply equation jointly with demand. In Section 2.2, we outline our estimation strategy.

Second, in Section 2.3, we use the demand model to calculate a number of quantities that are generally unobserved, but which will influence the effect of any policy change. In particular, we will calculate (i) own and cross-price elasticities for each model with respect to all other models in the market; (ii) unobserved vehicle quality, from the point of view of the consumer; (iii) the marginal costs for each vehicle that are consistent with the estimated price elasticities of demand and the observed prices. We do not estimate the supply side of the market directly, as it is not necessary to identify the demand parameters. It could result in more precise estimates and would allow one to impose the condition that firms always set prices on the elastic portion of demand, as theory implies. We will test how frequently this last condition is violated if it is not imposed. To calculate the elasticities and marginal costs we will assume that firms are playing a Bertrand price-setting game in differentiated products. We will take explicitly into account that firms that produce multiple models will internalize the effects of a price change of one model on the sales of all their other models.

Third, using the estimated demand parameters, price-elasticities, and marginal costs we conduct counterfactual simulations of market equilibrium—in Section 2.4. In particular, we look at the impact of elimination of the 6.1% import tariff on non-NAFTA vehicles. This will take the form of a reduction in the marginal costs for the affected importers by 5.75% (as the calculated marginal cost includes the current tariff rate). Different scenarios for the extent of trade liberalization will change the models which are affected[11]. We calculate a number of summary statistics in each scenario to illustrate the impact on prices, mark-up, sales, production, profits, consumer surplus,

[11] Note that a few models produced in the U.S. do not meet NAFTA content requirements, e.g. the BMW X5 and the Mercedes-Benz M-class SUVs. We will not consider trade liberalization that eliminates this content requirement because it would severely complicate the analysis. While this is strictly speaking not consistent with full trade liberalization, one of the scenarios considered, these models are sold in sufficiently small quantities that we are confident it has only a marginal impact on the results.

tariff revenue, and the differential impact on domestic producers and importers[12].

2.1 Specifying a model of demand

The automobile industry has proved to be a popular proving ground for discrete choice models that estimate demand for differentiated products. The state-of-the-art in estimating aggregate demand is the random coefficients model discussed in Berry (1994) and first taken to the data (U.S. automobile purchases) in Berry, Levinsohn, and Pakes (1995). Micro-level data, as in Goldberg (1995) or Berry, Levinsohn, and Pakes (2004), can be used to obtain more precise parameters. An intermediate solution, in Petrin (2002), adds micro-moments to the aggregate estimation. Several studies have used these models to evaluate trade policies. Important recent studies that use aggregate data include Irwin and Pavcnik (2004) for airlines and Fershtman and Gandal (1998), Berry, Levinsohn, and Pakes (1999), Brambilla (2005), Brenkers and Verboven (2006) for automobiles. Section 2.5 contains a (non-exhaustive) list of papers that use discrete choice models to estimate the demand for automobiles. No estimates for Canada are currently available.

We will use a nested logit model; see Anderson and De Palma (1992) and Verboven (1996a) for details and Berry (1994) for a comparison with the general framework. This model can be interpreted as a restricted random coefficients model, see Cardell (1998), where consumers share the valuation on all the observable characteristics, except on a set of nesting dummies that segment the market.

Consider the Canadian automobile market where I consumers are considering to purchase a car or light truck. They can choose between J available models, one of which is the outside good, i.e. purchasing a second hand vehicle or postponing the

[12] Note that we have explicitly chosen not to calculate employment effects. As the results will make clear, quantity changes are relatively small. It would be entirely arbitrary to map these small quantity changes in employment changes because production is organized in large scale plants and indivisibilities matter.

purchase. The utility of the outside good purchase will be normalized to zero[13]. A consumer *i*'s conditional indirect utility function from purchasing product $j = 1 \ldots J$ that belongs to nest/segment g is given by:

$$u_{ij} = \underbrace{\sum_{k=1}^{K} x_{jk}\beta_k + \xi_j - \alpha p_j}_{\delta_j} + \xi_{ig} + (1-\sigma)\varepsilon_{ij}$$

$$= \delta_j + \sum\nolimits_g d_{jg}\xi_{ig} + (1-\sigma)\varepsilon_{ij}$$

Utility thus consists of a component that is common to all consumers (δ_j) which groups together the first three terms, a random taste of consumer *i* for vehicles in segment *g* (which can be positive or negative), and an individual-model specific random utility draw (ε_{ij}). The common part (δ_j) depends on K observable characteristics that each consumer values identically (fuel-efficiency, horsepower, size, etc.), a model-specific unobservable characteristic (combining the effect of style, advertising, etc.), and price—the only endogenous characteristic (which has a negative coefficient attached to it). The benefit of such a modeling strategy versus specifying a traditional demand system at the product level is that with only a few parameters we are able to generate cross-price derivates between all models that are very general. Note that in 2005 a total of 238 different models were sold in the Canadian market. Specifying the demand directly would require an extraordinary amount of parameters to allow for flexible substitution patterns.

We assume that the distribution of the random utility term (ε_{ij}) follows the extreme value distribution, such that we can derive market shares in analytical form; for more details on the nested logit model see Anderson and De Palma (1992) and

[13] Note that to define market shares we have to define the potential market of consumers. With only two years of data, this decision is entirely inconsequential; it merely scales the market shares. We choose the number of Canadian households as our measure of *I*, which gives an market share for the outside product of almost 80%.

Verboven (1996a). We further assume the market can be partitioned into G exclusive and exhaustive segments. Each segment contains J_g models and $\sum_g J_g = J$. Each consumer will choose one model to maximize her utility.

The nested logit distributional assumptions on the random utility term yield the following choice probability for individual *i* for product *j* that belongs to segment *h* as a function of the entire *Jx1* price vector:

$$s_{ij}(p) = \frac{\exp((\delta_j - \alpha p_j)/(1-\sigma))}{\sum_{l=1}^{J_h}\exp((\delta_l - \alpha p_l)/(1-\sigma))} \cdot \frac{\exp(I_h/(1-\sigma))}{\sum_{g=1}^{G}\exp(I_g/(1-\sigma))}$$

where

$$I_g = (1-\sigma)\ln\sum_{l=1}^{J_g}\exp((\delta_l - \alpha p_l)/(1-\sigma))$$

is called the 'inclusive value' for segment $g = 1 \ldots G$. The predicted aggregate market share for model *j* is obtained by averaging the choice probabilities over all individuals, which in our (simple) case is simply $N.s_{ij}$ because our choice probabilities are not individual-specific[14].

The nested logit model will result in higher elasticities of substitution between models in the same segment than across segments, which is a major improvement over the simple logit model. An unattractive feature is that the own-price elasticity of substitution for each model will be increasing in price. This will be discussed at length in the next section.

The model can be generalized in a variety of ways. Two approaches to add flexibility to the estimated own-price elasticities is to let the parameter that governs the degree of substitution within

[14] In the full random coefficients model, see Berry (1998), the market shares cannot be derived analytically because the choice probabilities vary by consumer. As a result, a simulation estimator has to be used and the unobservable quality term has to be calculated using an embedded contraction mapping. Both of these complications severely increase the computational burden.

nests (σ) vary by segment. If demand elasticity is higher for cheap small cars than for expensive luxury cars, it would show up as a higher σ parameter in the small car segment; see Brenkers and Verboven (2006) for an illustration on the European car market. In order to estimate this model we would require more data than we currently have. The severe time constraints on this project necessitated us to estimate a relatively simple model[15].

An alternative would be to introduce (more) random parameters to the model, which would allow different individuals to value the characteristics differently. The most direct way to obtain more realistic demand elasticities would be to let the coefficient on price to vary by income level. By simulating a sample of consumers with income levels drawn from the national income distribution, we can calculate the choice probabilities at a more disaggregate level. However, working with individual-specific choice probabilities would greatly increase the computational burden on the estimation because closed form solutions would not exist anymore and a fixed point iteration would be required to uncover the unobserved model characteristics. Berry, Levinsohn, and Pakes (1995) outline the approach.

2.2 Estimating the demand model

We estimate the nested logit model introduced in the previous section using seven nests: small cars, mid-size and large cars, luxury cars, compact and mid-size SUVs, large and luxury SUVs, minivans, and pickup trucks. We collected data on each model for sale in the Canadian market in the 2004 and 2005 model years[16]. Dropping all models that sell less than 200 units per year gives us a sample of 442 observations, 218 in 2004 and 224 in 2005. We have renamed some 2004 models because the replacement models were introduced under a different name, even though they are

[15] With only two years of data available, the substitution parameters σ for some of the nests were estimated to be (insignificantly) larger than unity, which violates the theory. Therefore, we forced them to be the same across nests.

[16] The model year runs from September 1 to August 31. This will avoid including observations in the sample where a vehicle is only sold for part of the calendar year.

clearly replacing an existing car in their segment. This affects only the estimates that use random (or fixed) effects.

Table 2.1 Summary statistics for Canadian (domestic) market

	Average	Standard Deviation	Minimum	Maximum
Price ($)	37,480	20,403	12,995	131,300
Sales (units)	7,030	10,919	203	70,853
Model characteristics:				
Hp/weight	0.551	0.135	0.249	1.262
Size (l x w x h)	0.882	0.220	0.357	1.452
Miles/$	2.322	0.819	0.952	7.048
Automatic	0.554	0.498	0	1
Foreign brand	0.567	0.497	0	1
Production location (for vehicles sold in Canada):				
Canada	10.3%	30.4%		
U.S. & Mexico	48.2%	50.1%		
E.U.	17.0%	37.6%		
Japan	15.6%	36.4%		
South Korea	8.9%	28.6%		
Segment:				
small car	14.3%	35.1%		
middle car	18.8%	39.1%		
upper car (large & luxury)	18.3%	38.8%		
lower SUV	17.9%	38.4%		
upper SUV (large & luxury)	13.8%	34.6%		
minivan	8.9%	28.6%		
pickup	8.0%	27.2%		

As explanatory variables, we follow most closely the papers by Berry *et al.* (1995) and Petrin (2002). The following variables are included: power is captured by horsepower per weight, size by length x width x height, and fuel efficiency by miles per dollar. We include a dummy variable that indicates whether an automatic transmission is part of the standard equipment as a measure of luxury; and a dummy whether the nameplate has traditionally been owned by a domestic producer. Note, for example, that this latter variable is zero for the North-American produced Honda Civic—as Honda still tends to be perceived as a foreign car company. Similarly, all Volvos are foreign even though they are now owned by Ford and all Chevrolets are labelled domestic, even though some are manufactured by GM Daewoo in South Korea. Summary statistics are in Table 2.1.

Table 2.2 Demand coefficient estimates

	Dependent variable: logarithm of market share (relative to outside good)			
	OLS	**Nested logit**	**Nested logit with IV**	**Nested logit with IV and RE**
	(1)	**(2)**	**(3)**	**(4)**
Price	-0.037	-0.025	-0.052	-0.051
	(.003)***	(.001)***	(.003)***	(.004)***
Hp/weight	0.178	-0.198	1.648	0.823
	(0.511)	(0.220)	(.347)***	(.213)***
Miles/$	0.273	0.216	0.089	-0.003
	(.107)**	(.046)***	(0.065)	(0.061)
Size	1.196	0.075	0.454	-0.005
	(.443)***	-0.194	(.270)*	(0.222)
Automatic	-0.446	-0.026	0.203	0.177
	(.132)***	(0.058)	(.094)**	(.074)**
Domestic	-0.373	-0.133	0.050	0.020
	(.117)***	(.051)***	(0.077)	(0.092)
Nesting variable		0.859	0.693	0.698
		(.020)***	(.064)***	(.090)***
Year	0.000	0.054	0.037	0.020
	(0.102)	(.044)	(0.060)	(0.019)
Constant	-7.582	-3.580	-4.526	-3.474
	(.707)***	(.318)***	(.504)***	(.523)***
Observations	441	441	441	441
Adj. R^2	0.412	0.891	0.802	0.822

Notes: * Significant at the 10% level, ** at 5%, *** at 1%.

Parameter estimates for the demand system, using several estimation methodologies, are in Table 2.2. The simple least squares estimates, results in column (1), indicate that people positively value more engine power, greater fuel efficiency and a larger size. Contrary to expectation, a standard automatic is valued negatively and the willingness to pay for domestic cars is significantly lower than for foreign cars. Not surprisingly, consumers prefer paying a lower price, although the point estimate on the price variable is relatively low. Such a low coefficient estimate, -0.037, would indicate pricing on the inelastic portion of demand for a number of models, which is inconsistent with profit maximizing behaviour.

Coefficient estimates for the nested logit model, in column (2), are largely similar. Only the willingness to pay for horsepower turns negative as well, although insignificant. The parameter on the nesting variable is estimated to be positive and below one, in line with economic theory. The implication is that the cross-elasticity of price for models in the same nest is significantly higher than between models in different nests. This captures that consumers are more likely to substitute between models in the same nest; i.e., the segment classification that the industry usually employs makes economic sense. More worrying is the even lower estimated price coefficient than in the first column.

While the low estimates for the price coefficient, and the low demand elasticities this implies, are economically unappealing, they make perfect sense econometrically. The vehicle characteristics included in the model only capture a limited number of dimensions consumers care about. As a result the error term will include the effect of unobservables that consumers value and are willing to pay for (the ξ_j parameters in the model). Firms with price-setting power are likely to put a higher price on vehicles that have higher unobservable "quality".

This endogeneity will induce a positive correlation between price and the error term and lead to an upward bias on the price coefficient. In some applications, not taking this effect into account even leads to an upward-sloping demand curve. Expanding the number of observable characteristics will help, but it would be impossible to include every characteristic consumers care about. The attractiveness of the design, a good layout of the dashboard, or reliability are only some of the characteristics that are hard to measure reliably. As a result, we will use instrumental variables to control for price setting.

We require variables that are unlikely to be correlated with unobservable aspects of a vehicle's "quality", broadly defined, but are correlated with the price. For a detailed discussion of instruments in this literature, we refer to Berry *et al.* (1995). We basically follow their insight and use as instruments the average characteristics for competing manufacturers. The observable characteristics of vehicles produced by competing firms are plausibly exogenous to the unobserved quality that consumers attach to the vehicle of one firm, while in a competitive market setting these characteristics will definitely influence the pricing decision of the firm. The discussion in Berry *et al.* (1995) includes conditions under which these instruments resemble optimal instruments. In the nested logit setting, we include two sets of instruments: average characteristics of all models produced by other firms and the same set of variables but only averaging over competing models in the same segment. Adding this second set of instruments changes the point estimates of the coefficients only marginally but improves estimation precision.

Results for the nested logit model with instrumental variables for price are in column (3) of Table 2.2. This will be the preferred set of estimates that we will use to simulate the model. The coefficient on price changes a lot. It almost doubles in absolute value—in line with the expected increase. As a result, for virtually all models in the market we find that firms are setting the price on the elastic portion of demand—in line with profit maximizing behaviour. Consumers now have a positive marginal willingness to pay for all characteristics—also as expected. The power of the engine, a standard automatic transmission[17], and vehicle size are found to be most important. Fuel efficiency and a domestic nameplate both have a positive effect on demand, but

[17] Using other variables to measure luxury, such as standard ABS or models explicitly marketed in luxury segments, leads to similarly positive estimates.

are not significant at usual significance levels. Finally, the nesting variable is still estimated to be large and positive, albeit not as large as with OLS. Firms in the same nest seem to resemble each other also in terms of unobservables, which is plausible.

Finally, in column (4), we also report instrumental variables estimates of the nested logit model allowing for random effects by model, to control more explicitly for unobservables[18]. These estimates provide a robustness check for the results when we control more generally for model-specific time-invariant heterogeneity. Especially, the price coefficient (α) and nesting variable (σ) are estimated extremely similar. These are the only two parameter estimates that explicitly enter the elasticity calculation (see below). As a result, own and cross-price elasticities would be very similar for the model in column (4). The coefficient on size can hardly be identified anymore, which is not surprising as this is one characteristic that manufacturers can hardly change in successive model-years.

2.3 Calculating unobserved variables

The coefficient estimates for the demand parameters in column (3) of Table 2.2 are now used to calculate the demand elasticities, marginal costs, and unobserved vehicle quality. The first two will drive the results of the trade policy simulations in the next section[19].

The demand system yields own and cross-price elasticities for all 218 vehicles for sale in Canada. A benefit of the random utility framework is that it allows a general pattern of substitution, while requiring only the estimation of a limited number of coefficients—those associated with vehicle characteristics and the degree of substitution within each nest. As mentioned earlier, for a truly flexible substitution pattern one has to allow for more random coefficients than only on the segment dummies, e.g., on price.

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[18] Alternatively, we could estimate the model with fixed effects, but more than two years of data would be required. The random effects can be incorporated even with the limited data set we have to work with.

[19] From now on we focus on the results for 2005.

In the one-level nested logit model, the demand elasticities are:

$$\varepsilon_{jj} = -\frac{\partial q_j}{\partial p_j}\frac{p_j}{q_j} = \alpha p_j\left[\frac{1}{1-\sigma} - \frac{\sigma}{1-\sigma}\frac{q_j}{Q_g} - \frac{q_j}{L}\right] \qquad j \in \text{nest } g$$

$$\varepsilon_{jk} = \frac{\partial q_k}{\partial p_j}\frac{p_j}{q_k} = \alpha p_j\left[\frac{\sigma}{1-\sigma}\frac{q_j}{Q_g} - \frac{q_j}{L}\right] \qquad \text{both } j \text{ and } k \in \text{nest } g$$

$$\varepsilon_{jk'} = \frac{\partial q_{k'}}{\partial p_j}\frac{p_j}{q_{k'}} = \alpha p_j\left[\frac{q_j}{L}\right] \qquad j \in \text{nest } g, k' \in \text{nest } g' \neq g$$

Table 2.3 Own and cross-price elasticities for a select number of models

	Civic	Mazda3	Pursuit	Elantra	Golf	Escape	CR-V	Santa Fe	Equinox
Civic	-2.499	0.254	0.254	0.254	0.254	0.009	0.009	0.009	0.009
Mazda3	0.195	-2.574	0.195	0.195	0.195	0.007	0.007	0.007	0.007
Pursuit	0.137	0.137	-2.570	0.137	0.137	0.005	0.005	0.005	0.005
Elantra	0.062	0.062	0.062	-2.487	0.062	0.002	0.002	0.002	0.002
Golf	0.029	0.029	0.029	0.029	-3.121	0.001	0.001	0.001	0.001
Escape	0.004	0.004	0.004	0.004	0.004	-3.680	0.229	0.229	0.229
CR-V	0.004	0.004	0.004	0.004	0.004	0.210	-4.584	0.210	0.210
Santa Fe	0.002	0.002	0.002	0.002	0.002	0.121	0.121	-3.448	0.121
Equinox	0.003	0.003	0.003	0.003	0.003	0.152	0.152	0.152	-4.372

Note: The statistics indicate the demand elasticity of the model in column for price changes of the model in the column. Own price elasticities are on the diagonal.

We calculate the own and cross-price elasticities between all models—*J*(J+1)/2* elasticities (23871 elasticities in 2005)—as they are used to uncover the marginal costs the model implies. Table 2.3 lists the own and cross-price elasticities for a select number of vehicles from the two largest Canadian market segments. For each region of the world[20]—Canada, U.S. and

[20] These five regions will be considered separately in the trade policy simulations below.

Mexico, South Korea, Japan, and the E.U.—we include the best-selling vehicle. The first five models are from the "small car" segment, which combines the lower small, upper small and small specialty cars according to the market segmentation in Ward's Automotive Yearbook. The next four models are "small SUVs", a nest that combines the small and middle SUVs and small and middle cross-utility vehicles (car-based SUVs) segment[21].

A crucial—and admittedly undesirable feature—of the nested logit demand model is that within each nest the absolute value of the own-price demand elasticity is an increasing function of a model's price. This follows directly from the functional form for demand. Within each segment, all vehicles share the same demand curve, except for the random individual-model specific logit error draw. As a result, more expensive models will be priced higher up on the demand curve, where consumers are more elastic.

The cross-model elasticity of substitution is much higher for models in the same nest, driven by the high estimate for σ, and the elasticity of substitution between models in all other nests is the same. Ideally, we would let the added substitutability within each nest vary and estimate seven distinct σ parameters. Brenkers and Verboven (2006) illustrate that with such added flexibility substitution parameters in more expensive segments tend to be lower and own-price elasticities do not have to rise with price. However, given that we only have two years of data available, several of the estimated σ parameters were estimated higher than 1, although not significantly so, which is inconsistent with a well-behaved demand system. Therefore, we were forced to impose similarity of the σ parameter in each nest and as a result demand elasticities increase with price throughout. A factor that exacerbates this tendency is that more expensive segments in Canada tend to be more crowded, increasing demand elasticities further. The elasticity formula

[21] In the market segmentation followed in DesRosiers publications for Canada, "small cars" refers to subcompacts, compacts, and smaller sport cars, "small SUVs" would refer to compact SUVs, SUVs, and intermediate SUVs.

clearly indicates that own-price elasticity is increased if a vehicle has only a low market share within its segment.

The model does perform well in predicting different cross-price elasticities for models that are in the same segment and those that are not. For example, a 10% price increase for the Honda Civic, the most popular model, raises the expected sales of all other small cars by 2.54%. The effect on models in all other segments, including the outside good (i.e. second hand cars), is much smaller, a 0.9% sales increase. A similar price increase for the Mazda3 leads to only a 1.95% sales increase for other models in the small car segment. The difference is explained by the fact that the Mazda has only ¾ of the sales of the Civic, so given that the own-price elasticity is similar (-2.574 versus -2.499) the number of lost Mazda sales that spill over to competitors is proportionally lower.

In the consumer's random utility function is an unobservable model-specific characteristic (ξ_j) that directly enters the (normalized) market share function linearly—in our estimation it becomes the error term of the regression. This is the next quantity that can be calculated from the fitted demand model. While it will not play an independent role in the results, since results only depend on the joint effect of the entire part of the utility function that is common to all individuals' valuation (δ_j), it provides a useful check for plausibility of the model estimates. The average ξ_j is zero for the entire sample, but to aid comparability we normalize it to zero by segment. Vehicles with positive ξ_j have a higher demand than one would predict based on the observable characteristics. As such, it measures the unobservable "quality" of the vehicle.

Table 2.4 contains the name, production region, sales, and price of the same select group of vehicles that were included in Table 2.3. To give some idea about the relative position in their segment, their sales rank is also included[22]. The next column lists the unobserved "quality" of the vehicle, which by and large corresponds to our priors. The Honda Civic and Mazda3 record

[22] For the small SUVs, I did not include the sales leader, the Pontiac Montana SV6 because it was newly introduced in 2005.

positive unobserved quality, indicating that their sales are higher than one would expect based on the observable characteristics included in the demand estimation. In the case of the Civic, high resale value springs to mind, and for the Mazda3 the original new design can be noted. The Pontiac Pursuit, on the other hand, has a large negative quality. It indicates that the model would be expected to sell in much higher numbers, especially given its low price, strong engine, and large size.

