Impact of FTAs on Canadian Auto Industry

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Executive Summary*

This report consists of four complementary parts. In the first part we provide an overview of the Canadian automotive industry's position in the global industry and give an overview of important trends. In the second part we conduct counterfactual analyses of several trade liberalization scenarios for Canada. In the third part we conduct a similar simulation to study the expected impact of the recently signed Korea-U.S. FTA on the Canadian automotive sector. In the fourth part we assess the potential impact of Canadian tariff reductions on future FDI in the sector. We next highlight the main findings from each part.

First, the turmoil in the industry over the great 2008-2009 recession has really changed relative positions of firms in the industry. Ford and Hyundai have recorded the largest absolute increases in sales. Total Canadian production has almost recovered to pre-crisis levels, to a large extent due to capacity additions by Toyota and Honda, which now produce around half of their Canadian sales locally. In addition to the recovery from the great recession, important global trends are the emerging auto industries in large developing countries and the growing importance of technologies to boost fuel efficiency.

Second, we find only modest impact on domestic production for different possible trade liberalization scenarios. For example, our preferred estimates suggest that the elimination of the 6.1% import tariff on vehicles assembled in Korea would decrease local production by Canadian plants by 4,482 units. The highest effect we ever find for Canadian trade policy is in the case of full unilateral elimination of tariffs for vehicles from all three trading partners—Korea, Japan, and the E.U.—and assuming a restrictive demand system. Even in this scenario, total loss of local production is estimated to be at most 14,407 vehicles, or 0.70% of total domestic production. Using the average jobs-per-vehicle ratio for the entire Canadian automotive market, this translates into 660 jobs.

Third, a FTA between Canada and Korea is estimated to lead to a decline in sales of 1.47% for vehicles that are produced and sold in Canada. Because 85% of Canadian output is exported, it only amounts to 0.22% of total Canadian new vehicle production. A similar analysis for the recently signed FTA between Korea and the U.S. suggest a decline in Canadian production of 20,175 vehicles in that case or 0.98% of total output. Using the same underlying economic model, we find an effect for U.S. trade policy that is more than twice the size and the difference is even larger under some alternative modeling options.

Fourth, it is unlikely that any new vehicle assembly plants will be announced for North America in the next few years. Moreover, Canadian trade policy has only a marginal influence on this. The three firms that are most likely to find themselves looking for additional regional production capacity are, in order, Hyundai, Mazda, and Nissan.

* The views expressed here are the author's and are not to be attributed to Foreign Affairs and International Trade Canada or to the government of Canada.

1 Introduction

With the Doha round of multilateral trade negotiations progressing at a glacial pace, Canada has been actively pursuing bilateral trade liberalization initiatives. It has been negotiating both with South Korea and with the European Union to form Free Trade Agreements (FTA) that would abolish most import tariffs between the two countries or groups of countries. Early in 2011, Canada also launched a joint impact study to investigate the benefits of an Economic Partnership Agreement with Japan.[1]

As one of Canada's most important manufacturing sectors, it is only natural that the likely impact of these trade initiatives on the automotive sector is considered carefully. Apart from new vehicle imports from the United States and Mexico, which already enter the country duty-free, all new vehicle imports currently come from the three countries mentioned above: the E.U., Japan, and Korea. The most important aspect of these FTAs for the Canadian automotive market is that they would abolish the existing 6.1% preferential import tariff for WTO members on new passenger vehicles.[2]

In the economics literature, the automobile market is usually characterized as a differentiated goods oligopoly. Prices will be set strategically and the margin between prices and marginal costs provides firms with funds to cover fixed costs of operation. These include the establishment of production lines, vehicle development, maintaining a dealership network, advertizing, and other expenditures that allow firms to differentiate their product offerings. Note that it is impossible to observe fixed or variable costs directly. However, we can infer the underlying marginal costs that rationalize the observed prices from the consumers' estimated price elasticity.

Viewing the industry as a differentiated goods oligopoly has two important consequences for studying the likely impact on the domestic industry of a tariff reduction. First, the pass-through will be incomplete. Abolishing the current 6.1% import tariff on a sub-set of imports will lower the affected firms' landed marginal cost by 5.75%, but the expected price reduction will surely be less than that.[3] When a firm with some market power decides on its optimal pricing, it takes the elasticity of demand into account. As most realistic demand models feature a higher consumer price elasticity at higher prices, a firm will tend to choose a lower price-cost markup when faced with an import tariff. As a consequence, when the import tariff is abolished it will increase the optimal price-cost markup.

[1] A full list of Canadian initiatives in this area can be found online at http://www.international.gc.ca/trade-agreements-accords-commerciaux/agr-acc/index.aspx?view=d.

[2] It is possible that future FTAs will be accompanied by local content requirements as was the case for NAFTA. Given that the models that Canada imports from Korea, Japan, and the E.U. have such high shares of locally sourced components (in the respective countries or regions), they are certain to qualify for duty-free import into Canada under any reasonable local content rule.

[3] As the landed marginal cost includes the current 6.1% tariff rate, the cost reduction will only be 0.061/1.061 = 5.75%.

The second implication of viewing the industry as a differentiated oligopoly is that competing firms are expected to respond to each others' price changes. In particular, when one firm lowers its price as it benefits from a tariff reduction, its competitors will also adjust their prices—in almost all cases downward as well. This includes firms producing domestically and firms importing from countries that still face the import tariff which do not enjoy any direct benefit of the FTA-motivated tariff reduction.

A further complicating factor is that firms produce multiple products and they will internalize effects on their own products. All of these issues make it complicated to predict the price and quantity responses to tariff reductions. They also guarantee that adjustments will be highly asymmetric as not only the direct effect vary across firms, they also produce different ranges of products, produce products that vary in their substitutability with other products, and they might even face consumers with varying degrees of price elasticity.

The way we obtain estimates for the predicted changes in prices, quantities, and trade flows is by calculating a new industry equilibrium in three steps. First, we estimate a demand system that characterizes the purchase decisions in the Canadian automobile market. Second, we supplement the demand system with a model of firm price setting behavior to uncover the underlying (landed) marginal costs that are consistent with the observed prices. Third, we abolish import tariffs for vehicle models imported from a specific country and we calculate the new equilibrium prices and quantities for all active firms and models.[4]

Of course, Canada is not the only country pursuing bilateral trade deals. Both the E.U. and the U.S. have ratified a FTA with South Korea in 2011. In both cases, issues related to automotive trade have imposed delays between concluding the negotiations and ratifying the agreements.[5] The agreement with the U.S. in particular is likely to have important repercussions for the Canadian industry because the majority of vehicles produced in Canada are exported to the United States. Using an adjusted version of the methodology outlined above we estimate what the expected effect will be on sales of Canadian vehicles in the U.S. market when Korean firms lower their prices and all competitors are forced to respond.

The remainder of the report is organized as follows. In Section 2 we start with an overview of recent developments in the automotive industry, including the position of Canada in the global industry and important trends that have policy implications. In Section 3, we perform counterfactual simulations for a range of possible FTAs between

[4] Important methodological caveats are summarized in Section 3.1.
[5] The U.S. and South Korea signed the KORUS FTA on June 30, 2007, but it took until November 22, 2011 and one renegotiation for the agreement to pass both countries' parliament and become law. The agreement for the E.U.–South-Korea FTA was signed on October 15, 2009 and came in effect on July 1, 2011.

Canada and one or more of its trading partners. We discuss the expected impact on vehicle sales, imports, domestic production, and employment. In Section 4, we use the same methodology to estimate the expected effect of the KORUS FTA on the Canadian industry. In Section 5, we discuss possible effects of tariff elimination on Foreign Direct Investment in the Canadian auto industry. Section 6 summarizes the conclusions.

2 Trends in the automotive industry

2.1 Canadian sales and production

Total sales for the Canadian market in 2010, in units and market share, as well as the growth in sales over the last five years are depicted in the first three columns of Table 1. Total sales are approximately back to the level of 2005, but firms have experienced dramatically different fortunes. The two most eye-catching changes are the collapse in sales by General Motors[6] and the spectacular increase in sales by the two marks owned by the Korean Hyundai group, Hyundai and Kia, which even surpassed total sales by Toyota.

As a result, the market has become much more leveled. Sales of the top firm in Canada (Ford) are less than double the sales of the firm in the number six spot (Honda). The combined sales of the top six groups is now over three quarters of the market, with no firm dominating.

Somewhat surprisingly given the overall economic climate, the luxury brands have done extremely well, with large increases in the market shares of Volkswagen (Audi), BMW, Daimler (Mercedes-Benz), and Subaru. Also, Daimler is now again independent from Chrysler. Together with the strong performance of Nissan, it is likely that the market shares of different firms with converge further.

The production breakdown in the last five columns of Table 1 also tells an interesting story. Toyota and Honda are now the most Canadian of all firms. Both produce approximately half of their sales locally. The fraction for GM dropped below 20% and for Ford it even approached 10%, but it will rebound now that the St. Thomas plant has been closed (in September, 2011) which produced mostly for export. Overall, exactly 20% of all vehicles sold in Canada are produced domestically. Given that total Canadian sales only make up 11% of the entire integrated NAFTA market this is still a higher than proportional fraction.

[6] We have included sales of Saab in the total for GM and Volvo's sales with Ford, even though both makes have now been sold, respectively to the Dutch firm Spyker and to the Chinese firm Geely. Their sales are very small so they hardly affect the totals.