Table 2.4 Calculated unobservables for a select number of models

	produced	Sales	rank in segment	price	unobserved "quality"	marginal cost	mark-up
Honda Civic	Canada	63676	1	16200	0.523	9697	0.401
Mazda3	Japan	48576	2	16295	0.321	9616	0.410
Pontiac Pursuit	U.S. & Mex.	34852	4	15925	-0.823	8513	0.465
Hyundai Elantra	South Korea	16711	11	14994	-0.010	8655	0.423
Volkswagen Golf	E.U.	6258	21	18530	0.095	12428	0.329
Ford Escape	U.S. & Mex.	21466	2	22995	0.324	16239	0.294
Honda CR-V	Japan	16019	3	28200	0.266	21872	0.224
Hyundai Santa Fe	South Korea	12383	5	20995	-0.155	14589	0.305
Chevrolet Equinox	Canada	12291	6	26614	0.119	19042	0.285

Note that in absence of actual transaction prices we use MSRP as the price. The domestic manufacturers tend to discount their selling price more than imports. As a result, the unobservable quality that would be imputed for the Pontiac Pursuit if actual prices would be available would likely be even lower. It would be preferable to use transaction prices instead of MSRP, but data limitations make this impossible[23]. Another notable pattern is that both Korean entries in Table 2.4 have a below average imputed unobservable quality. Sales for these models are lower

[23] Note that J.D. Power collects transaction information for the U.S., but the cost of these data far exceeds the budget for this study.

than expected, especially given their attractive low price. This coincides with the general perception that although the quality of the Korean cars and SUVs has improved spectacularly over the last decade, they have not closed the gap with their Western or Japanese competitors entirely. Because we only included relatively successful vehicles in Table 2.4, average quality tends to be high. Vehicles ranked much lower in their segment tend to have lower imputed quality as well—partly as explanation of their poor sales performance.

Once we add a first order condition for price setting to the estimates of the demand system, we can uncover what marginal costs for each vehicle have to be to rationalize the observed prices. We assume that firms compete in prices and that observed prices are at equilibrium in a differentiated products (Bertrand) pricing game. Moreover, firms are explicitly modeled as multi-product firms, taking into account the effect of the price of each model on all the other models they own[24]. For a derivation of the first order condition, we refer the interested reader to Berry (1994) or Berry, Levinsohn, and Pakes (1995). The imputed marginal costs for a select group of vehicles are in the second last column of Table 2.4.

Finally, the mark-up on each vehicle, defined as $\frac{p_j - mc_j}{p_j}$ is in the last column. Note that we have explicitly incorporated multi-product behaviour by the firms. The effects can be seen by comparing the mark-up on the Pontiac Pursuit and the Hyundai Elantra. While the marginal costs of both vehicles are similar, GM chooses to put a much higher mark-up on the Pontiac. The reason is simply that 9 of the 32 models in the small car segment are owned[25] by GM and it takes into account that lowering the Pontiac's price will to a large extent merely cannibalize the sales

[24]We aggregated brands into corporate groups—denominated by "firms" in the paper. For example, even though Ford does not own Mazda outright, we assume their ownership share gives Ford enough influence to make sure externalities of Mazda pricing on Ford vehicles are included in Mazda's decision making. Table 2.9 below contains a list of the "firms" in the market.

[25] In light of the previous footnote, "owned" should really be interpreted as "controlled", as it includes Suzuki vehicles.

of its other offerings in the segment. The substitution patterns in Table 2.3 illustrate clearly that the bulk of cross-model substitution happens within each segment. The same reasoning explains the similar mark-up between the Chevrolet Equinox and the Hyundai Santa Fe in the small SUV segment, even though the estimated marginal cost for the Chevy is $4,500 higher.

The much smaller mark-ups for the small SUV segment versus the small car segment results from the higher average price for SUVs combined with the restrictive functional form assumption for demand. Given that the substitution patterns within each segment dominate and that prices are relatively similar within each segment, the impact of this on the trade policy simulations is likely to be second order as cross-product substitutions are not affected by this.

We now have all the ingredients—a demand system, imputed marginal costs for each model, and a market equilibrium assumption—to turn to the counterfactual policy experiments.

2.4 Simulating trade policy changes

In this section, we rely on the previously discussed results to perform four counterfactual policy simulations. We look at the impact of four trade policy changes on a number of important economic variables. The policy changes for Canada that we consider are:

- FTA (only) with South Korea
- FTA (only) with Japan
- FTA (only) with the E.U.
- Unilateral abolition of the Canadian import tariff on final vehicles

Currently, Canada imposes a 6.1% import duty on finished vehicles. In each of these four scenarios we will investigate how the market equilibrium would look differently if vehicles imported from one or more countries would be exempt from the import duty. A number of caveats are in order before we turn to the discussion of the results:

1. We do not consider domestic content requirements in this exercise. It is likely that any FTA agreement would specify domestic content rules, much like those in force under

NAFTA. We simply assume that all relevant firms would (costlessly) be able to satisfy those rules[26].

2. One should not interpret the results as a prediction of the likely future effects of such trade policy changes. We calculate what the market equilibrium would have looked like in 2005 if an alternative trade regime would have been in effect.
3. The results do take into account responses of only indirectly affected firms. The competitive situation and hence the optimal prices for domestically produced vehicles will differ if one or more importers are suddenly exempt from import duties. We let all market participants adjust to the new situation. Hence, our results should be interpreted as long-term effects.
4. We only vary the marginal costs of firms for which the import regime changes—as they do not have to pay duties anymore. In order to impute the marginal costs that rationalize the observed price vector, we had to assume marginal costs are constant, i.e. do not vary with output[27]. As such, the only thing that changes for domestic producers is the degree of competition.
5. The effects of the newly opened Hyundai plant in Alabama and the Toyota plants under construction in Texas and Baja California are not incorporated yet into this analysis.
6. With our model we are able to analyze the domestic Canadian market. We will study the impact of trade policy on sales, pro-

[26] As noted earlier, in the last two policy simulations we do not modify the duty treatment of the vehicles assembled by BMW or Mercedes-Benz in the U.S. Currently these vehicles do not satisfy the NAFTA domestic content requirements and incur duties when imported into Canada. Under an FTA with Europe or under unilateral free trade by Canada it would be reasonable to assume these vehicles would also be exempt from duty (as their joint E.U./NA domestic content will far exceed any plausible threshold). It would have been too time consuming to adjust our simulation programs to take this into account. Note that only 5000 vehicles annually are affected by this shortcoming, a mere 0.3% of the Canadian market.

[27] This assumption is made throughout in the literature. Relaxing it would directly affect all firms' first order conditions and severely complicate the calculation of a new equilibrium.

duction, imports, prices, mark-ups, profits, consumer surplus, and tariff revenue. We will break down the impact by the origin of production—produced in Canada or imported from one of the four other regions. However, we do not look at total Canadian production. Demand in other countries is unlikely to be affected in any important way by a change in Canadian import tariffs. As a result, Canadian production for export is assumed to remain unchanged. Furthermore, we cannot discuss the impact of an FTA with China or Mercosur, because that would be mere speculation at this point—how to know the elasticity of substitution between a Dodge Caravan and a not-yet-introduced Chinese-made vehicle?[28]

With these caveats in mind, we now turn to the results from the trade policy simulations. The actual and predicted levels of all economic variables are in Table 2.5. The four different policy changes are reported in the different columns. Table 2.6 contains the same results, but shows all effects as percentage changes relative to the 2005 baseline case. First, we discuss our calculations by introducing the results for the actually observed market equilibrium in 2005.

2.4.1 The baseline case: 2005 Canadian automobile market

The actual quantities of all the relevant economic statistics for 2005 are in the first column of Table 2.5. The average quantity-weighed price was just over $25,000. The average mark-up, again weighted by sales, was 31.1% which implies that the average marginal cost was $19,124. Note that this marginal cost excludes all fixed costs involved in making, marketing, and selling a vehicle: designing the vehicle, building and maintaining an assembly plant, retooling all capital equipment, all advertising and marketing expenses that are independent of the actual number of cars sold, fixed costs of maintaining a dealership network, etc.

[28] In Section 4, when we study automotive components, those regions will be studied.

The average price of vehicles produced in Canada is $822 below the national average, while the average American- or Mexican-made vehicle is $591 more expensive than the national average. Not surprisingly, the average European import is much more expensive—at $41,728—and the average Korean import much cheaper—at $17,678—while Japanese vehicles most closely resemble Canadian vehicles. In line with the earlier discussion, we find again that more expensive vehicles are associated with lower mark-ups. Note that throughout we will use the term Canadian vehicles for vehicles produced in Canada, including foreign nameplates such as the Honda Civic or Lexus RX220. Korean vehicles, on the other hand, will include vehicles badged by Hyundai and Kia, but also some Chevrolets and Suzukis. In the same spirit, Canadian profits are meant to indicate all variable profits made on vehicles produced in Canada, irrespective of the owner.

Total sales in Canada in 2005 amounted to almost 1.6 million vehicles, cars and light trucks combined; more than ¼ of these vehicles were assembled domestically[29]. Of course, the vast majority of cars assembled in Canada are exported, but as mentioned earlier, we assume Canadian exports are unaffected by trade policy changes and do not discuss them further. Canadian imports total 1.17 million and just over 2/3 of these come from the U.S. or Mex-

[29] Total Canadian sales of models that are produced in a Canadian assembly plant (and possibly in other plants as well) adds up to 401,292 units for the 2005 model year. Note that total production of these models is much higher as the majority of output is exported. Note also that actual domestic sourcing of Canadian-made vehicles is bound to be lower as firms produce some of their highest volume vehicles in a second assembly plant in the U.S. As actual configurations produced differ between plants, some Canadian demand for a vehicle produced domestically will be filled by U.S. plants. For example, in 2005 DaimlerChrysler sold 216,857 vehicles in Canada, 34,979 of these were produced locally. Total sales in Canada of the Dodge Caravan, produced in Windsor and St. Louis, exceeded 60,000. Similar problems exist for GM (Canadian demand of the Chevrolet Silverado and GMC Sierra, produced in Oshawa, exceeds their "total Canadian production for sale in Canada". For Honda (Civic) and Toyota (Corolla), the problem exists as well, but it is not as large. In absence of information at the model level of the final destination of vehicles, we are forced to use the definition of Canadian production we adopted.

ico, entering the country duty-free under NAFTA. The market share of cars made in Japan is 11.3%, which translates into a Japanese import share of 15.2%. For South Korea, the comparable statistics are 8.6% and 11.5% and, for the E.U., market and import shares are 4.5% and 6.0% respectively. Note that these shares differ from those in Table 2.1 as the model characteristics in that table are not weighted by sales volumes[30].

Converting the implied consumer surplus into a dollar amount using the estimated price coefficient yields a surplus of $33.8 billion—or an average of almost $29,000 per sold vehicle. This is the aggregate utility value over and above the sales price consumers attach to their new vehicle purchases. This implausibly high estimate is due to the fact that consumers get vehicle-specific draws in their utility function and, as a result, people tend to buy cars that give them a high utility level for factors mostly unexplained by the model. While this is a major problem investigating the introduction of new goods, see Petrin (2002), in the current application we do not change the range of models for sale in the market. While the level of the surplus is likely to be unreliably estimated, we will only look at changes. Aggregate variable firm profits are on the order of $11 billion, 26.7% of which are earned on vehicles made in Canada—approximately in line with the Canadian production share. Note, once again, that these are variable profits and that they include all the fixed costs firms incur. They are entirely incomparable to the accounting profits that firms have to report. Given that fixed costs are, by definition, fixed, we can still use the profit measure to get a reliable estimate of how trade policies will affect firms' profitability.

[30] While only 10% of the observations are models produced in Canada, they represent 25% of sales.

Table 2.5 Trade policy simulations: levels (model year 2005: Sept. 2004 – Aug. 2005)

	Actual situation in 2005	FTA with: South Korea	FTA with: Japan	FTA with: E.U.	Unilateral elimination of Canadian tariff
Aggregate effects on:					
Price (average)	$25,134	$25,045	$25,066	$25,372	$25,210
Mark-up (average)	31.3%	31.5%	31.4%	31.2%	31.5%
Demand	1,574,635	1,578,561	1,583,037	1,581,758	1,593,770
Canadian production	401,292	399,155	397,500	398,327	392,624
Imports (NA + ROW)	1,173,343	1,179,406	1,185,537	1,183,431	1,201,146
Consumer surplus (mil.)	33,819	33,914	34,022	33,991	34,283
Firm variable profits (m)	11,034	11,053	11,071	11,078	11,131
Firm profits in Canada	2,948	2,930	2,920	2,926	2,881
Tariff revenue	426	333	235	270	(
Domestic welfare (mil.)	37,193	37,177	37,177	37,187	37,164
Effects, broken down:					
Prices					
– Canada	$24,312	$24,314	$24,304	$24,256	$24,253
– U.S. & Mexico	$25,725	$25,732	$25,673	$25,598	$25,559
– South Korea	$17,678	$17,343	$17,648	$17,674	$17,309
– Japan	$23,505	$23,504	$23,603	$23,262	$23,343
– E.U.	$41,728	$41,774	$41,546	$44,016	$43,913
Mark-ups					
– Canada	32.4%	32.4%	32.4%	32.4%	32.4%
– U.S. & Mexico	29.9%	29.9%	29.9%	30.0%	30.0%
– South Korea	40.7%	41.7%	40.7%	40.7%	41.6%
– Japan	33.1%	33.1%	33.3%	33.3%	33.4%
– E.U.	18.9%	18.8%	18.9%	18.8%	18.8%
Quantities					
Canada (production)	401,292	399,155	397,500	398,327	392,624
U.S. & Mexico (import)	789,553	784,260	779,134	782,880	767,776
South Korea (import)	135,378	148,538	133,259	134,913	145,769
Japan (import)	178,319	176,753	205,255	175,698	200,315
E.U. (import)	70,093	69,855	67,889	89,940	87,285

Finally, we can also calculate the government's tariff revenue from imported vehicles. The model does not provide us with the import value of the vehicle that we can use to calculate the duty on. In absence of any other plausible magnitude, we use the estimated marginal cost for each vehicle as base to calculate duties (on average, across all vehicles, marginal cost is 70% of the final consumer price). While this excludes some of the fixed costs likely to be subject to tariffs, it includes any costs incurred in the distribution channels which should be excluded. Overall, we are not likely to misestimate tariff revenue by much and in addition, we are mostly concerned with changes over time. In 2005, our assumption leads to Canadian tariff revenue of $426 million, or just above $1000 per imported vehicle on average—note that vehicles imported from the U.S. or Mexico are excluded from duties.

Our measure of domestic welfare in the final goods sector of the industry is the sum of consumer surplus, profits earned on vehicles assembled in Canadian plants, and the government's tariff revenue.

2.4.2 FTA with South Korea

In the second column of Table 2.5, the relevant statistics are reported calculated from a new industry equilibrium where Korean imports are not subject to the 6.1% import tariff anymore. The first column of Table 2.6 contains the same results, expressed as changes from 2005. For the discussion, we will focus on Table 2.6[31].

[31] These statistics are calculated by computing a new price equilibrium from the vector of first order conditions for all firms. Bresnahan (1987) contains a very clear discussion of the derivation of the first order condition for multi-product firms. The marginal costs for Korean-made vehicles are lowered by 1/1.061 and using a contraction mapping the new price vector is calculated. Note that all elasticities and cross-price elasticities enter the first order conditions and influence the calculated price change. From the estimated demand system we can then calculate all new quantities, profits, trade flows, profits and consumer surplus.

Table 2.6 Trade policy simulations: changes

	FTA with: South Korea	Japan	E.U.	Unilateral elimination of Canadian tariff
Aggregate effects on:				
Price (average)	-0.35%	-0.27%	0.95%	0.30%
Mark-up (average)	0.16%	0.07%	-0.09%	0.11%
Demand	0.25%	0.53%	0.45%	1.22%
Canadian production	-0.53%	-0.94%	-0.74%	-2.16%
Imports (NA + ROW)	0.52%	1.04%	0.86%	2.37%
Consumer surplus	0.28%	0.60%	0.51%	1.37%
Firm profits	0.17%	0.33%	0.40%	0.88%
Firm profits in Canada	-0.61%	-0.96%	-0.77%	-2.29%
Tariff revenue	-21.83%	-44.84%	-36.62%	-100.00%
Domestic welfare	-0.04%	-0.04%	-0.02%	-0.08%
Effects, broken down:				
Prices				
– Canada	0.01%	-0.03%	-0.23%	-0.24%
– U.S. & Mexico	0.03%	-0.20%	-0.49%	-0.65%
– South Korea	-1.90%	-0.17%	-0.02%	-2.09%
– Japan	0.00%	0.42%	-1.03%	-0.69%
– E.U.	0.11%	-0.44%	5.48%	5.24%
Mark-ups (percentage point change)				
– Canada	-0.03%	-0.01%	0.03%	-0.01%
– U.S. & Mexico	-0.02%	0.00%	0.07%	0.05%
– South Korea	0.96%	0.00%	-0.01%	0.94%
– Japan	-0.02%	0.17%	0.18%	0.34%
– E.U.	-0.03%	0.02%	-0.09%	-0.11%
Quantities				
Production — Canada	-0.53%	-0.94%	-0.74%	-2.16%
Imports — U.S. & Mexico	-0.67%	-1.32%	-0.85%	-2.76%
Imports — South Korea	9.72%	-1.57%	-0.34%	7.68%
Imports — Japan	-0.88%	15.11%	-1.47%	12.34%
Imports — E.U.	-0.34%	-3.14%	28.32%	24.53%

The average price in the Canadian market is predicted to be 0.4% lower under an FTA with South Korea than the actual price observed in 2005. This is the combined effect of four influences. We will discuss each of these tendencies in detail for the FTA with Korea, but the same factors will operate in all other trade policy simulations. In the different policy scenarios discussed in the following sub-sections, the relative importance of each effect will vary substantially.

First, as a result of the import duty exemption, South Korean producers have a lower marginal cost which, ceteris paribus, lowers the market price. If their mark-ups would have been unchanged and if there were no response from competitors, all Korean prices would have been reduced by 5.75% (1-1/1.061). The model predicts the average Korean price to decline by only 1.9%, so more factors are at work. The pass-through to consumers of the tariff elimination was clearly less than 100%.

The second effect, which is directly within the Korean firms' control, is that, with the new marginal costs, optimal price-cost margins change. In particular, given that costs are lower, without changing mark-ups Korean vehicles would be priced at a lower point on the demand curve, where the elasticity of substitution is lower, and the optimal response would be to increase prices. The results indicate that the average mark-up did increase by 1%. We should point out that the size of this effect is likely to be overestimated because our functional form of demand imputes a very low demand elasticity for cheaper cars, a defining feature of many Korean vehicles. Furthermore, while the sole Korean firm is obviously most affected by this policy change—Hyundai imports 14 models that it assembles in Korea into Canada—GM's Daewoo subsidiary also exports 6 models to Canada, two of which are badged as Suzukis, one as a Pontiac and three as Chevrolets. Almost 1/3 of Korean imports in Canada are GM products.

Third, competitors will react to the Korean price cuts—the net effect of the lower marginal cost and the higher mark-up is to lower prices. The results indicate that the competitive responses of competitors are limited. Statistics in Table 2.7 indicate that the raw average price change of vehicles produced in Korea is -3.57%, while the price drop is several orders of magnitude smaller, between -0.01% and -0.03% for goods produced elsewhere. Note, once again that the price response of other producers will in turn lead to successively smaller price responses of Korean firms, etc. The statistics in Table 2.7 are the result of the eventual convergence of all these price responses, where no firm has any incentive to change its price anymore.

European producers have very little overlap with Koreans, most of their vehicles are in different segments, and they have the lowest price response. Several vehicles made in Canada, the first line in Table 2.7, are in segments where Korean vehicles are important, lower cars and lower SUVs and we find a larger response for Canadian-made vehicles. Disaggregating the price changes in Table 2.7 further (numbers not reported in the table) would reveal that Canadian-made vehicles in the small car segment see a 0.07% price drop, while those in the luxury car segment become only 0.02% cheaper. Similarly, averaged over all non-Korean producers, small SUVs become 0.05% cheaper while there is no noticeable price change in the upper SUV segment—where no Korean-made cars are sold.

Table 2.7 Average price change in response to trade policy change

	FTA with:			
Vehicles produced in:	**South Korea**	**Japan**	**E.U.**	**Unilateral elimination of Canadian tariff**
Canada	-0.03%	-0.02%	-0.06%	-0.11%
U.S. & Mexico	-0.02%	-0.05%	-0.02%	-0.08%
South Korea	-3.57%	-0.08%	-0.02%	-3.67%
Japan	-0.02%	-4.44%	-0.07%	-4.54%
E.U.	-0.01%	-0.06%	-4.81%	-4.87%

Fourth, composition effects cannot be ignored. In Table 2.6, average price changes are minimal for all other regions, but looking at further digits reveals that they are positive. As the results in Table 2.7 clearly indicate, this does not imply that firms actually increase their prices—in fact the price of every single vehicle sold in Canada declines with the FTA. Rather, it implies that the composition of goods sold changes. Given that Korean products—which tend to be priced at the low end of the market—are even more competitive after the trade policy change, other producers lose sales there, which changes the weight on their average price towards more expensive vehicles.

Similarly, the 5.75% decrease in Korean marginal costs combined with the 1% increase in the mark-up does not translate into 4.75% lower prices because the composition of sales also changes for Korean firms. This is the result of two factors that lead to a higher relative weight on more expensive vehicles also for Korean producers. First, given that the demand elasticity is estimated to be increasing in price, a much greater fraction of the tariff savings are passed along to consumers of more expensive vehicles. It improves the competitive position of Korean vehicles much more in more expensive segments (middle cars and lower SUVs). Second, Korean firms are not as well represented in these upper segments, so their lower prices are less likely to lead them cannibalizing their own sales. In the lower SUV segment only 10% of the models are produced in Korea, as opposed to 30% of lower car models. Both factors lead to higher sales increases for more expensive Korean vehicles, which increases their average price.

Given this elaborate discussion, the rest of the results should be straightforward:

- Average prices fall slightly, which is mainly driven by an imperfect pass-through of the tariff reduction on Korean vehicles and to a lesser extent the result of competitive responses by other producers.
- Average mark-ups increase for Korean firms, mainly as a result of their lower marginal cost. Foreign firms lower their mark-ups slightly, both as a competitive response to the Koreans and as a compositional effect as their sales become more heavily weighted towards expensive vehicles.
- Aggregate vehicle sales increase, not surprisingly, as the average price of every vehicle sold in Canada declines. The pattern follows the mark-ups. The magnitude of the increase is lower than the price increase (even though virtually all ve-

hicles are priced on the elastic portion of demand), because mark-ups increase as well.