Table 1: Total sales and country of origin for light vehicle sales in Canada in 2010

	Total Sales			Production location				
	units	share	growth 2005-10	Canada	U.S. & Mexico	Japan	Korea	E.U.
Ford	262,200	(17.1%)	25.4%	11.3%	86.2%			2.5%
GM	237,487	(15.5%)	-45.5%	19.3%	80.7%			0.0%
Chrysler	203,937	(13.3%)	-5.1%	35.0%	65.0%			
Hyundai	172,389	(11.3%)	84.8%		30.1%		69.9%	
Toyota	171,200	(11.2%)	-2.9%	51.4%	32.7%	15.9%		
Honda	141,070	(9.2%)	-8.7%	49.4%	42.3%	8.3%		
Nissan	82,993	(5.4%)	17.0%		64.3%	35.7%		
Mazda	78,662	(5.1%)	1.0%		17.7%	82.3%		
Volkswagen	59,584	(3.9%)	53.2%	1.7%	26.1%			72.2%
BMW	31,703	(2.1%)	47.1%		24.8%			75.2%
Daimler	30,081	(2.0%)	90.8%		14.2%			85.8%
Subaru	27,805	(1.8%)	74.2%		36.7%	63.3%		
Mitsubishi	19,504	(1.3%)	87.7%		8.2%	91.8%		
Suzuki	9,128	(0.6%)	3.6%		6.9%	93.1%		
Tata	3,302	(0.2%)	1.7%					100.0%
Total	1,531,045		-1.0%	20.0%	53.9%	11.6%	7.9%	6.7%

Notes: Based on 2010 sales statistics. Tata is counted as a European manufacturer (Land Rover/Jaguar)

Even though the two Japanese firms dominate the sales of vehicles that are produced domestically, accounting for 51.6% of all these vehicles, Table 2 shows that the picture is still different if production for export is included. When looking at total Canadian production for 2010, GM is still the largest producer. It just happens to produce vehicles that are more popular south of the border, exporting 91.4% of output. Its market share in Canada is also lower than in the United States. The production statistics also show a leveling in this respect with GM, Chrysler, and Toyota each producing between 460,000 and 530,000 vehicles in Canada. Furthermore, it is likely that Honda will have passed Ford in Canadian production in 2011.

Table 2: Total Canadian production and destination of output (2010)

		Total production	Sold domestically	Fraction exported
GM		529,568	45,776	91.4%
	Ingersoll (CAMI)	242,929		
	Oshawa	286,639		
Chrysler		475,382	72,520	84.7%
	Brampton	163,257		
	Windsor	312,125		
Toyota		458,729	87,966	80.8%
	Cambridge	307,698		
	Woodstock	151,031		
Ford		320,608	29,747	90.7%
	Oakville	224,607		
	St. Thomas	96,001		
Honda	Alliston	278,272	69,622	75.0%
Total		2,062,559	305,631	85.2%

Notes: In 2011, the CAMI plant that was started as a joint venture between GM and Suzuki became fully owned by GM. Ford closed the St. Thomas plant in September 2011.

The statistics in Table 1 and Table 2 together imply that Canada is still running a sizeable trade surplus in new vehicles. In 2010, vehicle exports totaled 1,756,928 and imports 1,222,504. Its net exports are thus 531,514 vehicles, more than one quarter of total production. We can thus characterize the Canadian automotive industry as highly integrated with the rest of the world. 80% of sales are vehicles assembled abroad; 26% even originates from another continent. 85% of production is exported—almost all to other NAFTA countries—and this share is lower for Japanese plants.

2.2 Major trends in the industry

The most important trends that are worth highlighting are the recovery in the aftermath of the great recession, the growth of the industry in large developing countries, and the growing importance of alternative fuel vehicles.

The recession of 2008-09 caused a tremendous crisis in the automotive industry as sales plummeted when consumers cut back on consumption of durables, in particular motor vehicles. The sales decline together with large legacy costs bankrupted GM and Chrysler, both of which emerged quickly from Chapter 11 restructuring under partial government ownership—jointly by the U.S. and Canadian governments. Fiat bought out the government stake from Chrysler in July 2011 and following an initial public offering on November 18, 2011, the government stake in GM was substantially reduced. For further details on the travails of the industry over the recession, we refer to Sturgeon and Van Biesebroeck (2009).[7]

The former Big 3 are looking a lot healthier today, but they have trimmed production capacity aggressively in North America, making it a much more leveled industry. The same has happened at the global level with GM, Ford, Toyota, Volkswagen, and Hyundai emerging as the five dominant groups. All indications are that global competition is getting stronger, also driven by the emerging auto sectors in large developing countries, which is discussed next.

Table 3: Impact of the crisis on quality initiatives of second-tier Canadian suppliers
(2009 survey; *percentage of responses*)

Survey questions	**Possible answers**	**Fraction answering "yes"**
Is the area of . . . in your company affected by the recession?	- Quality control	6
	- Top answer: human resources	25
	- Answered "all of the above"	37
Over the past 6 months, which of the following events have you noticed in your company?	- Cut in quality program	13
	- Top answers (cost reduction, layoffs, reduced working hours, waste reduction)	100
Rate your firm's involvement in the following programs (% answering "active" or "very active")	Before the recession	During the recession
Cost reduction activities	50	100
Customer satisfaction	100	100
Supplier development	37	24
Continuous improvement	69	37
New product development	13	6
Process/product innovation	63	25

[7] An earlier version of this work is available online as *World Bank Policy Research Working Paper No. 5060*, which can be downloaded from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/0,,menuPK:577938~pagePK:64165265~piPK:64165423~theSitePK:469372,00.html.

Source: Facey (2009)

In this respect, quality improvement and innovation is likely to become ever more important. A survey by Facey (2009) finds that second-tier Canadian suppliers have taken pains to avoid cuts in the quality control departments over the recession, which bodes well for the future. On the other hand, many aspects of company development and product improvement have been put on hold. Table 3 contains some highlights of her survey. The responses indicate that over the crisis, the fraction of firms that were active or very active in continuous improvement dropped from 69% to 37%. The fraction of firms that state being active or very active in new product development was low to begin with (13%), but even declined further over the recession (to 6%). Finally, process or product innovation was also scaled back substantially.

The second important trend in the global automotive industry is the growing importance of emerging markets. Large developing countries have now clearly become the engine of growth for the industry. This does not include Mexico, which in 2010 still recorded sales 28% below its pre-crisis level. The largest growth markets are China, India, and Brazil. China has now become the largest automobile market and this is likely to remain the case for a long time. Sturgeon and Van Biesebroeck (2010) discuss this evolution in detail and summarize policy options for developing countries.[8]

Table 4: Changing geographic exposure of Canadian Suppliers

(2004 survey, % *of survey responses)*

	Canada	United States	Europe	Latin America	Asia
Fraction of your firm's production taking place in facilities located in . . .	69.4	17.1	11.9	1.4	0.3
Fraction of supply needs that were sourced from . . .	51.1	33.3	9.0	1.9	4.7
Fraction of Greenfield investments (past 5 years) made in . . .	49	18	4	1	28

In the last three years, has one or more of your major customers ever threatened to switch to overseas suppliers?	71% yes
In the last three years, has one or more of your major customers asked your firm to initiate or expand activities in new geographical markets in order to facilitate its own expansion agenda?	64% yes

[8] An earlier version of this work is available online as *World Bank Policy Research Working Paper No. 5330*, which can also be downloaded from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/0,,menuPK:577938~pagePK:64165265~piPK:64165423~theSitePK:469372,00.html.

Countries mentioned most frequently: United States (33), Korea (33), China (33), Mexico (22)

Source: Asia Pacific Foundation of Canada (2005).

As a result, automotive suppliers in developed countries, like Canada, are often pressured by their clients to follow them overseas. We find some evidence for this from a survey by the Asia Pacific Foundation of Canada (2005). Table 4 groups the answers to five survey questions that probe the firms about their own production activities, sourcing, investments, and customer demands. These responses illustrate that activities of Canadian supplier firms already started to spread geographically long before the crisis.

If we compare the geographical distribution of three activities—production, sourcing, and investment—we see a clear trend away from Canada toward Asia. While almost 70 percent of the supplier firms' production takes place in Canada, only 51 percent of inputs are currently sourced domestically and only 49 percent of greenfield investment occurs in Canada. In contrast, Asia is the production location for only 0.3 percent of current output, but the source of 4.7 percent of inputs. Most importantly for the future, 28 percent of all greenfield investment by Canadian automotive parts suppliers are being made in Asia, ahead of even the United States.

An important impetus for Canadian suppliers to invest overseas is the explicit requests from current customers: 64 percent of suppliers report that they have received a request in the last three years to aid the overseas expansion of their customers by setting up overseas operations of their own. Some suppliers also indicated that they believe serving Japanese-owned firms in other countries will increase their chances of gaining new business to supply Japanese assembly in Canada.

The third global trend we highlight is the rising importance of alternative fuel vehicles, such as hybrid and electric vehicles. In Japan, the Toyota Prius already is the best-selling model and under the 20/20/20 strategy the E.U. has passed extremely ambitious regulations to increase fuel efficiency of the new vehicle fleet. The new CAFE standards that the Obama administration announced on August 1, 2011 intend to raise the average fuel efficiency of the new vehicle fleet in the U.S. to 54.5 mpg by 2025. While less ambitious than the European program, these standards will affect all plants producing for the NAFTA market, including Canadian plants.