- Korean imports increase, while all other regions—including production in Canada—lose. We conjecture that the current demand system—with elasticities being uniformly increasing in price—underestimates the impact of the Korean output response. The Korean import response is sufficiently large that net Canadian imports increase for sure.
- Lower prices lead to a higher consumer surplus, but less profit is made on vehicles produced in Canada—providing opposite effects on aggregate welfare.
- Tariff revenue for the government is reduced by almost 22%.
- If we look at aggregate welfare in dollars terms, Table 2.5, we find that consumer surplus increases by $95m, made-in-Canada profits fall by $18m, and government revenue falls by $93m, for a net Canadian loss of $16m or a mere 0.4% of the welfare generated in this industry. Two caveats go with this finding. First, a demand system that estimates a higher demand elasticity for vehicles made in Korean—which seems plausible—would increase the benefits. Second, the loss in firm profits will to some extent accrue to the foreign owners of the Canadian plants (U.S. and Japanese corporations)—although part of the increase in variable profits might be captured by the workforce. This might lead one to discount the profit loss in Canadian welfare calculations.

2.4.3 FTA with Japan

The gist of the analysis associated with a Japanese FTA is similar to the analysis in the preceding sub-section. The demand elasticities in Table 2.8 preview the effects one can expect. Even if we limit attention to cars—the pattern on light trucks which are on average more expensive would be similar—Korean firms have a median demand elasticity significantly below the median for all other production regions, especially below Japanese or European imports. The last column of Table 2.8 contains these demand elasticities for all cars. As mentioned earlier this is a combination of the functional form of our demand system as well with a crowded product space in more expensive segments of the market.

Importantly, the large difference in the last column is for the most part a compositional effect. Within each market segment the differences between the regions are much smaller. Korean cars simply tend to be positioned predominantly in the small car segment, where demand elasticities are estimated to be low for all producers. This fact will work its way through the entire analysis.

One notable effect is that even though Japanese firms lower their prices on every single vehicle in every segment—90% of the Japanese price reductions range between 3.6% and 5.1%, indeed very close to complete pass-through—the composition effects are so strong that the average sales-weighted Japanese price ends up 0.42% higher under an FTA with Japan. This is largely the result of very expensive Lexus, Acura, and Infiniti products that see relatively large sales increases and pull up the average Japanese price. Given that these models are priced at the very elastic point of the demand curve, pass-through of the tariff savings is almost perfect, while at the same time consumers are estimated to be very price responsive.

Table 2.8 Median own-price demand elasticity for all car segments

	by car segment:			
Vehicles produced in:	**Small**	**Medium & large**	**Luxury**	**All cars**
Canada	-2.47	-3.74	-3.29	-3.44
U.S. & Mexico	-2.60	-3.94	-8.14	-4.01
South Korea	-2.05	-4.56		-2.52
Japan	-2.57	-4.48	-7.04	-5.00
E.U.	-3.04	-4.75	-9.46	-6.99

Mark-ups are estimated to change less than with the Korean FTA, which is the result of a much smaller share of Japanese vehicles in the lowest price segments. The best-selling Toyota, Honda, and Nissan small cars are all produced in North America. Given that mark-ups are estimated to be lower in the more expensive segments, we find less of a response by Japanese firms as well as by competitors. Notably, the largest effect is for European producers which compete with Japan-made cars in all luxury segments.

Because the estimated pass-through of the tariff savings is higher than in the Korean FTA case and because the estimated demand elasticity for Japanese products is higher on average, the estimated import increase of Japanese cars and light trucks is higher, at 15.1%. This increase works its way into higher total imports in Canada, 1.04% higher, and lower domestic production, a change of -0.94%.

While the average price drop is lower under an FTA with Japan than with Korea, -0.27% versus -0.35%, to a large extent this is caused by consumers trading up and purchasing more expensive Japanese imports. The increase in consumer surplus is twice as high as in the previous analysis, +0.60% versus +0.28%.

While 2005 imports of Japanese vehicles were only 32% higher than Korean imports, the average value of these vehicles was much higher. As a result, the cost of the FTA in lost tariff revenue for the Canadian government is estimated to be more than twice as high as in the previous sub-section, -44.8% versus -21.8%. As a result of this final factor, and in spite of the robust consumer gains with a Japanese FTA, overall Canadian welfare is estimated to be lowered by exactly the same amount as in the preceding analysis, -0.04% or $15m. However, the distribution of that amount is noticeably different. Consumers would gain $203m, more than twice as much, while the bulk of the loss would fall on the government. Of course, indirectly this burden falls on the taxpayers, approximately 80% of which bought the outside good (i.e. not a new car) in 2005.

2.4.4 FTA with the E.U.

Finally, the higher demand elasticity of the median European car in every segment, see Table 2.8, leads to qualitatively similar results as in the Japanese FTA case, but with even stronger compositional effects. For example, the average price is predicted to increase, as the extremely expensive European vehicles gain market share. The same compositional effects, lead to a lower weighted-average European mark-up, as percentage mark-ups are estimated to be lower for more expensive vehicles. The intermediately-priced Japanese producers, on the other hand, see sales of their most expensive vehicles decline, which raises their average mark-up.

The price responses are rather impressive. The average Canadian price is estimated to increase by almost a full percentage point, even though the average mark-up goes down. Consumers trade up to more expensive vehicles very aggressively, which leads to an increase in consumer surplus almost as large as under the Japanese FTA—even though European imports numbered less than half of Japanese imports in 2005. This surge in expensive car purchases also boosts firm profits, which on average rise by 0.40%, although lower domestic production hurts Canadian producers. As before, the loss of tariff revenue on the expensive European imports is estimated to set Canadian tariff revenues back a full 36.6%, a revenue loss almost twice as high as under the Korean FTA even though Korean imports, in units, were almost double European imports in 2005. When all is said and done aggregate welfare hardly budges, falling by $6m or about 20c per Canadian.

We do not discuss these results at length because they depend crucially on the high demand elasticity for expensive vehicles. 30 of the 38 European imports are in the luxury car or large and luxury SUV segments. Even the three European entries in the small car segment are among the 10 most expensive vehicles in that segment. While only 17% of models sold in Canada are assembled in Europe, 56% of the luxury car segment entries are.

Moreover, the 38 European imports are sold by 6 different firms while the 20 Korean imports are sold by only 2 firms. As a result, in the case of a European FTA, multi-product considerations are not holding firms back from lowering their prices.

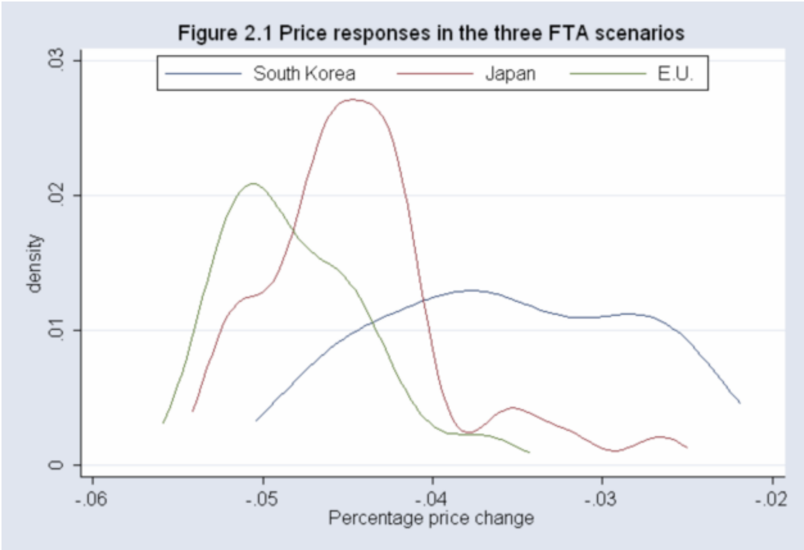

Figure 2.1 Price responses in the three FTA scenarios

The effects of this very different market presence and ownership structure for firms from the different regions shows up directly in the price adjustments to the different FTAs. The lines in Figure 2.1 plot a smoothed histogram for the distribution of percentage price changes under the three different scenarios only for the models that gain a direct advantage of the policy change, i.e. the price changes for Korean-made vehicles are plotted only in the case of the Korean FTA, and similarly for the other two regions. The green line represents the distribution of price responses for European-made cars under an FTA between Canada and the E.U. Clearly price changes are concentrated around -5.1%, very close to the 5.75% that would indicate complete pass-through of tariff changes. In contrast, the red line for vehicles made in Japan shows many more intermediate price changes, around -4.3%, while the blue line for Korea indicates that for many of those models price reductions are less than half of the tariff reduction.

While the extent of substitution between imports and domestic production and between the imports of the different countries is likely to be robust to the other specifications of the demand system, this difference in average price responsiveness by region hinges crucially on the average difference in demand elasticity. It is not impossible that consumers purchasing the expensive vehicles are indeed as price sensitive as the demand model predicts, but to increase confidence in the results, we would like to see how high the α coefficient on price would be estimated when price changes over time are used to identify the coefficient, rather than an identification solely from the cross-section of vehicles as is currently the case. Also, a more general demand model should ideally either incorporate a random parameter on the price or different nesting parameters by segment. Unfortunately, incorporating these changes would require much more data and take a lot of time.

2.4.5 Unilateral elimination of the Canadian import tariff

Finally, a unilateral elimination of the import tariff by Canada, results are in the final columns of Tables 2.5 and 2.6, is predicted to lead to the largest drop in aggregate welfare of the four trade policy experiments. One might be surprised by this finding, as the common economic wisdom predicts that free trade is good for welfare, or not? One should not forget that this is a concentrated industry with differentiated goods and firms are expected to have a lot of market power. Moreover, distributional effects between consumers, domestic and foreign profits, and the government are crucial.

In particular, consumers are estimated to gain the equivalent of \$464m in consumer surplus, while Canadian producers are expected to lose \$67m on their domestically produced vehicles—relative to the 2005 baseline. However, these same firms are also importing a lot of vehicles, and on average the worldwide firm profits are predicted to increase by \$97m.

The results in Table 2.9 break the aggregate profits down by firm. Firms that rely more on imports are likely to gain most. Most prominent are Hyundai, BMW, Nissan, and Ford. Note, however, that the new Hyundai plant in Alabama will lower the expected benefits that Hyundai can hope to achieve from tariff elimination. Only firms that produce a large fraction of their Canadian sales domestically, especially GM and to a smaller extent also Honda and DaimlerChrysler, stand to lose from the Canadian elimination of the import tariff.

Table 2.9 Change in profits without the Canadian import duty (by firm)

Corporate group	2005 profit	Change in profit without import duty	
	(million $)	(million $)	(%)
GM	$3,601	-$60	-1.67%
Ford	$2,136	$22	1.04%
DaimlerChrysler	$1,625	-$4	-0.25%
Toyota	$1,150	$15	1.33%
Honda	$962	-$11	-1.10%
Hyundai	$585	$53	9.00%
Nissan	$456	$24	5.35%
Volkswagen	$219	$13	6.17%
BMW	$140	$25	18.04%
Subaru	$93	$8	8.92%
Mitsubishi	$58	$3	4.90%
Porsche	$12	$8	64.23%
Total	$11,034	$97	0.88%

Note: The corporate groups include partially owned subsidiaries: GM includes Suzuki and Ford includes Mazda

So while consumers would gain from such a trade policy and most of the firms would as well, the Canadian government would lose $426m in tariff revenue, or approximately $24 per labor market participant, which is not negligible. On the other hand, the higher price for the average vehicle combined with higher demand would increase sales tax. Additional GST revenues would run to $42m for the federal government and a similar amount for the provinces. These numbers are not included in the welfare calculations because a gain for the government would be a loss to consumers.

At the same time Canadian production is estimated to decline by 8,668 units annually. While this is not nearly enough to noticeably impact assembly plant capacity decisions, no doubt some jobs would be lost—including employment in supplier plants—and some workers would face transition costs. On the production side, it is notable that the U.S. and Mexico would be slightly harder hit than Canada in percentage terms, but in total units of production the sales decline south of the border would total 21,777 units. Given the compositional effects discussed earlier, it is no surprise to find that although all three importing regions benefit, the import gains go disproportionately to the E.U., which sees its imports increase by almost 25% versus only 7.7% for Korea.

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3. Impact on FDI in assembly plants

This section assesses the potential impact of eliminating MFN tariffs discussed in section two above for new vehicles on the location decisions of auto assembly in North America, particularly in Canada. What will be the impact of Canada's bilateral or regional FTAs, those already in existence and those under negotiation (such as Canada-Korea) on other trading partners' location decisions in Canada?

A tariff on final vehicle imports provides incentives for foreign firms to establish local production capacity to avoid the tariff, so-called tariff-jumping. While at the margin the effect certainly exists, current tariff levels are sufficiently low and the overcapacity in the industry sufficiently large that we do not expect much of an impact. The expected cost of the elimination of the tariff on final vehicle imports is the product of the following four factors:

(1) Probability that a foreign firm will decide to build a new assembly plant in North America in the near future.
(2) If such an investment would take place, the probability that the elimination of the Canadian tariff would stifle the project.
(3) If such an investment would have taken place, the probability that a site in Canada would have been chosen over one in the U.S. or Mexico.
(4) Net benefit of an assembly plant to Canada.

Each of these four factors will be discussed separately in subsections 3.1–3.4. We will argue that (1) few new capacity additions in North America can be expected in the next decade; (2) the impact of Canadian trade policy on such FDI decisions is likely to be minor; (3) the likelihood of any future investment in North America assembly capacity going to Canada is lower than in more central locations; (4) a significant fraction of the value to the Canadian economy will be "lost" to the firm making the investment in the form of a subsidy to attract the FDI in the first place.

Moreover, if a change in Canadian trade policy is matched by a similar tariff concession abroad, the effect would also work in reverse, as discussed in Section 3.5. Tariff-jumping FDI abroad would stop, potentially increasing investment in new or existing North American plants.

3.1 New capacity additions in North America

The probability that a firm will expand assembly capacity in North America beyond the currently announced expansion plans is fairly small. Table 3.1 indicates the number of assembly plants in operation over the last thirty years. Even though the production level in North America was higher in 2004 than in 1985 (see Figure 1.1A), the number of assembly plants has remained more or less constant. Canada and the North-East of the United States have seen a loss in plants, and more closures have been announced. Mexico and the U.S. South-West, on the other hand, have seen more plants open than close over the last decade; these areas have been particularly popular with transplants—foreign producers.

Table 3.1: North American assembly plants (1975-2004)

	1975	1985	1995	2004	announced
Total plants	68	85	88	84	
By country					
Canada	10	12	14	10	+1, -1
USA North/East	35	46	43	41	-3
USA South/West	18	18	18	22	+2, -1
Mexico	5	9	13	11	1
By ownership					
American1	66	79	70	65	-5
Asian	1	4	14	16	4
European	1	2	4	3	

Notes: 1 Includes plants now owned by DaimlerChrysler; Ford will announce assembly plant closures in January 2006, the expectation is 3-4
Source: Ward's Automotive Yearbook (various years) and Ward's Infobank (2004)

A net decrease in capacity in the coming years is expected as GM and Ford are likely to close more plants than the European or Asian producers will open. In terms of FDI for Canada, it does matter where the transplants will put their new plants. For foreign producers that operate only a few plants on the continent, it is often advantageous to locate them close by one another so they can share suppliers more easily. Moreover, now that most cars and light trucks are produced in smaller model runs in a single plant and shipped across the continent, economizing shipping costs makes the centre of the continent relatively more attractive than Canada[32].

Table 3.2 lists each foreign firm currently selling vehicles in North America with their production and sales statistics for 2002. Firms are ordered by total sales; it is also indicated what fraction is satisfied by domestic production, and how many vehicles are imported.

Toyota has just completed construction of a compact pickup plant in Baja California, Mexico and will start production at its full-size pickup plant in Texas in 2006. It has announced a new plant for compact SUVs in Woodstock, Ontario. Production of each of these plants is not factored into Table 3.2 yet and they will add at least 400,000 vehicles to Toyota's North American production capacity. Given the high growth rate of Toyota's North American sales—it consistently averages almost 10% in Canada and the U.S. and it only recently entered the Mexican market—a new plant is certainly on the horizon.

Honda has also seen large sales increases, but in 2002 it only imported 334,000 vehicles. While this is certainly enough to fill an assembly plant, this total comprises a wide range of models that even with Honda's flexibility would be hard to produce in one plant. Honda now produces more vehicles in North America

[32] The changing geography of the industry in North America is a topic I cannot possibly do justice here. I refer the interested reader to recent work by Thomas Klier, senior economist at the Federal Reserve Bank in Chicago. His most recent analysis on the subject have appeared in the bank's *Economic Perspectives* series, third quarter of 2005. *Chicago Fed Letters* in February 2005 and March 2006 have featured articles on the transition of the auto supplier industry with a particular focus on the role of the Midwest. On the other hand, the analysis in the presentation that Sean McAlinden of the Center for Automotive Research gave at the April 2006 conference on "The New Geography of Auto Production" organized by the Chicago Fed in Detroit was much more critical of the North-South shift (the presentation is online at the web site of the Chicago Fed).

than in Japan. Its North American sales have increased a lot in the last three years as it entered many new segments, especially in light trucks. In the past, Honda added a second assembly line to an existing site (Marysville, OH and Alliston, Ontario) to increase capacity. Especially its latest plant in Lincoln and its Mexican plant are still a lot smaller than their other operations and could be expanded before Honda ventures to a new site.

Table 3.2: North American production and sales of foreign firms

	Production	Sales		
		total	domestic	imported
Toyota[1]	1,196,019	1,912,729	1,110,753	801,976
Honda	1,138,717	1,443,595	1,109,618	333,977
Nissan[2]	750,925	1,016,167	714,512	301,655
Volkswagen	332,876	662,585	297,211	365,374
Hyundai		442,036		442,036
Mitsubishi[1]	174,466	349,200	170,268	178,932
Mazda1	47,603	329,353	120,151	209,202
BMW	124,374	280,295	58,662	221,633
Kia		266,359		266,359
Subaru-Isuzu[1]	131,833	255,438	137,912	117,526
Mercedes-Benz	102,983	231,315	43,337	187,978
Suzuki1	12,609	79,413	8,380	71,033
Daewoo		38,254		38,254
Porsche		22,793		22,793
Renault		15,386	11,185	4,201
Peugeot		9,148		9,148

Notes:
1 Production includes the shares in joint ventures: NUMMI (Toyota), AutoAlliance (Mazda), CAMI (Suzuki), Subaru-Isuzu, Diamond-Star (Mitsubishi). Includes Toyota production at NUMMI;
2 Nissan production includes its output for Renault in Mexico

The third largest transplant producer, Nissan, operates a huge plant in Smyrna, TN and two large Mexican plants. In 2002 it imported 302,000 vehicles and it is growing strongly recently. Given the closer integration with Renault, there are always rumours that the French automaker might consider a comeback to the U.S., but that is highly speculative.

After a number of lean years, Mazda is working its Auto-Alliance joint venture with Ford flat out, producing more than

260,000 vehicles at full capacity. The majority of these, however, are Ford Mustangs. Even with a string of very well received models, in 2004 the Mazda 3 became Canada's best selling passenger car, its total North America sales have not increased beyond its 2002 level. Given that Ford, which owns a controlling stake in Mazda has a lot of spare assembly capacity, greenfield investments by Mazda are not on the horizon.

Mitsubishi, Subaru, Isuzu, and Suzuki are in not in great shape and surviving is the first priority for these firms now. The proliferation of vehicles, discussed in Section 1.3, greatly increases the development burden for these smaller firms. Mitsubishi was associated with DaimlerChrysler and they were developing a compact car together, but that link has been severed. Subaru was partly owned by GM, but that stake was taken over by Toyota. It will take a long time to integrate production of Subaru's in Toyota plants, should Toyota choose to do so. Isuzu and Suzuki are still partly owned by GM, but their total sales would barely dent the surplus capacity at GM.

Summing up for the Japanese producers, Toyota is likely to increase its North American assembly capacity by at least one plant in the next decade. Honda and Nissan might consider investing as well, but their plant has to be either relatively small or extremely flexible, because their imports are a varied bunch. The recent decrease in the yen, the possibility to expand existing North American factories (outside Canada), and Honda's overcapacity in Japan, makes a new plant unlikely to happen soon.

The next investor in North American assembly plants will be Hyundai, which recently opened a plant in Alabama. Early 2006 it decided on a site in Georgia for its Kia subsidiary, nearby its Hyundai plant in Montgomery, AL so it can share suppliers for its two plants. Further capacity expansions are highly uncertain; the viability of the Kia plant already relies on a very ambitious sales projection and the Alabama plant will take some time to ramp up its production to its full capacity of 300,000 vehicles per year.

Finally, in 2003-04 the European producers were also considering North American assembly plants when the euro was breaking records on the currency markets on a daily basis. More recently, North American production capacity is not the highest priority for most manufacturers. Volkswagen, the largest European importer, has seen sales of its main brand slump and faces high restructuring costs and overcapacity in Europe. An Audi plant is not entirely impossible, but at sales below 100,000 it is unlikely. Mercedes-Benz does not produce any sedans in North America and quality control problems makes this an unlikely proposition for the near future. BMW produces less than 10,000 cars in Mexico and around 25,000 roadsters in Spartanburg. The majority of its sedans and even its new compact SUV are imported. Given that it is unlikely that the Mini, the 3 series and its larger cars can be produced efficiently together in one plant, a new BMW plant in North America is also highly unlikely.

In sum, for the coming 10 years that leaves one plant for Toyota, probably one plant for Honda, and maybe one for Nissan to substitute domestic production for imports[33].

3.2 Sensitivity of investment in vehicle assembly to Canadian tariffs

If an assembly plant satisfies domestic content requirements under NAFTA, it qualifies for duty-free exports to other NAFTA member states. In this case, the effect of the elimination of the Canadian import tariff on a firm's likelihood to go ahead with the project is independent of the actual location of the plant—discussed in the next Section[34].

If a firm were contemplating constructing a new plant anywhere in North America (or add capacity to an existing plant), we have to consider how the probability of an investment

[33] At the time this document was last revised, both Honda and Kia had confirmed that they will build their next assembly plant in the U.S. Toyota's announcement to built a second assembly plant in Ontario almost guarantees no further assembly investments of the company in Canada in the near future. That leaves only Nissan as a possible new investor and according to news reports, the Ontario government has already started talks with the company (The Canadian Press, May 17, 2006).

[34] If a plant is located in Canada or Mexico, satisfying the domestic content requirements is imperative for a plant's viability because of the size of the U.S. market.

would be affected by a Canadian tariff cut. Given that production of virtually all North American plants is sold over the entire continent, Canadian sales will be proportional to Canada's size in the North American market. In 2002 this share was 8.7% and declining over time. Value weighted its share will be even lower as the average price of vehicles sold in the much larger U.S. market is higher and the lower average price in Mexico applies to only approximately half as many vehicles as sold in Canada.

For trade policy, the scenario we are interested in is a foreign producer that in the presence of the Canadian tariff of 6.1% would decide to build a North American plant, but in absence of the tariff would cancel the investment. For a typical greenfield investment of 150,000 vehicles that would mean on average 13,050 vehicles heading towards Canada. At a ballpark out-the-factory-door cost of $20,000, the elimination of the Canadian tariff would tilt the balance of costs and benefits of the new plant by less than $16m against investing in North America.

One can think of a lot of other idiosyncratic changes that would have an equal, even larger, effect. Note that the annual output of the hypothetical plant is estimated to be worth $3b and that each 1% change in the value of the foreign currency would have more than double the effect of the Canadian trade policy. To put this in perspective, over the last year the dollar has appreciated 15% against the yen and 12.5% against the euro. These trends are approximately 30 times as important as any change in Canadian trade policy. Any increase in shipping costs per vehicle by $105, which is likely to be less than the impact of the recent doubling in fuel prices, would have an equal effect in favour of locating in North America. A change in labour costs at the assembly plant of only 3.5% would also have a comparable effect.

In sum, we believe that the share of any North American production heading for the Canadian market is too small for the Canadian tariff of 6.1% to have much of an impact. Throughout, we have assumed that the U.S. tariff levels, at 2.5% for cars and 4% for light trucks, remain constant. Given the much larger importance of the U.S. market, the elimination of U.S. tariffs on final vehicle imports would have an impact on foreign firms' location decisions that is more than five times larger.

3.3 New capacity additions: Canada versus the U.S. or Mexico

Even if a firm would change its investment plans in response to a Canadian tariff cut, it would only constitute a loss of FDI for Canada if the plant would have been constructed there otherwise. As long as firms produce vehicles that satisfy the NAFTA domestic content requirements, currently 62.5%, the location within the NAFTA area is independent of the individual countries' tariff levels. Even though import tariffs on final vehicles in the U.S. are lower than in Canada and much lower than in Mexico, this does not make the U.S. a more attractive location because all local production can be traded within the area duty free.

Assuming a firm wants to establish a new assembly plant in North America (analyzed in Section 3.1) and assuming that this investment would be cancelled if Canada eliminated its import tariff (analyzed in Section 3.2), we now investigate what the probability is that Canada would have been chosen for a new assembly plant site. The Canadian track record in attracting FDI is readily available. Table 3.3 lists the ten most recently constructed or announced light vehicle assembly plants in North America. Only one of those plants will be built in Canada. The Northern U.S., the traditional hotbed of the industry only received two plants (one of which was very small). Clearly, the most popular region has been the Southern U.S. and to a lesser extent Mexico.

Three factors are important for future North American plants. There are clear network effects in organizing one's supply chain. If two assembly plants are located reasonably close, they can use the same supplier even for parts which are just-in-sequence, i.e., for which suppliers cannot be farther than a 2–4 hours drive. This makes it likely that the new Kia plant, which is supposed to be the next North American plant, will be constructed close to the Hyundai plant in Montgomery, AL. Such co-location decisions by foreign producers make it also more likely that their preferred suppliers from their home country will join them in North America.

Table 3.3: Location of the most recent light vehicle assembly plants in North America

Plant name	Owner	Start-up	Product
Canada			
Woodstock, ON	Toyota	2007	Compact SUVs
Northern United States			
Mishawaka, IA	GM (AM Gen.)	2001	SUVs
Lansing Gr. Rapids, MI	GM	2001	Cars and light trucks
Southern United States			
Lincoln, AL	Honda	2001	Light trucks
Canton, MS	Nissan	2003	Full size pickups
Montgomery, AL	Hyundai	2005	Cars and SUVs
San Antonio, TX	Toyota	2006	Full size pickups
Mexico			
Toluca	BMW	1999	Cars
Toluca North	DaimlerChrysler	2001	Light trucks
Baja California	Toyota	2005	Compact pickups

Source: Ward's Automotive Yearbook (various years); Automotive News (various issues)

Of course, given that both Toyota and Honda already own plants in Canada, this could work to Canada's advantage. In the case of Toyota, the ability to share suppliers with its well-established Cambridge operation was crucial in the selection of Woodstock, Ontario for its seventh North American plant. It is not implausible that Honda will also look at Ontario sites should it decide to build a new plant in North America. Furthermore, given that a lot of FDI takes the form of expanding an existing facility, the presence of two Toyota, one Honda, and one Suzuki-GM plant in Ontario also opens the door to further capacity increases in Canada. Table 3.4 contains all active, announced, and recently closed Canadian assembly plants.

Table 3.4: Canadian final assembly plants (light vehicles)

Plant name	Owner	Capacity	Start-up	Closed
Active:				
Alliston 1	Honda	390,000	1986	
Alliston 2	Honda		1998	
Cambridge North	Toyota	270,000	1988	
Cambridge South	Toyota		1998	
Ingersoll	CAMI (GM-Suzuki)	100,000	1989	
Oshawa Truck	GM	275,000	1964 (?)	
Oshawa #1	GM	545,000	1954 (?)	-1/3 in 2006
Oshawa #2	GM		1954 (?)	2007
Oakville	Ford	290,000	1953	
St. Thomas	Ford	230,000	1967	
Bramalea, (Brampton)	DaimlerChrysler	240,000	1986	
Windsor	DaimlerChrysler	350,000	1928	
Announced:				
Woodstock	Toyota	100,000	2008	
Closed:				
Ste. Therese, QU	GM		1965	2002
Ontario Truck (Oakville)	Ford		1965	2004
Pilette Road (Windsor)	DaimlerChrysler		1975	2003
Halifax, NS	Volvo		1963	1998
Bromont, QU	Hyundai		1989	1993

Notes: Unless otherwise indicated, all plants are in Ontario, this comprises all remaining plants.

A second factor, already mentioned before, is the desire to minimize shipping costs for vehicles, which tend to be much greater than for parts. As long as the most popular vehicles had annual sales greater than the minimum efficient scale of a single assembly plants, several plants around the continent were set up to satisfy demand. Currently, this is only the case anymore for a few full-size pickup trucks. Most other vehicles are assembled in a single North American plant. This makes a central location on the continent more attractive, and works to Canada's disadvantage.

The third factor that plays a large role in the selection of an assembly site is government subsidies. There is a large literature on location incentive tournaments that pit multinational enterprises against the governments in whose jurisdictions they consider investing. It is uncertain to what extent the subsidies influence the investment decision, but they certainly have an impact on the location if the FDI goes ahead. The decision of Ford to completely overhaul its minivan plant in Oakville, which has been operating below capacity for a while, and Toyota's decision to locate its latest plant in Ontario were facilitated by the Ontario and federal governments' recent subsidy initiatives. In April of 2004, the provincial government made $500m in funds available under the Ontario Automotive Investment Strategy, to cover 10% of investment costs of projects exceeding $300m. The federal government launched the Canadian Skills and Innovations Project in June, 2004 and pledged $1b for Canadian manufacturing, half to match the Ontario initiative. While this indicates that the different Canadian jurisdictions are willing to enter the subsidy game to attract investment—making investments in Canada more likely—it also lowers the (remaining) value of an assembly plant to the economy, as the investing firm is able to extract some of the surplus.

Finally, it should be mentioned that a plant located in the U.S. could choose not to satisfy the NAFTA domestic content requirements and simply pay import duties on the (small) fraction of production that is exported to Canada. For example, the BMW plant in Spartanburg, NC and the Mercedes-Benz plant in Vance, AL are estimated to have only 35% domestic content, well below the 62.5% required for duty-free access to Canada. Given that the models built in these plants are less appealing to the Canadian or Mexican market, luxury SUVs and a roadster, the companies simply pay the import duties. In this case, the elimination of the Canadian tariff would not lead to lost FDI for Canada, but it would cost Canada tariff revenues.

3.4 Net benefit of a new vehicle assembly plant to the Canadian economy

Finally, in the unlikely case that a firm decides to cancel a Canadian investment project because the Canadian tariff was cut, we discuss the loss to the Canadian economy of this lost FDI. This is a hotly debated topic and estimates range widely. The most recent paper on the topic, by Michael Greenstone and Enrico Moretti, estimates the spillover effect of such an investment on the regional economy from increases in local property values in the selected location relative to the trend in extremely similar runner-up location(s). They find a significant and positive effect using a sample of investment projects in a variety of manufacturing sectors.

The automobile industry is in some respects different from most industries. (i) With certainty additional employment will be generated in supplier plants that locate nearby, although the multiplier has been declining over time. (ii) Wage rates in the industry are substantially above manufacturing wages in similar locations and the difference seems too large to be explained entirely by human capital differences. The traditional explanation is that the well-organized unions have been able to extract some of the rents in this oligopolistic industry. (iii) The automobile industry is becoming increasingly high-tech. The R&D expenditure per capita in Michigan is the highest of any state in the United States and 85% of it is in automotive technology. Unlike many other sectors, the vast majority of research is privately funded. This research intensity can create technology spillovers to nearby firms and human capital spillovers in the workforce as workers receive continuous training.

While these factors would increase the beneficial effect for the local economy of attracting automotive investments, they have also encouraged governments to offer subsidies to attract these plants in the first place. While the size of the externalities associated with automotive FDI can be debated, they are certainly positive. However, the spillover effects would be positive for several jurisdictions. As a result, the competing jurisdictions will engage in a bidding war to attract the plant[35]. The winning jurisdiction does not have to give away the entire surplus, just enough to make the firm indifferent between itself and the next

[35] Maureen Molot-Appel (2005) discusses the subsidy games of the last two FDI waves in the automobile industry.

best alternative. The losing jurisdiction, however, should have offered the entire surplus it expected from the investment. As a result, the net gain to the Canadian economy of a successfully attracted FDI program is expected to be equal to the intrinsic value a Canadian location can bring to the firm.

Figure 2.1: An illustration of the optimal subsidy offer

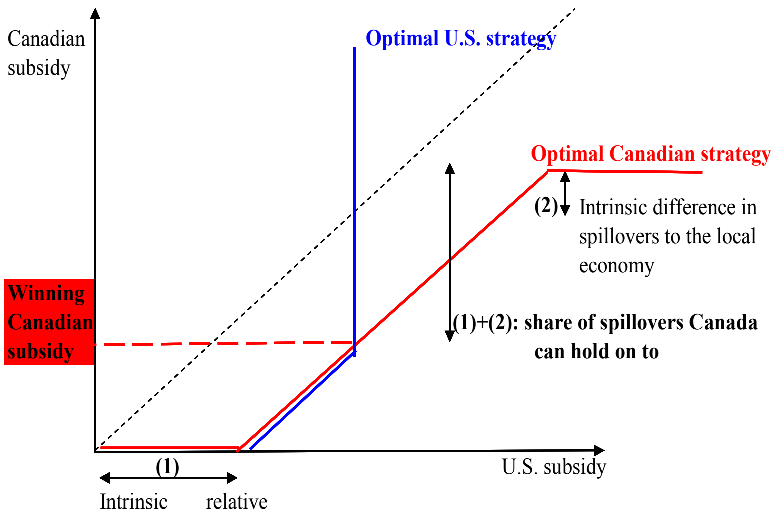

Figure 2.1 gives a graphical example of the equilibrium of such a subsidy game. In the hypothetical example depicted, a Canadian and U.S. jurisdiction compete to attract a new assembly plant by offering subsidies. Two magnitudes are important. (1) Indicates the intrinsic relative advantage of the Canadian site. As depicted, absent subsidies the firm would choose to locate in Canada. As long as the U.S. jurisdiction offers subsidies smaller than (1), where the blue line slopes upwards, Canada would be the preferred location. (2) Indicates the relative difference in spillovers to the local economy. In the example, this quantity would be greater for Canada, perhaps because of greater unemployment in the selected location, or more potential sites for suppliers to locate nearby. The maximum subsidy the Canadian jurisdiction will offer is equal to the total spillover it expects, indicated by the horizontal red line, and similarly the

maximum U.S. subsidy are its expected spillovers, the vertical blue line. Given that the blue U.S. line intersects the 45 degree line below the red Canadian line, we know that expected spillovers are larger for Canada, at least in this example.

The optimal subsidy offers are straightforward to derive. They are similar to the Bertrand Nash optimal price strategies discussed in most industrial organization books. The intersection gives the winning subsidy for Canada, $1 above the expected U.S. spillovers. Relative to the expected Canadian spillover, the winning jurisdiction is able to hold on to the magnitudes (1) and (2), its relative advantage for the firm and for itself over the next best alternative. Note that if the expected spillover would be larger in the U.S. jurisdiction, the relative size of (1) and (2) would determine the plant location and the winning jurisdiction would have to offer most of its advantage to the firm as a subsidy in order to attract the FDI.

The crucial insight to take away from this example is that even though the value to the local economy of automotive FDI might be very large, a significant fraction will accrue to the firm making the investment in the form of a subsidy to fend off competition from other jurisdictions.

3.5 Higher investment in Canada

Just as there is an ever so slight loss in FDI (in expectation) from the elimination of the Canadian imports, the same analysis can be applied in reverse if trading partners eliminate their tariffs. The expected benefit in this instance is the product of the same four factors considered above. Two differences are especially notable: foreign tariffs tend to be much larger, leading to a larger expected effect, but comparative advantage might disadvantage Canada in the relatively labour-intensive assembly stage of production, lowering the expected effect.

Exports of finished vehicles from North American are limited. Statistics in Table 3.5 are an attempt to construct export volumes for the major North American producers. While export statistics are not collected directly, we can obtain an estimate by subtracting sales of domestically produced vehicles from production. The result is the sum of exports and inventory accumulation. Only one firm, Ford, is a significant exporter. This pattern is unlikely to change in the future; no one expects North America to become an export base for finished vehicles.

Table 3.5: Exports of light vehicles from North America (2002)

	Passenger cars		Light trucks		Total light vehicles	
	Production	Exports[1]	Production	Exports[1]	Production	Exports[1]
General Motors	2,458,052	54,284	3,159,053	104,438	5,617,105	158,722
Ford	1,437,905	442,105	2,690,958	366,641	4,128,863	808,746
Chrysler Group	649,673	20,983	2,042,153	130,826	2,691,826	151,809
Toyota	750,621	58,093	445,398	27,173	1,196,019	85,266
Honda	835,335	14,114	303,382	14,985	1,138,717	29,099
Nissan	544,026	40,997	206,899	-4,584	750,925	36,413
BMW	24,234	12,349	100,140	53,363	124,374	65,712
Mercedes-Benz			102,983	59,646	102,983	59,646
Volkswagen	332,876	35,665			332,876	35,665

1 Exports include changes in inventories from one year to the next.
Source: Own calculations based on Ward's Automotive Yearbook (2003)

The reverse effect of the preceding analysis would predict that lower tariffs in other countries would reduce the necessity for firms to set up plants overseas and instead satisfy foreign demand by exporting Canadian production. As in the previous section, it would be implausible to expect large effects. The modern flexible production systems are designed to sacrifice some scale economies, but increase the ability to produce a greater variety of vehicles on the same assembly line. This helps firms to offer a wider selection of vehicles in mature markets. At the same time, it also facilitates firms to produce vehicles closer to the final consumer. Rather than having each plant dedicated to a single vehicle, even assembly in smaller (overseas) markets becomes viable if a large fraction of the lineup that is sold in that country can be assembled in a single local plant.

The recent record confirms that the emerging demand for vehicles in Asia and Latin America is being met by adding local production capacity. The European market is increasingly being served from plants in Eastern Europe, where wages are substantially lower. Earlier statistics also illustrated the growing importance of Mexico as a North American producer. While exports of finished vehicles from low-wage countries are only a marginal phenomenon for the moment, this might reverse in the near future. The labour cost in final assembly is too small to make up for the high transport cost of finished vehicles. Once the emerging producers develop their own supply chain and are able to produce a greater fraction of a vehicle's content domestically at lower wages, vehicle exports might take off. Hence, large export volumes of vehicles from Canada to the rest of the world seems an unlikely proposition.

4. Market analysis: aftermarket components

This section estimates the potential impact of eliminating MFN tariffs on aftermarket auto parts on the production, employment, consumption, and trade of aftermarket auto parts in Canada; documents and analyzes the industrial trends in the auto parts sector; and assesses Canada's position and advantages.

4.1 Aftermarket parts

To put in perspective what part of the automobile industry we will discuss in this section, Table 4.1 contains total employment statistics for all the different automotive sub-sectors.

In total, the industry is estimated to have employed 892,700 workers in 2004, an increase of 6.8% over the 2000 total. Total employment breaks down into 45.8% in the aftermarket sector, 26.8% in manufacturing (parts and final assembly combined), 18% in vehicle sales, and a final 9.3% in other automotive related sectors, such as road construction or rentals[36]. The breakdown has been relatively stable over the last five years, although manufacturing continues its decline, mirroring the trend in the aggregate economy. The service side of the industry has clearly becomes the most important employer—the sum of employment in aftermarket and sales stood at 63.8% of the automotive workforce. Given that these services are largely non-tradable, the importance of trade policy has declined over time. In terms of total sales or value added, however, the contribution of manufacturing will be much higher than its employment share.

[36] Note that these statistics draw on Statistics Canada Labour Force Surveys and the totals are markedly different (higher) from the totals obtained aggregating employment statistics from the Annual Survey of Manufacturing. The relative importance of the different sub-sectors, however, is relatively similar using either source.

Table 4.1 Total employment in different sub-sectors of the automobile industry	NAICS	2000	2004	Change 2004-2001
Aftermarket				
Motor Vehicles, Parts & Accessory wholesale	4152	23.3	29.1	24.9%
Automotive Parts & Accessories stores	4413	35.1	31.3	-10.8%
Gasoline Service Stations	4471	81.3	79.4	-2.3%
Other General Merchandise Stores	4529	98.8	120.1	21.6%
Automotive Repair & Maintenance	8111	140.1	149.2	6.5%
Total		**378.6**	**409.1**	**8.1%**
% of Automotive Employment		**45.3%**	**45.8%**	
Vehicle Assembly & Parts Manufacturing				
Motor Vehicle Manufacturing	3361	81.5	80.9	-0.7%
Motor Vehicle Body & Trailer Manufacturing	3362	20.1	18.4	-8.5%
Motor Vehicle Parts & Accessories mfg	3363	133.8	140.2	4.8%
Total		**235.4**	**239.5**	**1.7%**
% of Automotive Employment		**28.2%**	**26.8%**	
Wholesale & Retail Sales of Vehicles				
Motor Vehicles, Wholesale	4151	13	13	0.0%
Automobile Dealers	4411	134.3	147.7	10.0%
Total		**147.3**	**160.7**	**9.1%**
% of Automotive Employment		**17.6%**	**18.0%**	
Other Automotive				
Highway, Street and Bridge Construction	2373	57.4	60.8	5.9%
Automotive Equipment Rental & Leasing	5321	17.4	22.6	29.9%
Total		**74.8**	**83.4**	**11.5%**
% of Automotive Employment		**8.9%**	**9.3%**	
Total Automotive Industry		**836.1**	**892.7**	**6.8%**

Source: DesRosiers Automotive Yearbook 2005, Based on Statistics Canada Labour Force Surveys

An important feature of the automotive parts industry is that original equipment manufacturers (OEMs), i.e., the vehicle assemblers, can import parts duty free if they operate an assembly plant in Canada. Hence, trade policy affects only a fraction of the "Motor Vehicle Parts and Accessories Manufacturing" sector. All parts imports that are used in the assembly of new vehicles (OE parts) in North America are exempt from tariffs and hence unaffected by trade policy changes. As such, the import competition Canadian firms face on OE parts will not increase if current tariffs on parts are abolished. To the extent that other countries have extended similar duty exemptions for imported parts that enter locally produced vehicles, Canadian exporters are already exempt from duties on their OE parts exports as well. In addition, Canadian exports of parts are predominantly going to the U.S.; due to NAFTA, these are also not affected by tariffs. This is likely to be the case for aftermarket parts as well.

Only parts that are used in repairs, maintenance, or upgrades of existing vehicle (in the aftermarket sector) are subject to duties. Trade with the U.S. or Mexico—the vast majority of Canadian imports or exports—falls under NAFTA and does not incur duties. Imports from countries with most favoured nation status[37]—the vast majority of trade outside of NAFTA—is subject to tariffs ranging from 0 to a maximum of 8.5%.

In summary, current Canadian import tariffs outside NAFTA are set at 0—8.5% for aftermarket parts, 6.1% for finished cars and light trucks, and 0% for OE parts. Note that such discrimination between finished vehicles, and OE or aftermarket parts is common. For example, China has for a long time provided incentives for local assembly by setting the tariff rate on finished vehicles much higher than for parts (as high as 100%). On April 1, 2005 it overhauled its import regime, classifying complete kits used to assemble vehicles locally with minimal domestic value added as completed vehicles, incurring on average a 30% tariff rate. Parts used in local assembly, on the other hand, only incur 15% tariffs. In its agreement with the WTO, China committed to lowering these rates to 25% and 10.3%, respectively, by mid-2006[38].

Employees listed in the first sector of Table 4.1, "Aftermarket", are mostly engaged in sales, administrative, repair, and maintenance tasks. They are using components but not manufacturing them. Employees making parts will be listed in the NAICS

[37] With China's inclusion in the WTO in 2001, all Canada's significant trading partners in the automotive industry now enjoy MFN status.

[38] Automotive News, March 28, 2005 "China closes importer's tax loophole."

3363 industry, which employed 140,200 workers in 2004, an increase of 4.8% over 2000. However, the vast majority of those parts is destined to OEM. customers and is largely immune to any trade policy changes because competing imports are not subject to tariffs. However, on the export market it will depend on the tariff treatment of OE parts in overseas destinations. In South Korea, these parts are taxed at 8% and in China at 15%[39]. In order to get an idea of the relative size of aftermarket components in the parts manufacturing industry, we now discuss some trends and summary statistics for the automotive aftermarket.

Table 4.2 lists total retail sales of parts (all figures in billions of CDN$) from 1990 to 2003, the last year for which complete data are available, for the domestic Canadian industry.

Table 4.2 Total retail sales of automotive parts and accessories (at retail prices, billion CDN$)

	Total retail sales of parts	Do-It-Yourself (DIY)	Installed		DIY	installed	labour
			parts	labour	(% of retail sales)		
1990	$10.52	$2.09	$4.64	$3.79	19.9%	80.1%	36.0%
1991	$10.68	$2.13	$4.66	$3.89	19.9%	80.1%	36.4%
1992	$11.40	$2.23	$4.96	$4.21	19.6%	80.4%	36.9%
1993	$11.66	$2.17	$5.09	$4.40	18.6%	81.4%	37.7%
1994	$12.16	$2.25	$5.31	$4.60	18.5%	81.5%	37.8%
1995	$12.27	$2.06	$5.47	$4.74	16.8%	83.2%	38.6%
1996	$12.49	$2.08	$5.59	$4.82	16.7%	83.3%	38.6%
1997	$13.17	$2.18	$5.90	$5.09	16.6%	83.4%	38.6%
1998	$13.08	$1.97	$5.94	$5.17	15.1%	84.9%	39.5%
1999	$13.38	$1.89	$6.09	$5.40	14.1%	85.9%	40.4%
2000	$13.89	$1.90	$6.31	$5.68	13.7%	86.3%	40.9%
2001	$14.40	$2.00	$6.49	$5.91	13.9%	86.1%	41.0%
2002	$15.07	$2.13	$6.79	$6.15	14.1%	85.9%	40.8%
2003	$15.45	$2.21	$6.93	$6.31	14.3%	85.7%	40.8%

Source: DesRosiers Automotive Yearbook (2005)

[39] A FTA with Korea or China is likely to boost Canadian parts exports. For the results in Table 4.13, we do not distinguish between aftermarket and OE parts because these countries add tariffs to either category.