Vehicles that use new technology to boost fuel efficiency are largely absent from Canada's production plants. The Honda Civic GX, which runs on compressed natural gas, is not produce in Alliston anymore, but in Honda's Greensburg, IA plant. The fact that it was not certified for use on Canadian roads did not help to keep production in Canada. GM still produces flex-fuel vehicles that run on a mixture of 85% of ethanol in Oshawa, but the latest calculations of CO2 emissions over the full life-cycle have not been positive for ethanol as a fuel for the future. Finally, while Canada is still at the frontier of developments in fuel-cell technology, its applicability to motor vehicles is still as far out as ever.

3 Effects of eliminating preferential tariffs under Canada's trade agreements

3.1 The nature of the counterfactual analysis

The methodology to estimate the expected effect of a change in trade policy consists of the following three steps.

First, we estimate a demand model that characterizes the vehicle purchase decisions of Canadian consumers. In particular, using the observed vehicle characteristics, including prices, and market shares for the years 1998 to 2010, we estimate the parameters that determine consumer preferences. The key outputs from this step are estimates of the sales responsiveness of each model to a change in its own price and to price changes of all competing models, i.e. the full set of own and cross-price elasticities.

Second, we infer what the underlying (landed) marginal cost for each model must be for the observed prices to be the optimal choices of profit maximizing firms. In particular, we assume that firms compete by choosing prices (not quantities) for all their models, taking the pricing decisions of competitors into account. The observed prices are assumed to be the outcome of a differentiated products Bertrand-Nash equilibrium, which means that no firm should be able to increase its profits by unilaterally changing its price.

Third, we start from the observed market situation in 2010 and calculate *what prices and quantities would have been if a different trade policy had been in place in that year*. We assume that consumers still behave according to the demand function estimated in step 1 and that firms choose prices to maximize profits starting from the marginal costs calculated in step 2. We only change one primitive in the model—namely the import tariff applied to imports from one or more countries—and calculate the counterfactual equilibrium situation for the industry.

Note that in these calculations, all participants are allowed to adjust their behavior. All firms can change their prices to adjust to competitors and all consumers can change their purchase decisions to adjust to the changed prices. For each model sold in the Canadian market in 2010 our calculations will generate a new equilibrium prices and market share.[9]

In particular, if a FTA with South Korea had been in effect in 2010, the landed variable cost of all models imported from Korea would have been 5.75% lower than the marginal costs that the model has generated from the actual data that includes an effective import tariff of 6.1%. Our estimate of the consumers' price sensitivity will indicate how much of the tariff reduction will be passed on to Canadian consumers by a profit maximizing Korean firm. In addition, our pricing model together with the cross-price elasticities of

[9] We estimate the effects using a benchmark model and assuming firms set prices to maximize profits. In addition, we perform robustness checks using a more restrictive demand model and using the alternative assumption that firms set prices to maximize sales.

the demand model will indicate to what extent competing firms will want to respond to price cuts on Korean vehicles.

In the new price equilibrium all models will be cheaper, but vehicles imported from Korea will see the largest price decline. Models that are close substitutes will still see a noticeable price decline as firms will sacrifice some profits to limit the impact on their sales. Models that are poor substitutes for Korean imports will hardly see any price change. The demand model will further reveal the new market shares for all models implied by these new equilibrium prices.

In terms of interpretation, a few important caveats should be pointed out:

- One should not interpret the results as a prediction of the likely future effects of trade policy changes. Rather, we calculate what the market equilibrium *would have* looked like in 2010 if an alternative trade regime *would have* been in effect.
- The calculated effects should be interpreted as medium-term. The results take responses of directly and indirectly affected firms into account. All market participants have adjusted their price setting to the new tariff situation. However, we consider the location of production of each model and the firms' product portfolio as unchanged.
- Because transaction prices are not observed, we have to work with manufacturer suggested retail prices (MSRPs). If the gaps between listed and actual prices are similar for different firms or if the gaps in percentage terms remain the same before and after the trade policy change, the results would be the same using transaction prices.
- The estimated demand model plays an important role in the analysis. The specification we rely on is very flexible, incorporating observed and unobserved vehicle characteristics, market segmentation by vehicle type and ownership, and consumers that are heterogeneous with respect to their price elasticity. Nevertheless, one has to keep in mind that estimating the model over a different time period or including different characteristics or random effects would have an impact on the results. To verify robustness, we have included an alternative analysis using a more restrictive demand model.
- A final caveat is that the demand model and equilibrium calculations are inherently static. Firms do not consider spillover effects on subsequent years when setting prices and consumers are not forward-looking regarding price changes or take durability of vehicles into account.

There are two factors that explain the differences between the results in this report and those in Van Biesebroeck (2007). First, the benchmark year for the counterfactual analysis is now 2010, instead of 2005 before. Hyundai-Kia now operates two plants in North America[10] and the fraction of sales by foreign-owned firms that is produced within NAFTA has generally increased. Moreover, the recent recession combined with the increase in fuel price and greater awareness of global warming has tilted demand towards smaller size segments.