Over thirteen years, the industry increased sales by 46.9% in nominal terms or 3% per year, cumulatively. This is more or less in line with the rate of inflation for car-related expenses, indicating quantity is almost entirely flat over this period. This is clearly not a growth industry. The increased number of vehicles on the road tends to raise sales, but improved quality of the existing fleet offsets this to a large extent. If customers hang on to their vehicles longer, given the increased reliability, the larger number of cars will eventually lead to greater aftermarket sales. At least in the short run, all net growth for the aftermarket sector has to come from exports.

Breaking down the total retail sales into the "do-it-yourself" (DIY) market, parts customers purchase from retail outlets, and components installed by professional repair stores or at dealerships reveals that the relative importance of the DIY market has declined noticeably. The total value of parts that customers purchased directly has hardly increased in thirteen years. Two-thirds of the increasing share of installed parts is the result of higher labour charges—see the last column of Table 4.2.

The sector is also becoming more competitive at the retail end. Limited to the last ten years of data (1993-2003), Table 4.3 lists aftermarket parts sales at retail (first column) and wholesale (second column) prices. While retail sales increased from $7.26 billion to $9.14, an increase of 25.9% or 2.3% per year, wholesale sales increased by 30.9% from $3.62b to $4.74b, 2.7% per year. The good news for Canadian parts manufacturers is that sales of parts grow more quickly than what one would assume based on retail trends. However, it also reveals that the total (off-the-factory) market is relatively small. In 2003 the total Canadian market for aftermarket parts at wholesale prices is only $4.74 billion dollars, less than a tenth of the total parts market (including OE parts). It also suggests that there is severe price pressure. Retail mark-ups declined, which can be gathered from the increasing ratio of retail to wholesale sales[40]. Finally,

[40] The importance of the installed parts sector leads to a much larger mark-up than we would expect if all sales were directly to customers—a ratio of 51.9% translates to a 93.7% mark-up.

the last two columns indicate that more than half of the increase in parts sales can be explained by a larger number of registered vehicles in Canada. Average parts sales per vehicle increased by only 1.1% per year in nominal terms, or $27 cumulatively over the ten year period. Note that parts per vehicle are an increasing function of the age of the vehicle. As a result, countries outside of North America, which tend to have much older fleets than Canada or the U.S., will have larger aftermarket sales per vehicle.

Table 4.3. Retail and wholesale aftermarket parts sales and sales per vehicle

	Total aftermarket parts sales (DIY and installed)		ratio	registered vehicles	Parts sales per vehicle
	(retail prices)	(wholesale prices)	(retail / wholesale)	(millions)	(wholesale prices)
1993	$7.26	$3.62	49.9%	15.509	$233
1994	$7.56	$3.77	49.9%	15.578	$242
1995	$7.53	$3.77	50.1%	15.871	$238
1996	$7.67	$3.87	50.5%	15.316	$253
1997	$8.08	$4.10	50.7%	16.076	$255
1998	$7.91	$4.03	50.9%	16.322	$247
1999	$7.98	$4.06	50.9%	17.071	$238
2000	$8.21	$4.20	51.2%	17.101	$246
2001	$8.49	$4.35	51.2%	17.668	$246
2002	$8.92	$4.60	51.6%	17.911	$257
2003	$9.14	$4.74	51.9%	18.207	$260

Source: DesRosiers Automotive Yearbook (2005)

Another important trend is the increasing importance of original equipment suppliers (OES), the dealerships associated with the vehicle manufacturers, see Table 4.4. The relentless price pressure in the final vehicle market has reduced dealers' profit margins on new car and truck sales. They have moved downstream and after-sales maintenance and repairs are making up a growing share of their sales. Vehicle companies only took 26% of the total aftermarket parts sales in 1993, but 35.2% in 2003. This has come predominantly at the expense of retailers, while warehouse and distributors—who mostly supply non-dealer installers of parts—have kept their market share at 37.3%. For Canadian suppliers, it means that firms like NAPA or Uni-Select Canada are becoming relatively more important than Canadian Tire or Wal-Mart. Given that the former are industry insiders, while mass-market retailers are eventually marketing to customers directly, this changes the competitive position of Canadian firms relative to foreign competitors. It might be easier to bring factors other than price, such as quality or reliability of supply, into consideration.

Table 4.4. Aftermarket parts sales by distribution outlet

	Total aftermarket parts sales	warehouse /distributor	retail head offices	OES: vehicle companies	(as a % of the total market)		
	(wholesale prices)	(1)	(2)	(3)	(1)	(2)	(3)
1993	\$3.62	\$1.35	\$1.32	\$0.94	37.3%	36.5%	26.0%
1994	\$3.77	\$1.39	\$1.37	\$1.01	36.9%	36.3%	26.8%
1995	\$3.77	\$1.39	\$1.33	\$1.05	36.9%	35.3%	27.9%
1996	\$3.87	\$1.41	\$1.35	\$1.11	36.4%	34.9%	28.7%
1997	\$4.10	\$1.48	\$1.31	\$1.21	36.1%	32.0%	29.5%
1998	\$4.03	\$1.47	\$1.26	\$1.25	36.5%	31.3%	31.0%
1999	\$4.06	\$1.51	\$1.31	\$1.29	37.2%	32.3%	31.8%
2000	\$4.20	\$1.57	\$1.26	\$1.37	37.4%	30.0%	32.6%
2001	\$4.35	\$1.64	\$1.25	\$1.47	37.7%	28.7%	33.8%
2002	\$4.60	\$1.73	\$1.29	\$1.58	37.6%	28.0%	34.3%
2003	\$4.74	\$1.77	\$1.30	\$1.67	37.3%	27.4%	35.2%

Source: DesRosiers Automotive Yearbook (2005)

Finally, in Table 4.5 we compare the total size of the automotive aftermarket parts market with two benchmarks. In the first column, we replicate the aftermarket retail sales, studied in Table 4.2. The same market at wholesale prices, as in Table 4.3, is replicated in the second column. This is contrasted with the total market for OE parts—those sold directly to vehicle assemblers for installation in new vehicles. In Canada, this market has increased from \$45.10 billion in 1998 to \$48.09 in 2003. Comparable figures for the North American market, which is almost seven times larger, are in the fourth column. These numbers represent approximately 68% to 70% of the total value of shipments from automobile assembly plants. As Canadian parts suppliers are very much integrated into the North American automobile industry, they compete in a $304.92 billion CDN market when they supply OEMs directly. On the other hand, if they focus on the aftermarket, the entire North American market is likely to be at most one fifth—estimated at $61.7 billion CDN based on U.S. and Mexican registrations[41].

Table 4.5. Relative size of different automotive parts sectors (billion CDN$)

	Demand				Supply	
	Aftermarket parts (Canada)		OE parts		NAICS 3362	
	(retail prices)	(wholesale prices)	Canada	North America	Canada	US
1998	$7.91	$4.03	$45.10	$315.41	$26.04	$273.60
1999	$7.98	$4.06	$55.42	$370.01	$28.58	$301.32
2000	$8.21	$4.20	$56.05	$359.69	$29.89	$303.48
2001	$8.49	$4.35	$49.70	$345.41	$28.59	$289.74
2002	$8.92	$4.60	$50.29	$350.74	$29.69	$317.80
2003	$9.14	$4.74	$48.09	$304.92		

Source: DesRosiers Automotive Yearbook (2005)

When we analyze the impact of trade policy, no separate data are available for OE and aftermarket parts. We only observe trade flows of total parts and also at the industry level we only observe manufacturing for all parts combined (NAICS 3362). Sales of the parts manufacturing sector are listed in the last two columns of 4.5. A couple of ratios should be remembered:

- Aftermarket parts sales in Canada make up 8.97% of the domestic demand for automotive parts (including OE parts).
- At the North American level the comparable fraction is much higher, most likely in the 15–20% range (as Canada has a disproportionate demand for OE parts).
- Canadian parts production only covers 54.1% (in 2002) of domestic demand for parts. In contrast the U.S. and Mexico both run parts surpluses.

[41] In absence of comparable data to those in column 2 of Table 4.5 for the U.S or Mexico, we estimate the total North American aftermarket by multiplying the average cost of automotive parts per vehicle for Canada, in Table 4.3, by the total registrations in North America.

4.2 Parts manufacturing (NAICS 3363)

When we study the impact of a changed trade policy, we will focus on NAICS industry 3363: "Motor Vehicle Parts & Accessories Manufacturing." Table 4.6 presents total employment statistics for the different sub-sectors.

Table 4.6. Total employment in motor vehicle parts and accessories manufacturing

		Total employment		
NAICS		**1998**	**2002**	**change**
3361	**Motor Vehicle Manufacturing**	**51,440**	**47,495**	**-7.7%**
3362	**Motor Vehicle Body & Trailer Manufacturing**	**17,502**	**19,528**	**11.6%**
3363	**Motor Vehicle Parts & Accessories Manufacturing**	**94,264**	**88,840**	**-5.8%**
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	10,227	10,522	2.9%
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing	6,565	6,366	-3.0%
336330	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing	6,616	4,792	-27.6%
336340	Motor Vehicle Brake System Manufacturing	7,671	6,556	-14.5%
336350	Motor Vehicle Transmission and Power Train Parts Manufacturing	11,090	9,886	-10.9%
336360	Motor Vehicle Seating and Interior Trim Manufacturing	13,130	12,598	-4.1%
336370	Motor Vehicle Metal Stamping	16,133	13,255	-17.8%
336390	Other Motor Vehicle Parts Manufacturing	22,832	24,835	8.8%
3361–63	**Automobile industry (manufacturing)**	**163,206**	**155,863**	**-4.5%**

Source: DesRosiers Automotive Yearbook 2005, based on Statistics Canada Census of Manufacturers

Note that the aggregate statistics differ from those in Table 4.1. While the former are compiled from labour market surveys, the statistics in the current table are the sum of employment of all establishments assigned to the NAICS 3363 industry. Plants that produce more other goods than automotive parts (for example assembly plants where some parts are produced on site) are excluded here, while workers could still denominate their industry as NAICS 3363.

The total parts manufacturing sector employs 87% more workers than vehicle assembly (NAICS 3361): 88,840 versus 47,495. The most important sub-sector, increasingly so over time, is "Other Motor Vehicle Parts Manufacturing", while stamping and seats and interior trim are also very important in Canada. The only two sub-sectors that increased employment from 1998 to 2002 are engines & engine parts and "other parts". By 2002, the latter accounts for 28% of employment in the sector.

Table 4.7. Summary statistics on the motor vehicle parts and accessories sector

		employment share		production workers in employment (%)		value added per production worker		value added per hour worked (prod.)	
NAICS		1998	2002	1998	2002	1998	2002	1998	2002*
3363	Parts	100%	100%	86.5%	85.3%	$139,232	$144,496	$65.34	$67.81
336310	engine	10.8%	11.8%	85.2%	88.5%	$337,637	$177,734	$143.06	$75.31
336320	electrical	7.0%	7.2%	88.1%	83.2%	$117,731	$101,952	$57.86	$50.11
336330	steering & suspension	7.0%	5.4%	87.2%	88.0%	$118,823	$150,977	$55.49	$70.50
336340	braking	8.1%	7.4%	87.8%	84.8%	$123,256	$117,703	$60.45	$57.73
336350	transmission	11.8%	11.1%	87.4%	83.4%	$143,750	$191,659	$62.83	$83.77
336360	interior	13.9%	14.2%	87.7%	87.2%	$120,589	$149,695	$58.77	$72.96
336370	stamping	17.1%	14.9%	86.2%	85.7%	$109,222	$141,341	$53.61	$69.38
336390	other	24.2%	28.0%	85.0%	83.6%	$98,447	$126,541	$46.42	$59.67

Source: own calculations based on DesRosiers Automotive Yearbook (2005) and Statistics Canada

In Table 4.7 we calculate a number of crucial summary statistics for the different sub-sectors. The share of production workers in employment is declining slightly over time in most sectors. This trend is particularly pronounced in electrical & electronic equipment manufacturing and the important "other parts" sub-sectors and could indicate an increasing level of technical sophistication. The average value added per production worker increased only slightly from $139,232 in 1998 to $144,496 in 2002, but this masks big differences between sectors. The highly capital intensive engine & engine parts sector operated in 2002 at less than 53% of its value added of 1998. Inspection of the different components that enter these calculations reveals that this is the result of increased purchases of parts and materials, up 58%, while employment and total shipments increased only slightly.

Two more sectors saw their value added per worker slump, albeit not as drastically. The electrical & electronic equipment and braking sectors saw (nominal) declines of 13.4% and 4.5% respectively.

Two factors contributed positively towards aggregate value added growth for the industry. First, even though the engine sector saw its labour productivity decline, it is still above the industry average. Given that it increased its share of parts employment from 10.8% to 11.8% this relative reallocation of workers increased aggregate productivity. Second, labour productivity growth is positive and large in the remaining sectors. Average productivity growth is 28.5% over four years or 6.5% per year, if it is positive, ahead of the average growth for the manufacturing sector. The steering & suspension, transmission, and stamping sectors achieved this productivity growth by reducing total employment and keeping value added more or less constant. The seats & interior trim kept its employment constant, but increased its share of total parts manufacturing employment. Finally, the "other parts" industry increased labour productivity by 28.5%, while at the same time employing 1350 more workers. Finally, in the rightmost columns we calculate labour productivity per hour worked where the same trends are apparent. Normalizing by the average number of hours worked in each sub-sector, the same trends show up, but the dispersion across industries at each point in time is reduced.

4.3 Threats and opportunities

4.3.1 Threats

Before analyzing the impact of trade policy changes, we briefly discuss the most pressing threats and opportunities faced by the Canadian automotive parts industry. We draw from industry coverage in the weekly *Automotive News* magazine and a survey of Canadian parts manufacturers organized jointly by the Canadian Auto Parts Manufacturers Association (APMA) and the Asia Pacific Foundation of Canada[42].

The most obvious threat to Canadian firms in the last couple of years is the appreciating Canadian dollar. The Canadian-U.S. **exchange rate** moved from a low of 0.618 on January 21, 2002 to a high of 0.885 on March 2, 2006. That is an appreciation of 43.2% in only four years. Given that the U.S. is by a wide margin Canada's largest trading partner this matters a lot. In addition, some export contracts to other countries are likely to be priced in USD as well.

While such exchange rate movements make Canadian suppliers less competitive internationally, they also hurt firms on their existing contract if **contractual prices** are specified in U.S. dollar terms. With volatile exchange rates, raw material prices (see below), and customers' market shares (see below), it becomes crucial not to be pinned down by fixed nominal prices in long term contracts.

Prices of raw materials, especially steel and oil, but other metals as well, have also increased enormously in recent years. These have been cited in most prominent U.S. Chapter 11 bankruptcy filings, e.g., Tower Automotive and Collins & Aikman. Of course, the extent to which firms are affected depends again on whether they are compensated for this. In the case of Tower Automotive, its customers have only agreed to change the agreed prices to reflect higher input costs of steel after the firm filed for bankruptcy.

Market share of traditional (Big 3) customers[43] is declining. Most domestic suppliers tend to have a disproportionate exposure to these firms. In addition, each of these firms is run-

[42] "The East Asian Automobile Industry: Opportunity or Threat? Results of a Survey of the Canadian Auto Parts Manufacturers," Canada in Asia report, January 2005.

[43] Throughout, we will be referring to the "Big 3" to indicate GM, Ford, and DaimlerChrysler; traditionally the largest three OEM customers in North America.

ning a very aggressive cost-cutting program to reduce their input purchase bills.

For example, in 2004 it took Ford almost a year to convince some of its global suppliers to sign the new contracts. In addition to severe price cutbacks, major concerns were raised by stipulations in the contract that allowed Ford to hand R&D work over to competitors. **Ownership of IP** is quickly becoming an important part of sourcing relationships. For example, in 2005 Multimatic sued Faurecia alleging it sourced a proprietary design with a competitor to get a lower price. With the rise of China's manufacturing capabilities, conflicts over IP are rising overseas as well.

A more general problem is that contracts often specify a fixed price per part. Firms spread out **fixed investment costs** over the expected model run. If a model proves less successful than anticipated, the contracted average price will not allow firms to recover their fixed setup costs. As suppliers are shouldering more of the R&D burden, this problem is becoming more widespread.

Not surprisingly, **import competition** was also cited by Canadian suppliers as one of the most significant threats. The two countries mentioned most often were the U.S. and China.

FDI by foreign suppliers who followed OEM transplants to North America is also perceived as a threat by domestic firms. For example, even before Toyota announced its intention to build a new assembly plant in Woodstock, Ontario, its seat supplier Araco of Japan opened a seat and interior trim plant in Ontario to keep up with Toyota's production expansion in North America. Similarly, Honda suppliers like Musashi Seimitsu (suspension and steering parts) or Ube (wheels) are expanding in Ontario to serve customers besides Honda as well.

On the export front, many firms also mention **difficulties exporting to the U.S.** This covers both concerns about insufficient (government) investments in border infrastructure as well as rising U.S. protectionism in the wake of 9/11.

4.3.2 Opportunities

Luckily, not everything is grim in the outlook of Canadian suppliers. One of the most frequently cited opportunity is the **expansion of production overseas**, especially in China. The vast majority of Canadian suppliers, 64%, have been asked by their North American clients to expand production capacity overseas to serve them better in locations abroad. Given that net growth in worldwide demand for new vehicle is predominantly outside of North America, it clearly makes sense to focus on developing countries.

In addition, many firms perceive foreign expansion as a way to attract new customers. The expectation is that these relationships will eventually translate into new supplier contracts to **North American transplants** as well.

In contrast to what one would gather from reports in the media, lowering costs is not one of the main motivations to **increase foreign sourcing**. Access to important customers, strategic geographic positioning, and strategic fit (patents, R&D, staff) all rank higher than cost considerations.

In contrast with the focus on **Asia**, which more than 70% of Canadian suppliers perceive as an opportunity, the Free Trade Area of the Americas does not seem high on the radar screen, neither as a threat nor as an opportunity.

As mentioned in section 1, Canada has considerable expertise in **fuel cell** research. In addition, from early on the R&D efforts have been well plugged in to the automotive industry. Once the technology is ready for prime time, Canada is expected to be one of the major players (in sharp contrast with the hybrid technology which will only come to Canada in 2010).

The Canadian industry has frequently argued that in order to be globally competitive and form a thriving industry it needs a solid base. Most directly, expansion of **assembly capacity** of final vehicles in Canada was a prime objective—communicated very clearly by the Canadian Automotive Partnership Council. The investments by Ford in Oakville, the commitment to keep St. Thomas open (at least in the short run), the current negotiations to avert some of the announced capacity reductions at

GM's Oshawa facility, and especially Toyota's announcement to build a new plant in Ontario are all very encouraging.

OEMs are **increasingly outsourcing** more steps in the production process. This can both be a threat and an opportunity for suppliers. As mentioned earlier, the success of these outsourcing relationships hinges crucially on the contractual details. For example, DaimlerChrysler is compensating Karmann when the demand for the Crossfire vehicle that Karmann assembles fell off more quickly than expected. Without such guarantees, outsourcing becomes a risky endeavour for suppliers. If structured properly, these outsourcing trends open up new growth opportunities in an otherwise mature industry.

4.4 Industry structure

4.4.1 Exit

The difficulties in the industry have led to a large number of bankruptcies in the U.S., where 138 of the top 150 North American suppliers have their headquarters (including regional headquarters). Table 4.8 lists the thirteen largest bankruptcies by U.S. suppliers in the past 5 years. Eight U.S. companies that were among the 100 largest OEM parts suppliers worldwide filed for Chapter 11 restructuring, which is almost a quarter of the 34 U.S. companies on the list. A further five Tier 1 suppliers went under that did not make the global list, but are listed (or at least have been recently) on the list of 150 largest North American suppliers. Note that these companies often suffered a couple of years of declining sales before filing, at least relative to more successful companies, and their 2004 rank understates their importance. For example, Amcast ranked as high as 82 in North America in 1993 and 122 in 2003, but fell off the list in 2004.

Among the list of bankrupt companies, firms headquartered in Michigan are very prominent, firms producing steel-intensive products, stampings, castings, or frames, are also overrepresented. Federal-Mogul and Hayes Lemmerz International filed a couple of months after the 9/11 terrorist attacks when the U.S. seemed heading for a recession and these companies had trouble servicing their debt. The other bankruptcies are more recent, with filings accelerating at the end of 2004. Total output in the North American automobile industry was still going strong—it still is—but these firms were exceedingly exposed to raw material prices, the sales decline of the traditional Big 3 (U.S.) OEMs, and import competition.

Table 4.8. Recent major bankruptcies by U.S. automotive parts suppliers

Firm	Headquarters	filed for Chapter 11	World-wide rank (2004)	Global OEM parts sales	Employ-ment
Delphi Corp.	Troy, MI	Oct-05	1	$28.60	185,200
Dana Corp.	Toledo, OH	Mar-06	15	$9.06	46,000
Collins & Aikman Corp.	Troy, MI	May-05	20	$3.98	23,000
Federal-Mogul Corp.	Southfield, MI	Oct-01	39	$3.35	42,000
Tower Automotive Inc.	Novi, MI	Feb-05	45	$3.20	12,000
Hayes Lemmerz International	Northville, MI	Dec-01	64	$2.00	11,000
Oxford Automotive	Troy, MI	Dec-04	98	$1.08	3,800
Meridian Automotive Systems	Dearborn, MI	Apr-05	99	$1.03	5,900
			NA rank (2004)	**Global OEM parts sales**	
J.L. French Automotive Castings Inc.	Sheboygan, WI	Feb-06	102	$0.50	1,800
Intermet Inc.	Troy, MI	Sep-04	68	$0.70	5,200
Citation Corp.	Troy, MI	Sep-04	79	$0.60	5,200
Key Plastics, LLC	Northville, MI	Mar-00	132	$0.70	4,000
Amcast Industrial Corporation	Fremont, IN	Dec-05	N/A	$0.42	2,600
Total				**$55.22**	**347,700**

Notes: Ranks are from the Automotive News list of 100 largest suppliers worldwide or 150 largest suppliers in North America. Sales are global OE parts in 2004 in billions of USD. Employment statistics are the latest available (generally 2005).

The scale of this wave of bankruptcies is unprecedented. The thirteen largest filings accounted for annual sales of $55.22 billion USD in 2004 and an even higher volume in the preceding years. This number only includes OE parts sales, with total sales often much larger still. At the time of this writing, these companies employed a total of 347,700 employees[44]. While it is unlikely that much of the production capacity and associated jobs will be liquidated, many workers will have to transition into new jobs and have to take pay cuts.

Furthermore, this is certainly not the end of the restructuring in the parts industry. Lear Corp., the 5th largest supplier in North America, is struggling to make its debt payments and its market value plunged by more than 60% in the preceding year as more analysts see a Chapter 11 filing as a distinct possibility. Lear employs 115,000 workers worldwide. A bankruptcy by Visteon, currently employing 49,000 full time employees, was only narrowly avoided courtesy of a very generous payout package by its former parent. Some plants were transferred back to Ford, which is trying to sell them off, and some workers also transferred back to Ford. While the old Visteon employed 70.2% of its workers in the U.S., the restructured Visteon counts 56.1% Mexican workers in its hourly workforce. Only 12 of its plants remain organized by the UAW, the principal labor union in the U.S. automotive industry[45]. Delphi counts approximately 60,000 hourly employees at its 50 Mexican plants.

The bankruptcy of Delphi, the largest supplier worldwide, is likely to have wide-ranging effects on the industry. The tiered organization of the supply chain means that financial problems at a large Tier 1 supplier trickle down to the next levels very quickly. If Delphi defaults on some of its trade credit, some of its suppliers that are already stretched by the increased competition would have a hard time surviving. The wave of Tier 1 firm bankruptcies in Table 4.8 has led a lot of smaller suppliers to file for Chapter 11 restructuring as well. An incomplete list is in Table 4.9.

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[44] Delphi employs 185,200 employees worldwide and 76,000 in the U.S. 42 of its U.S. corporate entities are involved in the restructuring.

[45] Automotive News, June 20, 2005, “New Visteon has Mexican flavor”.

Table 4.9. Recent bankruptcies by smaller U.S. automotive parts suppliers

Year	Smaller suppliers filing for bankruptcy
2006	Hastings Manufacturing Company
2005	American Remanufacturers Inc.; Allied Holdings, Inc; Metalforming Technologies Inc.; Trim Trends Co. LLC.; BBi Group
2004	Andover Industries
2003	Liteglow Industries, Inc.
2002	Harvard Industries, Inc.
2001	Rankin Automotive Group, Inc.; Valeo Electrical Systems, Inc
2000	Cambridge Industries, Inc.; Safety Components International, Inc.; Dorsey Trailers, Inc.; Safelite Glass Corporation

Another notable outgrowth of the supplier distress is that Delphi managed to negotiate a two-tiered wage system in its 2003 labour contract negotiations with the UAW[46]. This allows the company to pay new workers lower wages than its existing employees. The union has always resisted such discrimination, even though the OEMs have repeatedly pushed for this as well. It remains to be seen how important this change will turn out to be in practice.

Quite remarkably, Canadian firms have survived this carnage almost scot-free. Given the increased cost pressure induced by the adverse exchange rate movement, the rising importance of the U.S. border in the post 9/11 world, and the traditional over-exposure to the Big-3 traditional customers for Canadian firms, one could have expected even more problems than in the United States.

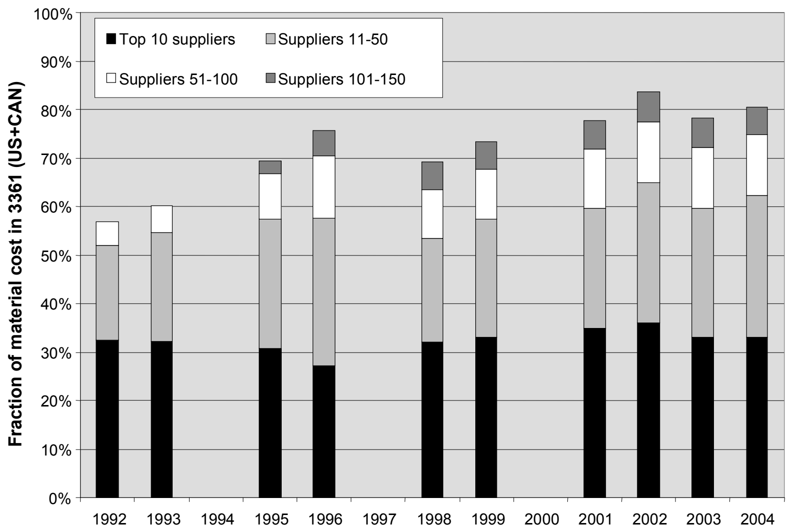
4.4.2 Concentration

While a lot of large firms are in financial difficulty, total industry concentration has clearly been increasing. Figure 4-1 plots the evolution in the share of the total material cost for the motor ve-

[46] Automotive News, September 29, 2003, “UAW gives Delphi half a loaf.”

hicle assembly industry (NAICS 3361) in the U.S. and Canada combined that is accounted for by different groups of firms[47].

Figure 4-1 Top suppliers' sales as a fraction of total material cost in NAICS 3361 (US + Canada)



The share of OE parts sales in North America by the 100 largest suppliers, the longest time trend is available for this group, increased from 57% in 1992 to 75% in 2004. The bottom bars in each column, which track the sales of the top 10 suppliers, indicate that the increase is not caused by the very top firms. They kept their share approximately constant at one third. The largest increase is for firms in the second group, suppliers ranked 11 to 50 on the North American supplier list. This group increased its share from 19.4% to 29.2%, an increase of almost 50%. In order to break the top 50 in 2004, a firm had to sell $1 billion worth of OE parts.

In 1992 this would have secured the 21st spot on the list! Given the very moderate price increases in the industry—as

[47] Given that the share of Mexico in North American production has increased over time, the increase in concentration for the total North American industry will be slightly lower, but the difference will be very small.

documented earlier—firms are clearly becoming much bigger. The next group of suppliers, ranked 51 to 100, only sold 4.8% of North American automotive materials, but 12.5% in 2004—an increase of 160%.

These patterns have two important consequences. In the tiered supplier system that is now in effect, only a couple of hundred firms have access to the final vehicle manufacturers. They decide which firms to outsource components to further down the line. For the vast majority of firms in the industry, relationships with these large tier 1 suppliers are crucial. Among the 150 largest suppliers were 9 Canadian firms in 1999, but only 7 remain. Four are in the top 100, versus 5 in 1999. The enormous expansion of Magna, which moved from the 7th spot in 1993 to 3rd in 2004, has increased the Canadian share on the list, but at the same time it concentrates a lot of Canadian automotive employment in a single company.

I have documented elsewhere[48] that the location of supplier headquarters is increasingly concentrated in Michigan. Several firms that used to operate regional headquarters in Canada have centralized their headquarters activities in their U.S. headquarters. Moreover, the number of Mexican, European, and Japanese suppliers on the list has crept up over time as well. All these factors imply that decisions about (overseas) outsourcing are increasingly being made outside of Canada, even though these decisions have an important impact on the Canadian industry.

An important reason for suppliers to become bigger has been the larger role in R&D that they have assumed in recent years. In order to diversify risk and to spread fixed costs of the development of new technologies over a larger volume of sales, scale is important. The relatively diminished role of Canadian firms in the upper echelons of the parts sector is likely to have an impact on the extent to which innovative activities are carried out in Canada.

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[48] Van Biesebroeck J. (2006), "Trends and Complementarities in the Canadian Automobile Industry, (*forthcoming*) in Z. Chen and M. Duhamel, Industrial Economics and Performance in Canada.

4.5 Import demand and export supply

4.5.1 Elasticities

In order to assess the effect of trade liberalization on the domestic Canadian market and the export potential of Canadian firms overseas, we need estimates of the demand and supply elasticities for the different sub-sectors of the automotive parts industry. Methods to estimate demand elasticities in differentiated goods market developed in the industrial organization literature tend to be too data intensive to be widely applicable. In section 3 we estimated such a model for the Canadian final vehicle market and the data requirements clearly exceed what can conceivably be obtained for the parts industry.

In recent years, the international trade literature has also taken the fact that goods are differentiated more seriously and more reliable elasticity estimates are obtained exploiting properties of the constant elasticity of substitution (CES) demand system. A paper by Feenstra (1994) pioneered the approach and the estimation method was subsequently refined and applied to a much wider range of industries (products) by Broda and Weinstein (2006)[49]. The benefit of this approach is that demand estimates control explicitly for heterogeneity across goods, albeit in a restrictive way. The method can also deal with increasing variety and with quality or taste differences across goods or country of origin.

The estimates have been used to calculate the value of increased variety as an additional gain from trade. For example, Broda and Weinstein (2006) estimate the contribution of unmeasured growth in product variety in U.S. imports between 1976 and 2001 to be approximately 2.6% of GDP. They also find that the "true" import price index increases 1.2% per year more slowly—approximately one quarter of the annual increase—because of the increase in variety.

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[49] Feenstra, R. (1994), "New Product Varieties and the Measurement of International Prices," *American Economic Review*, 87 (1), March, pp. 157-177 and Broda, C. and D. E. Weinstein (2006), "Globalization and the Gains from Variety," *Quarterly Journal of Economics*, 121(2), *forthcoming*, May.

A similar exercise on the export side, see Feenstra and Kee (2004, 2005), models a nation's output using a CES cost function that is decreasing in the number of varieties. An increase in variety in a sector will raise the sectoral price index and draw resources to the industry. An empirical application finds that in a cross section of countries, productivity levels are positively correlated to the number of varieties that are exported to the U.S. Over time, the relative evolution of a nation's productivity level is found to be similar to the evolution of its variety in exports.

For details on the methodology, we refer the interested reader to the papers by Feenstra (1994) and Broda and Weinstein (2006). Here we just provide a brief explanation of the underlying theory and some details on our implementation. Underlying the theory is a three-tiered CES utility function. At the upper level, consumers have preferences over two composite goods, one domestically produced and one imported:

$$U_t = \left(D_t^{\frac{\kappa-1}{\kappa}} + M_t^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}}, \quad \kappa > 1.$$

D is the domestic good and the import composite, M, will be defined below. κ is the elasticity of substitution between the two goods. If this is equal to the elasticity of substitution between different imported varieties, the upper nest disappears[50].

In the second tier, the composite import good is defined as:

$$M_t = \left(\sum_{g \in G} M_{gt}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}, \quad \gamma > 1$$

where M_{gt} is the sub-utility derived from the consumption of the imported good g in time t; γ denotes the elasticity of substitution among the imported goods, and G is the set of all imported goods.

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[50] This is what one has to assume to use the model to investigate the impact of trade liberalization on the domestic industry; otherwise consumers allocate a fixed proportion of their budget to domestic and imported goods.

At the most detailed level, different varieties (c) are imported of each good (g) and we can use the non-symmetric CES utility function to define M_{gt}:

$$M_{gt} = \left(\sum_{c \in C} d_{gct}^{\frac{1}{\sigma_g}} m_{gct}^{\frac{\sigma_g - 1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g - 1}}, \quad \sigma_g > 1 \quad \forall g \in G$$

For each good, imports are treated as differentiated across countries of supply. Tastes for varieties can differ or, alternatively, d_{gct} can represent heterogeneous quality levels for imports coming from different countries.

A major attraction of this framework is that one can construct a price index using the theory of exact index numbers without having to estimate the different taste or quality parameters (d_{gct}), only the elasticities of substitution. If a good is consumed (imported) even though its quality or desirability is lower than that of other goods, this difference has to be reflected in the price. Using expenditure shares one can aggregate prices to construct an exact price index. Note that for the demand system to be well-behaved, all elasticities of substitution have to exceed unity.

The demand system can be manipulated to find an explicit expression for the import demand equation for each good. Differentiating with respect to time gives the following demand equation in first differences:

$$\Delta \ln s_{gct} = \varphi_{gt} - (\sigma_g - 1)\Delta \ln p_{gct} + \varepsilon_{gct}$$

where φ_{gt} is a function of the same variables that enter the price index for good g and does not differ across the country of origin (it is a random effect in the demand equation). $\varepsilon_{gct} = \Delta \ln d_{gct}$ is the random term in the regression and can be interpreted as taste or quality shocks across import destination.

The export supply equation is specified exogenously, but allowed to vary with the amount of exports:

$$\Delta \ln p_{gct} = \psi_{gt} + \frac{\omega_g}{1 + \omega_g} \Delta \ln s_{gct} + \eta_{gct}$$

where $\varphi_{gt} = -\omega_g \Delta \ln E_{gt} / (1+ \omega_g)$; $\omega_g \geq 0$ is the inverse supply elasticity, assumed to be constant across countries and $\eta_{gct} = \Delta \ln v_{gct} / (1+ \omega_g)$ captures any random change in a technology factor v_{gct}. A special case of this supply equation would be a horizontal, perfectly elastic supply, in which case $\omega_g = 0$.

Obviously, the system of demand and supply is not identified without instruments or identifying restrictions. Lacking instruments for the entire range of industries we would like to estimate this system for, we instead assume that $E(\varepsilon_{gct}\, \eta_{gct}) = 0$, i.e. once good-time specific effects are controlled for, demand and supply errors at the variety (destination country) level are assumed to be uncorrelated.

Details of the estimation procedure follow Leamer (1981)[51]. Both equations are normalized by a reference variety (k) and parameters are estimated from the second moments in the data. The estimation equation becomes:

$$(\Delta^k \ln p_{gct})^2 = \theta_1 (\Delta^k \ln s_{gct})^2 + \theta_2 (\Delta^k \ln p_{gct} \Delta^k \ln s_{gct}) + u_{gct}$$

where

$$\theta_1 = \frac{\omega_g}{(1+\omega_g)(\sigma_g - 1)}, \quad \theta_2 = \frac{(1-\omega_g)(\sigma_g - 2)}{(1+\omega_g)(\sigma_g - 1)}, \quad \text{and } u_{gct} = \varepsilon^k_{gct} \eta^k_{gct}$$

All the k superscripts indicate differencing by the corresponding variable for the kth reference country. In order to recover the structural parameters of interest σ_g and ω_g, we have to solve the nonlinear system of equations. For some parameter values, there will only be imaginary solutions, which obviously do not make economic sense. The endogeneity of the price on the right-hand side is solved by instrumenting with country dummies, see Feenstra (1994) for details on the practical implementation of the weighted IV estimator.

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[51] Leamer, E. (1981), "Is it a Demand Curve, or Is It a Supply Curve? Partial Identification through Inequality Constraints," *Review of Economics and Statistics*, 63(3), pp. 319-327.

To assess the reasonableness of these parameter estimations we present our estimates for the σ_g parameters in 4.10, side by side with the estimates obtained by Broda and Weinstein (2006). We follow these authors by including different goods in the same SITC 3-digit sector imported from one country as different varieties. We present estimates for all automotive sectors (broadly defined). The first two columns replicate the demand elasticities that Broda and Weinstein (2006) obtained using a GMM estimator that avoids the risk of finding imaginary values for any of the structural parameters by doing a grid search restricted to the allowable interval. In the next column we present our results using the same data, made available by Feenstra[52]. In the fourth column, we replicate the analysis on a more recent data set we purchased from Global Trade and Information Services, Inc. The latter spans the 1995-2005 period.

Table 4.10. Demand elasticity estimates at the SITC 3-digit level

	SITC (Revision 3)	Broda & Weinstein		Replica-tion	GTIS data:'95-'05	
		('72-'88)	('90-'01)	('90-'01)	(1)	(2)
621	materials of rubber	3.52	2.67	1.77	2.31	2.29
625	rubber tires	2.18	1.98	3.70	4.96	3.10
713	**internal combustion engine**	**25.03**	**2.69**	**3.46**	**3.21**	**2.42**
781	motor vehicles for passengers	1.63	3.02	15.55	2.21	2.48
782	motor vehicles for goods	103.03	6.70	5.00	9.46	N/A
783	road motor vehicles, n.e.c.	10.59	3.82	7.71	367.44	N/A
784	**parts and accessories for MV**	**7.76**	**2.79**	**2.04**	**1.48**	**1.68**
785	motorcycles and bicycles	1.30	1.15	2.52	1.83	2.08
786	trailers	3.73	1.89	2.00	1.77	1.87
Nobs		246	256	9	9	7
Mean		6.78	4.01	4.86	43.85	2.28
St.Dev (Mean)		1.19	0.50	1.48	40.46	0.18
Median		2.54	2.24	3.46	2.31	2.29
Max		1.08	1.05	1.77	1.48	1.68
Max		228.75	108.19	15.55	367.44	3.10

Notes: The first three column use data available online through the NBER website. The last two columns replicate the same analysis using more recent data from the Global Trade Atlas, compiled by Global Trade Information Services, Inc. (1): normalization by largest Canadian hs10 product, in terms of trade volume; (2): normalization by smallest Canadian hs10 product.

[52] http://cid.econ.ucdavis.edu/data/sasstata/usiss.html

In each estimation, market shares are calculated using reported import values for the U.S., omitting re-exported goods. Prices are constructed as unit values, dividing the value of imports by quantity. Ideally, we would like to carry out the estimation for Canada as well, but for the automotive parts, all goods starting with 8708 in the Harmonized System of trade classification had missing quantities.

Simply comparing the results in the first two columns, the Broda and Weinstein (2006) results already indicate that estimates are not always robust over time. For example, motor vehicles for goods transport have an estimated elasticity of 103 in the early period 1972 to 1988, basically indicating these are homogenous goods. In the later period, 1990 to 2001, the elasticity declines to 6.70 indicating some differentiation—optimal monopoly mark-ups would increase from less than 1% to 17.5%. While it is not entirely impossible that these goods have changed this much over time, it is doubtful. For some other goods, the parameters are much more stable over time. For example, the demand for rubber tires and motorcycles & bicycles is estimated to be highly inelastic in both periods.

For some goods our results are relatively close to the ones obtained by Broda and Weinstein (2006), but this is not always the case. Most pertinent for this section are the estimates for the internal combustion engine & parts sector (SITC 713) and motor vehicle parts & accessories (SITC 784), which are both indicated in bold. Our results are relatively close. For a lot of goods, Broda and Weinstein (2006) find a declining trend in the elasticities, indicating increased product differentiation over time. We find similar results and extending the data set to 2005, results in the fourth column, tends to lower the elasticities further.

Because the estimation procedure is nonlinear, the results might be sensitive to the normalization chosen. We have always normalized by a Canadian good, because the U.S. has positive imports from Canada in the largest set of products throughout the entire sample period and also in terms of market share Canada is important and stable over time. However, at this aggregate level we lump a lot of products (at the most detailed 10-digit HS classification) together when we carry out the estimation for each SITC 3-digit industry separately. In the fourth column, we normalize by the Canadian product with the largest market share, while in the fifth column the estimation procedure is identical, only now we normalize by the Canadian product with lowest market share. Results are somewhat sensitive to this normalization, but there is no consistent direction for the bias. Also note that with this alternative normalization we cannot obtain the demand elasticities for industries 782 and 783.

To gauge whether the results are still reasonable when we carry out the estimates at finer levels of aggregation, Table 4.11 contains the demand elasticities for the detailed sub-sectors in engines & engine parts (SITC 713) and automotive parts and accessories (SITC 784). In the first two rows we repeat our estimates from the 3rd and 4th column of Table 4.10, for the aggregate sectors, and we add the estimates of the supply elasticities as well. One pattern that seems to come out of this is that goods with a high demand elasticity tend to have a lower supply elasticity. Combinations of high demand and supply elasticities, which would give rise to large quantity volatility over time, seem to be rare. Similarly, we only find a single good with a demand elasticity below the median that also has a supply elasticity below the median (motor vehicle bodies, SITC 78421). A situation like this is likely to lead to high price volatility over time when either of the curves shifts.

Overall, the estimates seem reasonable. The median demand elasticity across all parts sectors is 2.53 in the 1990-2001 period and 2.70 in the 1995-2005 period. The averages are larger because some sectors are estimated to have much lower product differentiation, while the estimate for the demand elasticity can never fall below 1 (to be consistent with the model). Median supply elasticity is 0.78 in the 1990-2001 period, notably below infinity (the perfectly competitive benchmark). This makes sense: as we estimate that products are differentiated, it makes sense to find that the supply curve is not entirely horizontal. We also find that the supply elasticity declined in the later period. The median declined to 0.36 and, omitting the outlier motor vehicle engines with spark-plugs larger than 1000cc (SITC 71322), the average supply elasticity also declined from

0.82 to 0.65. Increased product differentiation seems to make it harder for firms to quickly scale up production. Increased foreign competition would tend to increase the supply elasticity.

Table 4.11. Demand and supply elasticity estimates at the SITC 5-digit level

	Feenstra data(1990-2001)		GTIS data (1995-2005)		
	demand	**supply**	**demand**	**supply**	**description**
713	3.46	0.33	3.21	0.38	
784	2.04	0.97	1.48	1.61	
71321	(b)	(b)	(b)	(b)	MV engine – spark < 1L
71322	2.59	2.48	2.31	19.8	MV engine – spark > 1L
71323	(a)	(a)	8.83	-0.3	MV engine – diesel
71381	8.71	0.02	6.97	0.75	engine other, spark
71382	7.36	0.14	(a)	(a)	engine other, diesel
71391	2.52	0.78	2.03	0.97	parts – spark
71392	2.27	0.41	2.51	0.35	parts – diesel
78410	(a)	(a)	36.92	0.35	chassis with engine
78421	2.06	1.44	(b)	(b)	MV bodies
78425	(a)	(a)	9.57	0.21	other bodies
78431	2.38	0.81	2.9	-0.15	bumpers
78432	1.6	0.86	1.64	0.95	other parts of bodies
78433	4.31	-0.17	2.3	0.29	brakes
78434	1.94	3.32	1.95	3.38	gearboxes
78435	3.14	2.27	6.07	0.01	drive-axles
78436	2.86	-0.23	5.23	0.38	non-driving axles
78439	2.53	0.21	1.63	1.22	other MV parts
Nobs	**13**	**13**	**14**	**14**	
Mean	**3.41**	**0.95**	**6.49**	**2.01**	
St.Dev (Mean)	**0.6**	**0.31**	**2.45**	**1.39**	
Median	**2.53**	**0.78**	**2.7**	**0.36**	
Min	**1.6**	**-0.23**	**1.63**	**-0.3**	
Max	**8.71**	**3.32**	**36.92**	**19.8**	

Notes: (a) imaginary number; (b) no data

Finally, in Table 4.12, we also show the demand and supply elasticities estimated at the 6-digit level of aggregation for the Harmonized System of trade classification. This is the level of detail that we will use to simulate the impact of the changed trade policy. The same products as in Table 4.11 are included.