Second, the demand model that the analysis relies on has been improved greatly and is now estimated more robustly using 13 years of data instead of only 2 years of data in the previous report. Consumer preferences are now modeled much more flexibly with price elasticities allowed to vary by income level and the closeness of substitution within segments to differ across segments.

3.2 Data set

We assembled annual information on each passenger vehicle model for sale in the Canadian market between 1998 and 2010. Models that sell less than 50 units per year are dropped, as well as pure luxury brands such as Ferrari or Porsche. We further dropped commercial vehicles and full size vans, which gives us a sample of 2,751 observations, growing from 153 in 1998 to 244 in 2010. Average annual sales for Canada total 1.54 million units, growing from 1.34 million in 1998 to 1.56 million in 2010 with a high of 1.67 million in 2002.

We observe the specifications and prices for several varieties of each model, but only the sales information at the model level. Therefore the entire analysis has to be conducted at the model level. We use the specifications, including the price, of the cheapest variety of each model available for sale in a given year—the 'base' model.

The most important characteristic for the trade policy simulations is the assembly location and we also use that of the cheapest version. In most cases where different varieties of a model are assembled in different countries, this is immaterial for the trade analysis as they come from different NAFTA countries, e.g. the Nissan Sentra is assembled in the U.S. and Mexico. In a few cases, the multiple origins are a temporary situation as production has switched, e.g. from Japan or South Korea to North America, but there were still imports from the old production location in the start-up year.

In 2010, several models are affected by this problem, i.e. they are assembled in two different countries and at least one is not in the NAFTA free trade area. Most importantly, the following models are all treated as assembled in the country where the majority of production takes place: BMW X3 in the U.S. (85% of its Canadian sales come from the U.S.), Honda Civic in Canada (99.4%), Honda Ridgeline in Canada

[10] The Hyundai plant in Montgomery, AL started production of Sonata and Elantra sedans in 2006. (Note that in 2010 most Elantra sales are still reported to be sourced from Korea. In our model we assume they are still subject to the 6.1% Canadian import tariff.) The Kia plant in West Point, GA started production of SUVs in November of 2009. Both plants have an annual production capacity of 300,000 vehicles.

(57%), Hyundai Sonata in the U.S. (99%), Hyundai Elentra in Korea (99%), Lexus RX in Canada (63%), Nissan Juke in Japan, Volkswagen Golf/Rabbit in the E.U. (81%), Toyota Highlander in U.S. (80%), and Toyota RAV4 in Canada (97%).

The sourcing location for a few other models deserves some further comments. The Mercedes-Benz G-class is mostly assembled in the U.S. (97%), but its sales numbers are only reported together with the GLK model which is produced in Europe. Given that the latter is sold in larger quantities, we assigned the combined G-class/GLK model to the E.U. Finally, GM has gradually switched most of the production of the Chevrolet Aveo and Pontiac Wave from Korea to Mexico. Given that the successor 2011 model, the Chevrolet Sonic, went in produced in Michigan in 2010, we assign both the Aveo and the Wave to U.S./Mexico. For the Suzuki Swift+, which is basically the same model as well, we could not find a reliable sourcing location (it was only sold in Canada and has already been discontinued) and we assigned it to the same location as the Aveo/Wave on which platform it stands.

In order to incorporate consumers that did not purchase a vehicle at prevailing prices in 2010, but which might be enticed to enter the new vehicle market at lower prices, it is customary to include an "outside good". This requires an estimate for the potential market size, which we take to be the total number of households—12.58 million in 2010. As such, in an average year we find that 87% of households choose not to buy a new vehicle.

The dependent variable in the demand estimation is the market share of each model. As explanatory variables, we follow most closely the papers by Berry *et al.* (1995) and Petrin (2002). The following variables are included: price (in thousands of dollars), power per weight (maximum power in kw divided by weight), size (length x width x height), and fuel efficiency (liters of gasoline per 100 km). In addition, we include a dummy variable whether the brand has traditionally been owned by an American firm to capture the historical reach of the dealership system.

Summary statistics for 2010—the year for which we do the trade policy simulations—are in Table 5. Vehicles are assigned into one of 5 segments, listed at the bottom, which will play an important role in the demand estimation.