Table 4.12. Demand and supply elasticities at the 6-digit HS classification

	Feenstra data (1990-2001)		GTIS data (1995-2005)	
Harmonized System	**Demand**	**Supply**	**Demand**	**supply**
8407-8409	3.53	1.09	3.16	0.81
8708	2.03	0.59	1.47	1.30
840730	2.07	-2.69	2.56	303.74
840731	3.91	-0.47	2.00	2.52
840732	6.11	0.75	10.08	1.36
840733	4.48	0.31	26.49	1.11
840734	2.59	2.48	2.31	19.80
840790	8.71	0.02	6.97	0.75
840820	(a)	(a)	8.53	-0.30
840890	7.36	0.14	(a)	(a)
840991	2.88	1.28	1.89	4.91
840992	2.81	0.77	2.31	0.64
840999	2.25	1.29	2.51	0.35
870810	2.38	0.81	2.90	-0.15
870820	2.96	1.75	(b)	(b)
870821	(b)	(b)	4.80	0.02
870829	1.55	0.44	1.64	0.95
870831	4.60	2.05	1.85	3.44
870839	3.22	-0.10	3.22	-0.52
870840	1.94	3.32	1.95	3.38
870850	3.14	2.27	6.07	0.01
870860	2.86	-0.23	5.23	0.38
870870	3.38	-0.20	1.85	1.43
870880	1.77	3.30	2.82	0.39
870891	1.84	-7.11	1.80	5.17
870892	2.37	1.05	1.53	2.03
870893	2.14	0.17	1.43	4.18
870894	2.04	0.16	1.89	-0.24
870899	2.29	0.02	1.87	0.84
HS 6-digit				
Nobs	27	27	27	27
Estimated	25	25	25	25
# of varieties (median)	40	40	39	39
Mean	3.27	0.46	4.26	14.25
St.Dev (Mean)	0.36	0.41	1.04	12.09
Median	2.81	0.44	2.31	0.95
Min	1.55	-7.11	1.43	-0.52
Max	8.71	3.32	26.49	303.74

Notes: (a) imaginary number; (b) no data

With the exception of a few outliers, the estimates are now very similar for the two time period. Engines & engine parts, those components starting with 8407, 8408, or 8409 seem less differentiated than other automotive parts. They have larger demand elasticities, although the supply elasticity is only estimated to be larger in the earlier period.

4.5.2 Export potential

Using the U.S. estimates in the previous section as indicative of the demand and supply estimates for all exporters in all markets, we can simulate what the impact of a trade agreement would be on Canadian exports. While it might seem like a strong assumption to use the U.S. estimates for other countries, it is not that farfetched in this case. The production technology used in the automotive industry is the same the world over. The same firms are also operating assembly plants in all of the regions we will investigate and in the U.S. This should make the demand elasticity estimates—which are input factor demands—comparable. Moreover, the Canadian industry is the most important trading partner of the U.S. and supply elasticities identified from U.S. imports should be highly representative of the Canadian industry. As such, the supply elasticities should be equally valid. Note that for the estimates in the previous section to be valid, we had to assume anyway that supply and demand elasticities were identical across countries. If countries differ substantially in technology, this will show up in the relative importance of different goods in their trade flows[53].

To calculate the impact of an elimination of tariff rates under FTAs between Canada and different countries, we exploit the properties of the CES demand system that underlies our

[53] As mentioned earlier, we were unable to carry out a similar estimation for Canada, as quantity data was not available. For the U.S. trade flows, the Feenstra data has missing observations for physical quantity (import values are always available if trade flows are positive) in less than 10% of the observations. In the Trade Analyzer Database of Statistics Canada, the automotive parts information had more than 95% of the quantities missing (finished vehicles were reported in physical units).

elasticity estimations. A good reference for the crucial equations is Melitz (2003)[54]. In the CES model, mark-ups will be constant for all producers as each firm/country faces a residual demand curve with the same elasticity of substitution (which differs by product). Price will be set by the following mark-up pricing rule:

$$p_{ct} = c_{ct}(1+t)\frac{\sigma}{\sigma-1},$$

where c_{ct} is the marginal cost of production (including transportation) for country c at time t, existing import tariffs increase the marginal cost and the mark-up is only a function of the product's elasticity of demand in the importer country. For the moment, we assume marginal costs are constant, i.e., the supply curve is perfectly elastic (this will overestimate the effect of the trade policy change). We relax this assumption later.

Total imports for each country are given by

$$m_{ct} = R_t\left(\frac{p_{ct}}{P_t}\right)^{1-\sigma},$$

where the relative price is what matters, i.e., country c's price relative to the aggregate price index for the importing country. Given that Canada is a relatively small trading partner for the countries we consider, we will throughout take total import spending R and the aggregate price index P to be exogenous to Canada's price and quantity choices. In this case it is straightforward to derive that the impact of a trade policy on Canadian exports will be given by

$$\frac{\partial \ln m_{ct}}{\partial t} = (1-\sigma)\frac{\partial \ln p_{ct}}{\partial t}.$$

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[54] Melitz, M. (2003), "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica*, 71(6), November, pp. 1695-1725.

Given the constant mark-up in the pricing rule, the derivative on the right-hand side is equal to $\Delta t/(1+t)$. The model predicts that the mark-up will not change and that the elimination of the tariff will be passed on to consumers proportionally to the current final good price. At the same time, the quantity sold will increase by (- σ) times the price decline. Note that the CES model of monopolistic competition assumes that Canadian firms do not take the effect of their pricing decisions on their competitors' behaviour into account. Given the low market share of Canadian firms (between 1% and 3% in the different markets), this seems like a plausible assumption.

In our calculations we take into account that different products face very different demand elasticities, as calculated in the previous section. Hence, the distribution of Canadian exports over the different sub-sectors will be very important. We calculate the effect of three possible free trade agreements (FTAs)—with China, with South Korea, and with the enlarged E.U. (with 25 members)—under which Canadian parts exporters would see their import tariffs eliminated. We do not include an FTA with Japan, as it currently does not impose any import tariffs on automotive parts.

Current Chinese tariff rates are 15%, but they are scheduled to decline to 10.3% under its WTO agreement. South Korean tariffs are, as far as we have been able to determine, currently 8% uniformly across all automotive parts. European tariffs are lower and vary somewhat by category. On small engines and most engine parts, the E.U. levies 2.7%, on larger engines the rate is 4.2%. On most other components it levies 3% duties, but on a whole range of "not elsewhere classified" products, the duty is 4.5%. For China and the E.U. we present two alternative sets of results, using the lower or the upper range for the tariff rates.

For all three countries, we also present alternative calculations using the highest demand elasticity estimate obtained for each good, see Table 4.12, or using the low demand elasticity. We calculate the absolute value of the expected import increase (Canadian exports) by summing over all the 6-digit HS categories. We also express the total amounts as a fraction of the current Canadian export levels. The top panel of Table 4.13

contains the four sets of results if we use the 2005 trade flows as benchmark, the bottom panel uses the average 2004-2005 trade flows as a robustness check to guard against annual fluctuations.

Table 4.13. Counterfactual simulations of Canadian import changes following separate FTAs with three trading partners

demand elasticity	initial tariff	China		South Korea		E.U. 25	
2005 Canadian import levels							
min	low	$8.61	10.4%	$1.43	8.4%	$5.90	3.4%
min	high	$12.03	14.6%			$8.83	5.4%
max	low	$13.13	15.9%	$1.98	11.6%	$9.08	5.2%
max	high	$18.34	22.2%			$13.58	7.9%
Average 2004-2005 Canadian import levels							
min	low	$17.89	10.2%	$0.96	8.7%	$5.33	3.7%
min	high	$25.00	14.3%			$8.00	5.5%
max	low	$26.88	15.4%	$1.34	12.2%	$8.05	5.6%
max	high	$37.54	21.5%			$12.07	8.3%

Note: Effects are expressed in million CDN$ or as a percentage of initial parts exports

Before we discuss the results, it is important to stress that this is a counterfactual analysis, not a prediction. We tried to assess what Canadian exports would have been had exports not been subject to import tariffs in 2005. Given the rapid change in the industry, this is quite different from the expected export change if tariffs will be eliminated in the future. Even without any trade policy change the 2006 statistics are likely to look very different from 2005[55].

The predicted changes are rather large. For 2005, they range from 10.4% to 22.2% for a FTA with China, from 8.4% to 11.6% for a FTA with South Korea, and from 3.4% to 7.9% for a FTA with Europe. Given that the average demand elasticity is around two (using the “min” elasticity), we find that quantity exported increases approximately twice as much as

[55] As an example, Canadian parts exports to China nearly halved from 2003 to 2004 as shipments of body panel for the Buick model assembled in Shanghai stopped.

price decreases and the net gain in import revenue is roughly equal to the initial tariff rate. When we use higher demand elasticities, the price response does not change, but quantity changes more, leading to larger effects.

The difference in import response across the different trading partners is predominantly the result of differences in the current tariff rates. However, the composition matters as well. For example, exports to the E.U. are largest in the HS 870829 category, which has one of the lowest demand elasticities. As a result, total exports to the E.U. increase slightly less than the average tariff decline, while we find the reverse for the FTAs with China or Korea (a slightly more than proportional export increase). Similarly, for Europe the predicted import increase of Canadian products is almost twice the average level of tariff reduction in the most optimistic case, reflecting that for some important goods (in particular HS 870870 and 840891) the high demand elasticity is almost double the low elasticity. High elasticities mean low mark-ups and the same price reduction has more impact and, moreover, consumers are more responsive.

Another point worth noting is that the absolute values are sizeable. Even though China's automotive industry is not very large yet, it does import a lot of components. This tends to be typical of low-wage assembly centres. Imports of components outstrip exports and the reverse holds for finished goods. In the automotive industry, China is a large importer of both components and finished vehicles. The large import response we estimate would translate into extra sales for the Canadian industry in China with estimates ranging from \$8.79 to \$18.34 million CDN, depending on the choice of demand elasticity and initial tariff level. Consistent with the previous discussion, we find smaller effects in the most recent year (using the 2005 import data) than using average imports for the 2004-2005 period. It indicates that the Chinese industry is rapidly increasing its level of self-sufficiency.

Finally, we cannot distinguish between OE parts and aftermarket parts in this part of the analysis. The trade statistics are not broken down along that dimension. We do not know the share of aftermarket parts in total parts exports, but it is likely to exceed the share of aftermarket parts in domestic production. While Canadian firms are very tightly integrated in the North American industry, that is much less the case overseas. Canadian exporters often claim they have a very hard time penetrating overseas OEM markets. Given that Japanese and Korean firms take a long time to increase the domestic content in the vehicles they assembly in North America, this seems plausible. The current analysis assumes all Canadian parts exports are aftermarket, which is obviously an overestimate of the likely effect of the FTAs, but not necessarily a very large overestimate. For the actual effect, we should simply pro-rate the absolute import increases (by the share of aftermarket parts in exports), while the percentage changes are valid.

Another factor that would lower the expected impact of tariff reductions is an upward sloping supply curve. The results in Table 4.14 incorporate the estimated slope of the supply curve in the simulations. The estimated supply elasticities correspond to the inverse of the effect of increased output on marginal costs. Incorporating this effect in the pricing rules gives

$$\frac{\partial \ln p_{ct}}{\partial t} = \underbrace{\frac{\partial \ln c_{ct}}{\partial t}}_{= \frac{\partial \ln c_{ct}}{\partial \ln q_{ct}} \frac{\partial \ln q_{ct}}{\partial t}} + \underbrace{\frac{\partial \ln(1+t)}{\partial t}}_{=1/(1+t)} + \underbrace{\frac{\partial \ln(\sigma/(1-\sigma))}{\partial t}}_{=0} .$$

Table 4.14. Counterfactual FTA simulations with an upward sloping supply curve

demand elasticity	supply elasticity	initial tariff	China		South Korea		E.U. 25	
2005 Canadian import levels								
mean	mean	low	\$2.68	3.25%	\$0.31	1.83%	\$1.84	1.07%
mean	mean	high	\$3.75	4.54%	\$0.31	1.83%	\$2.76	1.61%
max	max	high	\$5.20	6.30%	\$0.54	3.14%	\$4.36	2.54%

Note: Effects are expressed in million CDN\$ or as a percentage of initial parts exports

The first term under the first bracket is (*1/ω*), the inverse of the supply elasticity, the second term can be expressed as a function of the price change by taking the derivative of the relative import demand, which gives $-\sigma \frac{\partial \ln p_{ct}}{\partial t}$. Solving for the optimal price response, we find that the earlier price change Δt/(1+t) is adjusted by a factor $(1+\sigma/\omega)^{-1}$. A higher supply elasticity (ω) will lead to a larger price response as marginal costs are almost constant. A higher demand elasticity (σ) will lead to a smaller price decrease for any positive supply elasticity, because it leads to larger cost increases as quantity is very responsive.

When we perform the counterfactual simulations taking supply effects into account, the import effects are much smaller, not surprisingly given the low supply elasticities estimated in the previous section. In the first line of Table 4.14 we use the average demand and supply estimates and the low initial tariff rates. In the next line, we use the high tariff rates instead. In the third line, we calculate the most optimistic FTA effect if supply effects are taken into account. We take the maximum estimate for the demand elasticity (which makes quantity very responsive to price declines), the maximum estimate for the supply elasticity (to minimize the increase in marginal cost), and we take the high initial tariffs. Even under this scenario, the estimated impact is reduced by a factor of more than 3 in each country, relative to the upper range of the predictions in Table 4.13. As before compositional effects are important. Even though the tariff reduction is almost twice as high in Korea compared to Europe, the composition of Canadian exports leads to a comparable percentage effect in both countries/regions.

A final caveat is that these calculations assume that the impact of a free trade agreement is proportional to the decline in tariff rates. There are some indications that non-tariff barriers are important. While this is particularly true for final vehicles, it probably affects parts and accessories as well[56]. Unfortunately, there is no clear way to quantify this.

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[56] Even though the Japanese and Korean market shares in the U.S. and Canada vehicle markets are sizeable by now, they have not been able to

4.5.3 Import competition

Even though the calculations would be straightforward, we refrain from carrying out the same type of analysis as in the previous section to study increased import competition in Canada. We expect it would result in very implausible estimates because the large domestic automotive assembly sector imports a lot of OE parts that already enter duty free. For example, while Canada exported $29.2 million worth of parts to Japan in 2004, imports stood at $1743.2 for a deficit of $1713.9 millions. Obviously the majority of these parts enters the assembly process and do not incur any duties. Given the small size of the aftermarket, discussed earlier, especially relative to the large volume of imports, any estimate of the fraction of imports going to the aftermarket would be subject to a very large margin of error.

With South Korea, the E.U., and China, the Canadian deficit in parts is also very large, running to $266.0, $636.3, and $664.7 million respectively, in 2004. Including trade with the US and Mexico, total parts imports in Canada were $42,859 million in 2004 which was approximately 10 times larger than the entire aftermarket parts sales.

Given that in Table 4.10 the rubber tires and parts & accessories industries—the two sectors containing the bulk of aftermarket parts—were estimated to have the lowest demand elasticities of all automotive industries, import responses are likely to be moderate. The effects on import values abroad we estimated in the previous section are a combination of price declines and quantity increases. In sectors with a lot of product differentiation (low demand elasticity) as the aftermarket parts sector, quantity increases will be low—less harm to the Canadian industry, but these will be accompanied by more moderate price declines—smaller benefits for the Canadian consumers.

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penetrate each other's market. In 2003, only 3774 Japanese passenger cars were sold in Korea and 2573 Korean cars in Japan, which represent a market share of 0.28% and 0.04% respectively.

4.6 Pricing-to-market

In section 4.5, the simulations are carried out assuming all firms behave competitively, i.e. the CES demand system leads to a monopolistically competitive industry, where the slope of the residual supply function is not affected by a firm's actions or any action of its competitors. In particular, we have assumed that Canadian exporters do not take the response of foreign competitors into account when they decide how much to lower their price following a tariff cut. While this is probably a good assumption given the small Canadian market share overseas, we verify here how sensible this assumption is.

Using the methodology developed by Goldberg and Knetter (1999)[57] we estimate the slope of the residual demand Canadian firms face in the markets abroad considered in the previous Section. The idea is to identify the slope of the residual demand exploiting exchange rate variability as an indicator for cost changes. Note that these will differ from the demand elasticities estimated earlier. Residual demand elasticities include supply responses by competitors, which will depend on the type of market equilibrium the industry is in—which is not specified explicitly. The estimating equation is as follows:

$$\ln p_{mt}^{ex} = \lambda_m + \eta_m \ln Q_{mt}^{ex} + \alpha' \ln Z_{mt} + \beta' \ln W_{mt} + \varepsilon_{mt}$$

The residual demand for exporter *ex*, to destination market *m*, at time *t*, expresses the price the exporter charges (in the importing market's currency) as a function of its own quantity, demand shifters for the overseas market (*Z)* and cost shifters for its competitors (*W*).

Given that we only have 11 years of data to estimate the equation, we have to be extremely parsimonious in the specification. The only demand shifter we include is a time trend and as cost shifters we use the exchange rate of the two largest importers, apart from the country under investigation. As

[57] Goldberg, P. K and M. M. Knetter (1999), "Measuring the intensity of competition in export markets", *Journal of International Economics*, 47, pp. 27-60.

instrument for the endogenous quantity level, we use the exporter's exchange rate—a valid cost shifter[58]. The results in Table 4.15 are obtained from separate regressions for each of the three regions and for each of the five exporters. Even though the countries sell in the same import market, they will face a different residual demand, because they face different competitors.

Table 4.15. Elasticities of the residual demand curve for total automotive parts

	South Korea		China		E.U. (25)	
	market share	residual demand elasticity	market share	residual demand elasticity	market share	residual demand elasticity
Canada	**0.6%**	**0.184 (0.63)**	**1.1%**	**-0.354 (2.12)**	**1.8%**	**-0.710 (2.88)**
Japan	39.3%	-1.052	42.5%	-11.990	53.8%	-1.396
United States	15.9%	-1.464	8.1%	0.078	32.5%	-0.758
Euro-area	34.3%	-2.667	22.7%	-1.354		
China	5.5%	0.188			6.1%	-0.134
South Korea			22.0%	-0.743	3.1%	0.632

Note: Sample includes all imports of engines & engine parts and automotive parts and accessories over the 1995-2005 period. t-statistics in parenthesis

Even though Canada has a very small market share in each of the three markets, we find that it has a surprising amount of market power. The statistics are the inverse of the elasticities, as is customary in this literature. An estimate of -0.71 for Canadian exports to the E.U. corresponds to a residual demand elasticity of only 1.41. In the Chinese market, Canada is still estimated to have a decent amount of market power, with an implied elasticity of 2.83, significantly different from a perfectly elastic residual demand. Only in Korea, we find no

[58] One might argue that in this industry pricing is in US dollar and that the methodology will not be adequate. However, if that were really the case, one has to be willing to assume that the 30% appreciation of the Canadian dollar against the US dollar in the last two years has been absorbed by profit margins of Canadian suppliers or offset by productivity growth. Assuming a profit margin in excess of 30% in 2003 or productivity growth of 15% per year seem highly implausible.

market power for Canadian firms. The results are relatively similar once we limit the estimation to only a single sub-sector of automotive parts, but many parameters become unstable.

While Canada has some market power, the implied residual demand elasticities we find for Japan, the E.U., or the U.S. are notably lower. Only in the Chinese market do Canadian firms have more pricing power than the U.S. In contrast, Chinese firms are never estimated to have any significant market power and the only negative coefficient for South Korea, for its exports to China, is estimated very imprecisely (t-statistic is 1.21)—even though its market share is quite large. These results are intuitive as we would expect the countries with the most developed automotive industries to have the most sophisticated and differentiated goods, and hence the largest market power—which lines up well with the estimates in Table 4.15.

In light of these results and the very low market share for Canada in automotive parts exports to South Korea, China, and the E.U., we think that it is plausible to assume Canadian firms will not act strategically in their response to tariff policy changes, as was assumed in Section 4.4.

5. Future direction of the industry

This section analyzes the future direction of the auto industry, particularly in the North American market, in the next 5-20 years, Canada's potential to move towards high-value production of auto products, and the potential to attract future assembly and production of auto production. What would be needed, including vis-à-vis trade policy, to promote high-value production?

5.1 Future direction

Most of the relevant issues have already been addressed in the preceding Sections. Here I just summarize the most important trends—most important in terms of likely future impact.

5.1.1 Fuel

The great unknown for the industry is what type of fuel cars will drive in the future. Currently, the vast majority of vehicles today use a gasoline internal combustion engine, but that is likely to change in the not so distant future[59]. The corporate average fuel efficiency norms (CAFE) have been tightened repeatedly for cars, and the Bush Administration finally raised the standards for light trucks as well, which currently account for more than 50% of new vehicle sales in the U.S.[60]. More efficient, direct injection gasoline engines have started to appear, but more radical alternatives are also on the horizon.

It is not impossible that diesel engines will become much more popular in North America. In Europe they already account for more than 50% of new vehicle sales. A number of big manufacturers, especially Volkswagen and DaimlerChrysler, are committed to offer a greater selection of diesel engines in their passenger vehicle lineup. The advent of clean (low-sulfur) diesel

[59] The most popular current alternatives are diesel (especially for pickup trucks), LPG (especially for taxis and limos), and hybrids.

[60] Automotive News, March 29, 2006, "Fuel economy is toughened for 2008-2011 trucks".

in the U.S. in 2006-2007 is a pre-requisite for modern diesel engines. The future of diesel is by no means secure. The cost penalty to lower diesel emissions to the same level of gasoline emissions is proving to be much more costly than anticipated. At the same time, many of the fuel-saving technological advances common in today's diesels are often not yet introduced in gasoline engines (variable valve timing, turbo charging, and direct injection). Fiat estimates that a diesel engine would cost 1,000 euro more in production than a comparable gasoline engine, have the same CO2 emissions, and only a 5-10% fuel efficiency advantage. A U.S. government plan to provide tax incentives for diesel could prove decisive, but the details remain to be determined. Currently, no diesel engines are manufactured in Canada.

Furthermore, another advantage of the gasoline engine is that it can burn alternative fuels, such as natural gas or hydrogen, with few modifications. This multi-fuel use has proved to be a boon for the electricity generation industry, where modern generating stations switch between natural gas or oil depending on the price of the month. A diesel engine cannot achieve the same feat, although several European countries, especially Sweden and Germany, are making bio-diesel, made from organic material widely available.

While the engine is the most expensive single part of a vehicle, the alternative powertrains considered would have a much greater impact on the structure of the industry. Foremost, hybrids are likely to keep increasing in popularity. Total hybrid sales in 2005 exceeded expectation at 205,749 in the U.S. alone—52% of this by the Toyota Prius, representing 1.2% of all new vehicle sales. This ranges from a share of hybrids in total sales of approximately 8% for Toyota, 4% for Honda, less than 1% for Ford, and negligible for all other manufacturers[61]. A survey of North American automotive executives by KPMG yielded a unanimous prediction that hybrids will increase market share in the coming years[62]. Currently, no hybrids are

[61] GM has delivered 430 diesel-hybrid busses in the U.S. and Canada and expects to add 237 to that total in the remainder of 2006.

[62] On the sample of worldwide automotive executives, 88% anticipated a rising market share for hybrids.

manufactured in Canada. This will change once Ford introduces the hybrid versions of the Ford Edge and Lincoln MKX in its Oakville assembly plant. The gasoline versions will start production in 2006 as a 2007 model, but production of hybrids is expected to start only in 2010.

Plug-in hybrids could also become more popular in the future. These are hybrid cars with an enlarged battery pack that can be recharged from the electricity grid, not only by the on-board gasoline engine. For the vast majority of trips, only the electric engine would be used and the battery pack recharged overnight or at the office. Only on longer trips would the combustion engine be used. This setup does away with a major disadvantage of the previous generation of electric cars: the risk of getting stranded if the battery runs out.