Table 5: Summary statistics for 2010 (244 models)

	Average	Standard deviation
Sales (units)	6,275	12,087
Model characteristics:		
Price (‘000 $)	37.542	19.759
Power/weight	9.670	2.697
Size	14.224	3.015
Liter/100 km	10.526	2.485
Domestic brand	0.336	0.473
Production location	**Fraction of models**	**Fraction of sales**
Canada	11.1%	20.0%
U.S. & Mexico	45.5%	53.9%
E.U.	18.4%	6.7%
Japan	17.6%	11.6%
South Korea	7.4%	7.9%
Segments	**Fraction of models**	**Fraction of sales**
Regular cars (all sizes)	30.7%	39.5%
Luxury or sporty cars	23.0%	5.8%
SUVs	34.8%	28.6%
Pickups	7.0%	19.7%
Minivan	4.5%	6.4%

3.3 Demand estimation

The automobile industry has been a popular proving ground for discrete choice models to estimate demand for differentiated products. The state-of-the-art in estimating aggregate demand is the random coefficient model discussed in Berry (1994) and first taken to the data in Berry, Levinsohn, and Pakes (1995) to estimate the U.S. demand for automobiles. Several studies have used this general class of models to evaluate trade policies. For the automobile industry in particular, we can mention Goldberg (1994), Fehrstman and Gandal (1998), Berry, Levinsohn, and Pakes (1999), Brambilla (2005), and Brenkers and Verboven (2006). The only previous estimates for the Canadian automobile market are in Van Biesebroeck (2007).

The advantage of this modeling strategy instead of specifying a traditional demand system at the product level is that only a few parameters can generate very general cross-price substitution patterns between all models. This is an important feature, given that in each year 200 to 250 different models are sold in the Canadian market. Specifying the demand directly would require an extraordinary amount of parameters to allow for flexible substitution patterns. As a result, the discrete choice approach has become the dominant way to study differentiated goods markets.

In this study we use a nested logit model, see Anderson and De Palma (1992) and Verboven (1996) for details. It can be interpreted as a random coefficients model where consumers share the valuation on all observable characteristics, except on a set of nesting dummies that segment the market (Cardell 1998). The same model was used in Van Biesebroeck (2007), but we include two modifications to allow for more flexible price elasticities. We now estimate different parameters for each segment (σ_g) and we incorporate a random price coefficient (α_i) in the model.

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 purchase to a future year. The utility of the outside good purchase will be normalized to zero. Each consumer chooses one model to maximize her utility. The conditional indirect utility function for consumer *i* from purchasing product *j* that belongs to nest/segment *g* is given by:

$$u_{ij} = \sum_{k=1}^{K} x_{jk}\beta_k + \xi_j - \alpha_i p_j + \zeta_{ig} + (1-\sigma_g)\varepsilon_{ij}$$

The first term combines the effect of *K* observable product characteristics, such as fuel-efficiency, horsepower, size, etc., on product demand. The second term is an additional product characteristic that consumers and all other firms observe, but is unobservable to the econometrician. It includes the effect of style, advertising, etc. These first two terms in the random utility function are valued the same by all consumers. The next three terms are consumer specific.

The effect of price on utility is expected to be negative and to vary across consumers inversely with their income (y_i). To incorporate in the model that consumers with higher income are likely to be less price sensitive than low-income consumers, we model the α_i parameter as α/y_i. In the estimation we use a frequency estimator to simulate market shares using the observed Canadian income distribution over ten deciles to generate hypothetical consumers.

The next term (ζ_{ig}) is a random taste shock of consumer *i* for vehicles in segment *g*, which can be positive or negative. We partition the market into 5 exclusive and exhaustive segments: regular cars, luxury and sporty cars, SUVs, pickup trucks, and minivans. The final term is an individual-model specific random utility draw (ε_{ij}), which is assumed to follow the extreme value distribution.

The nested logit model generates higher elasticities of substitution between models in the same segment than across segments if the σ coefficients are estimated positively. A high estimate would indicate that the likelihood that substitution in response to price changes remains within the segment is high. As a result, competition within the segment will be fiercer and price-cost markups lower. The segment with the highest σ_g parameter will have strongest substitution between the vehicles it contains and the highest own and cross-model price elasticities. Brenkers and Verboven (2006) find in their application to the European car market that vehicles in the ‘small car’ segment are the closest substitutes, which is intuitive.

The standard transformation of the model yields the following log-odds ratio that consumer *i* purchases model *j* rather than the outside good:

$$\ln(\Pr_{ji}) - \ln(\Pr_{0i}) = \sum_{k=1}^{K} x_{jk}\beta_k - \alpha_i p_j + \sum_{g=1}^{5} d_{[j\in g]}\sigma_g \ln(\bar{s}_{ji|g}) + \xi_j .$$

It is a linear function of the *K* characteristics, the price, the conditional market share of vehicle *j* within its segment *g*, and the term for the unobserved quality of the good, which takes the role of the error term in the equation. The difficulty for estimation is that we only observe aggregate quantities, while some of the terms on the right-hand side vary across consumers. This makes it impossible to obtain closed form solutions for aggregate market shares and requires a simulation estimator.

A simple logit model would have two unattractive features for our purpose: (i) all cross-model substitution is proportional to market shares and (ii) own-price elasticities are increasing in the price of each model. The nested logit eliminates the first drawback and the introduction of segment-specific σ_g parameters eliminates the second. However, they do so only in a very limited way. To allow for more flexible own- and cross-elasticities it is crucial to incorporate the heterogeneous price coefficients.