Much further down the line is the changeover to the hydrogen economy and vehicles driven by fuel cells. Current expectations of most automakers are that by 2010 most of the technical aspects will be solved on the experimental models that are now touring the globe. It is also expected to take until 2020 or so before mass manufacturing would make affordable cars possible. An average sized car currently can store about 3 kilograms of pressurized hydrogen gas which can go about 200 to 280 kilometres under normal conditions before refuelling. Developing reliable storage for hydrogen and rolling out a distribution system are considered the biggest challenges for this new technology. As discussed in Section 1.5, Canada is very active in the development of fuel cells.

5.1.2 Assembly location

The second great unknown for the industry is whether final vehicle assembly will stay as close to customers as it has thus far. In the first decades after World War II, the industry produced very large production runs of a small number of vehicles in branch assembly plants close to population centres. For example, U.S. sales of the different guises of the main Chevrolet model totalled almost 1,500,000 units in 1966 and these were assembled in six different assembly plants across the country.

Declining model runs have resulted in very few cars or light trucks being produced in more than one U.S. plant. Except for a few instances where models are moved between assembly plants, not a single car was produced in more than one U.S. assembly plant in 2004[63]. The larger average production run for light trucks makes it more common for them to be assembled in more than one location, but the recent proliferation of crossover vehicles is lowering production volumes of light trucks as well.

Firms could have decided to develop vehicles for the global market, produce them in a single country, and ship them around the world, as is the current practice in the consumer electronics industry. With a few exceptions, this has not happened. Instead firms are investing in flexible manufacturing systems in order to build multiple vehicles on each assembly line[64]. This allows firms to produce a wide range of vehicles on each continent. It is unlikely that this decision is to a large extent driven by trade policy. Most developed countries charge only modest import duties on vehicles. Shipping costs for a bulky and easily damaged (scratched) product like an automobile are likely to be non-negligible and not decreasing over time. Proximity to consumers in a mature industry, where responding quickly to changing tastes is important, is probably another important factor.

The industry has also repeatedly flirted with made-to-order systems. The current industry benchmark for new vehicle inventories in the U.S. is 60 days, which is worth at least $60 billion (US). That is a lot of working capital sitting idle. In practice, inventory is larger for most vehicles; surprisingly, inventories tend to be higher for domestically produced vehicles. In a market where the number of available varieties totals almost 300, the risk of mismatching production and sales is enormous. The potential cost, in terms of a forced discount, to be able to sell undesirable vehicles, is corre-

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[63] A number of the largest volume vehicles, such as the Toyota Corolla, Chevrolet Malibu, or Ford Focus, are still produced in more than one North American plant.

[64] See Van Biesebroeck (2006), "Complementarities in Automobile Production", NBER Working Paper for a discussion.

spondingly enormous. Made-to-order, which is popular in Europe, would tie the assembly location to North America.

Even though a lot of components are currently outsourced to low cost countries, this has not happened with finished vehicles. Two Chinese firms are planning to start exporting finished vehicles from China to North America (Gheely in 2007 and Chery in 2008) and Honda is exporting its Fit subcompact car from Guangzhou to Europe. While the labour cost in assembly is too small a fraction of the total cost of a cart to justify producing it in a low-wage country like China, the trade-off changes once firms would be able to leverage the lower wages over the entire supply chain and produce most components at the low Chinese wage as well. The rapid development of the Chinese domestic industry is quickly making this a possibility. For example, the engines installed in the Chevrolet Equinox in the CAMI plant are shipped from China.

It took Japanese producers only 10 years after their first sales success in North America to establish local assembly capacity, although this choice was accelerated by the voluntary export restraints. Hyundai did not even wait this long to (entirely voluntarily) open up its first assembly plant in Alabama; its second plant, for its Kia subsidiary, has been announced at a time when it is not even certain it will be able to operate the plant at full capacity[65]. An important distinction is that the much larger labour pool in China is likely to keep wages depressed for a longer time than in Japan or Korea. It might make China an attractive assembly location for exports to North America in the future. The major Chinese car and component producers are currently benefiting a lot from their collaboration with leading western automotive companies. They are unlikely to anger their joint venture partners by challenging them in their home market. However, once they feel they have learned what they wanted to know, their incentives will change.

A final issue that has come up repeatedly in this report is the future division of labour between OEMs and suppliers. Many tier 1 suppliers are playing an increasing role in R&D and

[65] An earlier venture in Quebec in 1989 was of a much lower scale.

design. Several firms, e.g., Magna International, are also taking on assembly tasks. Whether this makes it less or more likely that assembly will move overseas remains to be seen.

5.1.3 Volume

As discussed at length in section 1.4, we anticipate a reduction in future North American sales (and production), especially in the U.S. Registrations are at an all-time high and especially very new vehicles abound after a sustained string of bumper sales years. Many industry observers rationalized the large Big 3 sales decline in the fall of 2005 as a mismatch between the gas-guzzling vehicles they produce and consumers' newly acquired taste for fuel-efficiency in the post-hurricane Katrina spike in fuel prices. It seems much more likely that the spectacular summer sales, fuelled by employee discount programs, were responsible. Over the summer, large SUVs had been the most successful market segment and the market is probably saturated[66].

The increased durability of modern vehicles will make sure the current stock of vehicles will be around for quite some time. The large number of fuel-inefficient SUVs and other types of trucks sold in recent years make the fleet of second-hand vehicles less suitable for exporting to less developed economies, especially with the current high fuel price. Exporting new vehicles to keep assembly plants operating at full capacity seems also a very unlikely proposition, as discussed in section 3.5.

The large reorganizations, announced by GM on November 21, 2005 and by Ford on February 19, 2006, seem to suggest that these companies want to aggressively align their North American production capacity with their current production. Further erosion of their market share can then be used to build up some spare capacity to respond to sales opportunities. At the same time, through investments in flexibility OEMs will try to operate their existing capacity much more intensively than before.

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[66] The incentive to switch your purchase decision between time periods to chase after a temporary discount is clearly larger for more expensive vehicles.

5.2 High-value production in Canada

The automobile industry is surprisingly high tech. The five biggest companies (GM, Toyota, Ford, DaimlerChrysler and Volkswagen) combined spent a total of $33.7 billion USD on R&D in 2004! There is not a single other industry with five firms spending an average of almost $7b on R&D. One can count the number of industries with *any* firm spending that much on one hand. R&D spending by suppliers is also increasing rapidly. By 2005, the automotive firm holding most U.S. patents was Robert Bosch GmbH, now the largest OEM supplier worldwide. The Ford Motor Company was runner-up. A search of the NBER patent database reveals that these two companies combined hold more than 11,000 patents and indirectly through subsidiaries countless more.

R&D is not only concentrated by firm, it is also predominantly carried out in Michigan. Its importance is not only apparent from the location of headquarters (more than 50% of the 150 largest North American suppliers are located there), but also in terms of recorded R&D spending. The Michigan Automotive R&D directory estimates that in 1999 total R&D spending in Michigan totalled US$18b, almost all of which was privately funded, and involved 65,000 employees. Only California performs more R&D, but on a per-capita basis Michigan is unrivalled in the United States[67]. 70% of the research, US$13.1b, was on automotive applications and Michigan alone represents 85% of total U.S. R&D spending in the industry.

It is not immediately obvious how Canada will attract a piece of the research pie. The vast majority of Canadian suppliers is in favor of government support for R&D activities; see below. Recent capital investment subsidies under the (federal) Canadian Skills & Innovation Project and the Ontario Automotive Investment Strategy have tied funding to locating some innovative activities in Canada. Ford is adding a research centre to its Oak-

[67] At $180,000 per capita of R&D, Michigan is only rivaled by Massachusetts (#3 at $151,000) and tiny states with many headquarters like Delaware (#2) or Rhode Island (#4).

ville assembly plant. GM's Beacon project features heavy investments in human capital. Canada's largest automotive firm, Magna International operates a total of 60 R&D centres and test facilities, but only 8 in Canada. While regrettable for Canada, it is hard to imagine it being otherwise as only a quarter of its production facilities is located in Canada. In terms of policy, all the government can do is to create an environment conducive to R&D such that firms that reorganize have an incentive to locate research activities in Canada. Given the generous tax treatment of R&D in Canada, current policy seems adequate[68]. It is certainly not obvious how trade policy can play a role.

In terms of high value-added production activities, Canada is keeping up better with the U.S. in the assembly sector than in parts. Table 5.1 compares the productivity record of the two countries in both automotive sectors. In the top panel, one can see that shipments per employee are equally large in both countries, in excess of $1 million CDN. The fraction of value added is similar as well and slightly higher in 2002 than in 2000. Value added per employee was higher in Canada in 2000 and only slightly lower in 2002. The fraction of production workers is a bit lower in the U.S., which increases the 2002 U.S. labour productivity advantage slightly, but at $433,574 (U.S.) versus $405,963 (Canada) the values are extremely high. The significantly higher salary for U.S. production workers, 42% higher in 2002 (31% in 2001), is almost entirely the result of a much larger share of value added being paid out to workers in the U.S. than in Canada. The U.S. industry employs more and better paid salaried employees, but that explains only a small fraction of the gap in value added going to wages, 16.0% in Canada versus 24.5% in the U.S. The much vaunted lower wage cost in Canada, courtesy of the nationally funded health care system, seems to benefit predominantly the employer.

[68] See Van Biesebroeck (2006), "Impediments and Facilitators to Technology Adoption. A literature survey", report prepared for Industry Canada.

Table 5.1 Productivity comparison: Canada versus the U.S.

	Canada			US		
	2000	2002		2000	2002	
Assembly (NAICS 3361-3362)						
Shipments per employee	**$1,147,471**	**$1,141,529**	**-0.5%**	**$1,079,286**	**$1,191,334**	**10.4%**
VA as % of shipments	28.8%	30.9%		26.8%	30.7%	
Value added per employee	**$330,728**	**$352,655**	**6.6%**	**$289,188**	**$365,156**	**26.3%**
Prod workers as % of total employment	84.3%	86.9%		85.0%	84.2%	
Value added per production worker	**$392,246**	**$405,963**	**3.5%**	**$340,391**	**$433,574**	**27.4%**
Production wages as % of value added	14.1%	14.0%		21.3%	18.6%	
Production wages per production worker	**$55,445**	**$56,658**	**2.2%**	**$72,490**	**$80,562**	**11.1%**
Payroll as % of value added	17.2%	16.9%		26.3%	22.6%	
Average salary of white collar workers	**$65,111**	**$79,303**	**21.8%**	**$95,346**	**$92,536**	**-2.9%**
Parts (NAICS 3363)						
Shipments per employee	**$330,460**	**$334,145**	**1.1%**	**$378,133**	**$433,291**	**14.6%**
VA as % of shipments	40.1%	36.9%		41.3%	42.4%	
Value added per employee	**$132,521**	**$123,186**	**-7.0%**	**$156,337**	**$183,686**	**17.5%**
Prod workers as % of total employment	87.2%	85.3%		80.1%	79.5%	
Value added per production worker	**$152,001**	**$144,496**	**-4.9%**	**$195,192**	**$230,983**	**18.3%**
Production wages as % of value added	29.6%	32.7%		31.1%	27.3%	
Production wages per production worker	**$44,959**	**$47,261**	**5.1%**	**$60,699**	**$63,071**	**3.9%**
Payroll as % of value added	36.1%	40.7%		41.8%	37.2%	
Average salary of white collar workers	**$67,706**	**$66,829**	**-1.3%**	**$84,088**	**$89,204**	**6.1%**

Note: all figures in CDN dollar

Source: Own calculations based on DesRosiers Automotive Yearbook (2005) and data from Statistics Canada and U.S. Census Bureau

The situation is notably different in the parts sector. The salary gap between U.S. and Canadian production workers is similar 33.5% higher in the U.S. in 2002 (35% in 2001), but here it is mainly driven by much less value added generated in Canadian firms. The share of value added paid out in wages and benefits is comparable across the two countries. The fact that Canadian firms have much fewer salaried employees makes the difference in labour productivity—measured as value added per production worker—particularly stark; it was 60% higher in the U.S. in 2002.

A couple of caveats are required to put this comparison in perspective. First, a larger fraction of the parts sector output stays in Canada and the very low Canadian—U.S. dollar exchange rate in 2002 undervalues Canadian output in that year. Second, the mix within the parts sector is disadvantageous for Canada. A greater fraction of U.S. employment is in engine production which is highly capital intensive, which biases U.S. value added upward[69]. In addition, the Canadian engine sector was operating in 2002 at approximately 50% of its usual value added per worker. Third, the Canadian industry is reallocating its parts employment towards a number of sub-sectors with higher than average value added per worker: engine & engine parts and interiors, while maintaining a large employment share in a third high value added sector—transmissions (see statistics in Table 4.5).

Finally, in Table 5.2 we present a breakdown of total value added generated in the U.S. automotive industry in different years, as estimated and predicted by the Center for Automotive Research in Michigan[70]. The most important sub-sector throughout was parts and components. Increased cost pressure, due to import competition and purchasing plans of OEMs, depressed its share slightly in 2000 to 56.0%. Increased use of electronics is predicted to raise its share to 60.1% of total value

[69] Given that the two countries use a different breakdown of the NAICS industry classification below the "Parts and accessories manufacturing" (NAICS 3363) level, it is impossible to control for the mix of industries to make the value added comparison.

[70] Center for Automotive Research (2002), "Estimating the New Automotive Value Chain," a study prepared for Accenture.

added generated in the industry by 2010. The share of value added generated by OEMs (including assembly) is predicted to decline considerably from its 2000 high to 26.4%, slightly more than one quarter of the industry. For these firms, assembly wages are predicted to decline from 35% of their value added in 1990 to 23% in 2010. Clearly, high value added activities in the automotive sector increasingly means parts and R&D.

Table 5.2 Breakdown of the total value added generated by automotive sub-sector

(billion USD)	1990	2000	2010
Total automotive sector (U.S.)	**$291.0**	**$432.0**	**639.5**
Distribution (Advertising – dealers – freight)	$36.0 (12.4%)	$43.0 (10.0%)	$64.6 (10.1%)
Vehicle manufacturers – wages	$25.2 (8.7%)	$31.2 (7.2%)	$39.1 (6.1%)
Vehicle manufacturers — other value added (design, R&D, investment)	$46.2 (15.9%)	$97.2 (22.5%)	$129.9 (20.3%)
Parts & components	$169.7 (58.3%)	$241.9 (56.0%)	$384.2 (60.1%)
Other material inputs (energy, warranty,…)	$13.9 (8.2%)	$18.7 (4.3%)	$29.5 (4.6%)

5.3 Policy

To gauge the importance of different policy options for the industry, it is useful to take a look at the answers Canadian parts suppliers gave to the previously mentioned APMA survey. On a scale from 1 to 7 firms were asked to rate the usefulness of different policy initiatives on a list of 20. The results of this survey are in Table 5.3. The first column indicates the number of suppliers that find the initiative useful (more than moderately so); the second column is the fraction of respondents that find the policy initiative "very useful" or rate its usefulness "extremely high"; and the third column sums the two groups. The different initiatives are organized in order of total support—any answer from 5 to 7.

Table 5.3 How useful to you find the following policy initiatives?

"Industry observers have suggested policies that the government could take to facilitate or enhance the growth of the Canadian auto industry. Several of those proposals are listed below. From the perspective of your firm, please rate the usefulness of these government policy proposals from 1 to 7 based on the following scale:"

		Fraction of positive ratings		
	POLICY INITIATIVES:	**5**	**6-7**	**5-7**
1.	Increase funding and/or tax incentives for R&D and innovation	7.1	78.6	85.7
2.	Increase incentives to domestic investors	14.3	71.4	85.7
3.	Expedite transportation infrastructure upgrades	7.1	71.4	78.5
4.	Increase incentives to foreign investors	21.4	57.1	78.6
5.	Increase funding for Technology Partnerships type programs	28.6	42.9	71.4
6.	Implement electronic border clearing system compatible with US Customs	14.3	50.0	64.3
7.	Remove tax and other barriers that slow domestic industry consolidation	14.3	50.0	64.3
8.	Change tax law to permit more rapid depreciation of new equipment	16.7	41.7	58.3
9.	Assistance for implementing productivity-enhancing equipment/systems	33.3	25.0	58.3
10.	Renew emphasis on government-industry partnerships and task forces	21.4	35.7	57.1
11.	Increase funding for auto-sector related technical education	21.4	35.7	57.1
12.	Provision of capital to facilitate new international joint ventures	14.3	42.5	56.8
13.	Increase incentives to firms using alternative energy	21.4	21.4	42.9
14.	Government-led marketing/branding initiatives focusing on the auto sector	28.6	14.3	42.9
15.	Make the use of anti-dumping/countervail legislation easier	16.7	25.0	41.7
16.	Facilitation of Canadian auto sector in rapidly growing markets	8.3	25.0	33.3
17.	Increase tax credits for firms that implement retraining/'reskilling' programs	0.0	21.4	21.4
18.	Reduce immigration restrictions on young, technologically skilled workers	0.0	21.4	21.4
19.	Rescind Canadian ratification of the Kyoto Protocol	0.0	15.4	15.4

Notes: scale of usefulness: 1 = extremely low, 4 = moderate, 7 = extremely high

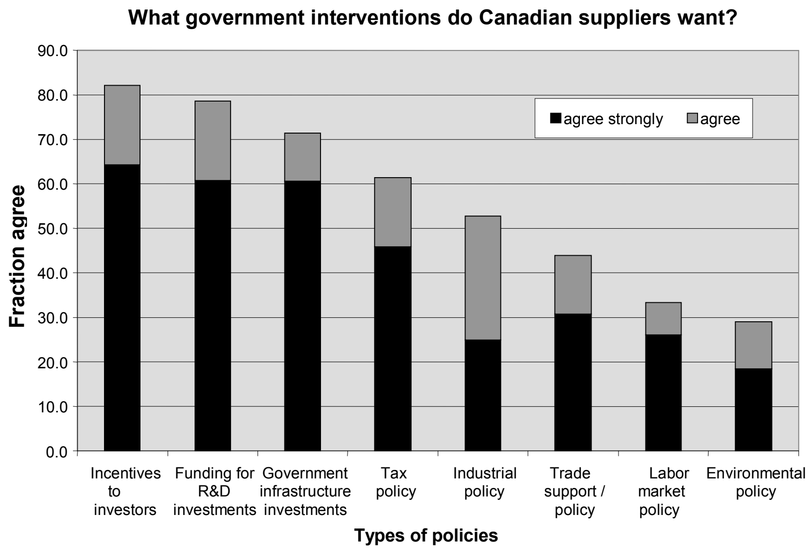
84 respondents

Source: "The East Asian Automobile Industry: Opportunity or Threat? Results of a Survey of the Canadian Auto Parts Manufacturers," Canada in Asia report, January 2005

It is clearly noticeable that R&D support and investment incentives figure high on the list. These issues get almost universal approval—86% of firms support such initiatives and almost 80% of firms strongly support R&D support. On the other hand, a number of issues that have received prominent attention in the media, do not carry much industry support. For example, Canada's ratification of the Kyoto emission abatement agreement is not perceived as much of a problem. Providing support for technical education carries some support, 57% of firms, but reducing immigration restrictions on young skilled workers is not seen as a solution to the industry's shortage of skilled trades people.

In Figure 5-1, we group the average support of different initiatives by policy area. For example, investment incentives for domestic firms and FDI are grouped together. Support for R&D and funding for Technology Partnership type programs are grouped under innovation policies. The pattern that appears is quite striking. Given that only a single policy would be assigned a different priority when we use strong support instead of total support, we will use total support numbers in the discussion[71].

Figure 5-1 Ranking of interventions by policy area



Investment support of different sorts is by far the preferred form of government intervention. More than 80% of firms think it would be a good idea for Canada to provide direct investment incentives; the level of support is only slightly higher for incen-

[71] While 52.8% of firms support some form of industrial policy, only 25.0% finds these very useful. Limit attention to firms that strongly support a policy, industrial policy would become second least importance.

tives for domestic than for foreign firms. In addition, assistance for firms that innovate is also widely supported. This can take the form of direct funding support, tax incentives, or funding for Partnership Programs. Finally, government investment in infrastructure, electronic border clearing with the U.S. or transportation infrastructure, is also supported by 71.4% of firms.

The next policy area receives a full 10% less support and even 15% less if we only count strong supporters. Even more striking is that the next priority is tax policy. An area of government policy that is likely to differ only in implementation from the more pro-active forms of investment support in the first three areas. The remaining policy areas, industrial, trade, labor market, or environmental policy all carry much lower levels of support. The only popular trade policy (Provision of capital to facilitate new international joint ventures) is again a form of investment support. Restricting import competition by facilitating the use of antidumping measures as well as more active government support to facilitate Canadian exports in rapidly developing markets do not gather much enthusiasm.

The overall picture that emerges is that the only interventions that carry widespread support are government investments or support for private investments. With respect to trade policy, these sentiments from the industry are reinforced by much of the analysis in the preceding chapters. Current tariff levels are sufficiently low that they are not viewed as very important policy tools. In the analysis, consumer gains from lowering tariff levels counteract producer losses with minimal net effect on Canada as a whole. In addition, the dominance of the U.S. as trading partner for the industry further reduces any effect of trade policy.

5.4 Conclusion

The sentiment towards government policy in this industry is not entirely at odds with the bulk of the results we have uncovered in this report. To summarize:

- One of the greatest changes in the industry, the changing vertical organization, is almost entirely beyond government influence. Increasing technological intensity is driven by consumer demand. Proliferation of vehicles has lead firms to adopt flexible technology and environmental awareness has spurred the development of alternative fuel vehicles. While firms clearly benefit if the government covers part of their R&D costs, the greatest success story to date, the Toyota Prius, hardly benefited from government subsidies. It remains highly doubtful to what extent government intervention can successfully steer the industry. (Section 1)
- Decreasing or abolishing import tariffs on final vehicles will benefit consumers (somewhat) and hurt Canadian production (somewhat). The net effect on welfare is likely to be very small and actual estimates, like the ones we presented in this report, will be sensitive to modeling assumptions. (Section 2)
- The only candidate firm for near term investments in new assembly capacity in Canada is Nissan. Trade policy is likely to be of limited impact in securing such investment. Infrastructure or direct investment support are likely to be much more important. The Ontario government has already started talks. (Section 3)
- The parts sector is much more vulnerable to exchange rate fluctuations, raw material prices, and bankruptcies of large firms, factors largely beyond the Canadian government's control. The very limited export success of the Canadian industry beyond the U.S. is unlikely to be to a large extent the result of trade restrictions[72]. Of course, at the margin every-

[72] Japan, the largest market after the U.S. and distinctly high-cost, does not charge any import tariffs, but Canadian producers have not made significant inroads.

thing helps. Current trade protection for the parts sector in Canada is very low. If giving up the limited protection that exists would lower overseas trade barriers (which tend to be higher), the net effect is likely to be positive. (Section 4)

- When asked about preferred government interventions, a large majority of firms in this industry refer to investment, R&D, and infrastructure support. (Section 5)