In a robustness check to the model, we do impose a constant price coefficient α on all consumers. With this modification, the model simplifies to a simple nested logit model and we can derive market shares in analytical form. In the equation above, the left hand side simply becomes $\ln(s_j/s_0)$, the normalized market share for vehicle *j*, and the *i* subscripts on the right hand side can simply be dropped. The demand equation can then straightforwardly be estimated using least squares.

However, to obtain consistent parameter estimates, we still need to take into account that firms will set prices knowing the value for ξ_j. Vehicles that are very desirable, e.g. because of attractive styling or reliability, will attract more consumers and firms can raise the price. To break this link between the error term and the price variable, we use the standard instruments, see Berry, Levinsohn, and Pakes (1995). In the specific context of a nested logit model with nest-specific market shares, the endogeneity problem carries over to the within-nest market share variable, and we use the optimal instruments proposed by Brenkers and Verboven (2006).[11]

For details on the econometrics, we refer to Grigolon and Verboven (2011). The estimation algorithm involves the following steps:

- The observed sales are set equal to the predicted relative sales, which are obtained using the above formula and starting values for all coefficients. The difference between the two gives the error term ξ_j, now a function of the model parameters.
- Because consumer tastes are heterogeneous and the ξ_j term is constant for all consumer types *i*, an analytic solution is not available. Instead, we use the contraction mapping suggested by Berry, Levinsohn, and Pakes (1995).
- The error term ξ_j is then interacted with the instruments to obtain a GMM estimator. Each time the estimation converges and produces new parameter estimates, we resolve the contraction mapping for ξ_j and re-optimize the GMM objective, until the estimates do not change anymore.

In Table 6 we present two sets of estimates. Both use all model-year observations over the 1998–2010 period and include year and year-squared and model-fixed effects as controls in the equation. This reduces the endogeneity problem in estimation. In the first column, we use heterogeneous price effects and two-level nesting of models—at the first level there are five market segments and below that two levels for the nationality of the firm (domestic or foreign). In the second column, we assume a homogenous price effect and use just one level market segment nests. This last model is almost as in Van Biesebroeck (2007), but allows the substitution parameters to vary across nests.

All coefficient estimates, except for one, have the predicted signs. Consumers dislike high prices and low fuel efficiency. They prefer vehicles with a higher power to weight ratio and a larger size. Only for Model 2 do we find a negative coefficient on the power/weight coefficient. The reason is that high performance, which consumers like, tends to go together with a higher price, lower fuel efficiency, and smaller size, all of which consumers dislike. The simple linear specification does not do a good job at disentangling the partial effects of the severely multi-collinear variables. Notice for example that the negative coefficient on the power/weight variable is accompanied by a much lower estimate on the size coefficient. Given that we are not interested in these point estimates per se, we leave it at this.

[11] Instruments for price should be uncorrelated with unobservable aspects of a vehicle's quality, broadly defined, and only predict sales through their correlation with the vehicle's price. The average characteristics for competing manufacturers should do the job. In a competitive market setting these characteristics will definitely influence the pricing decision of other firms.

Table 6: Demand coefficient estimates

	Model 1		Model 2	
Price	-1.565	(.344)***	-0.586	(.335)*
Power/weight	0.010	(.008)	-0.015	(.010)
Fuel efficiency (l/100 km)	-0.010	(.008)	-0.014	(.007)**
Size	0.081	(.014)***	0.039	(.020)**
σ_1 (regular cars)	0.836	(.031)***	0.943	(.065)***
σ_2 (luxury & sports cars)	0.727	(.064)***	0.847	(.076)***
σ_3 (SUVs)	0.189	(.224)	0.225	(.047)***
σ_4 (pickup trucks)	0.798	(.051)***	0.734	(.169)***
σ_5 (minivans)	0.068	(.117)	0.309	(.131)***
Sub_σ_1 (domestic/foreign)	0.836	(.031)***		
Sub_σ_2 (domestic/foreign)	0.754	(.040)***		
Sub_σ_3 (domestic/foreign)	0.399	(.067)***		
Sub_σ_4 (domestic/foreign)	0.798	(.051)***		
Sub_σ_5 (domestic/foreign)	0.518	(.108)***		
Observations	2752		2752	
Adjusted R^2	0.822		0.806	

Notes: Model (1): two-level nested logit (first level are 5 market segments, second level is domestic/foreign firm) with heterogeneous price effect by income estimated by simulated GMM. Model (2): one-level nested logit with 5 market segments and homogenous price effect estimated by IV. Instruments are average rival characteristics for price and number of rival products in same segment for the segment variables. The price variable is normalized by the average income level ($28,300). Regression includes year, year-squared and model-fixed effects as controls. ***, **, * indicates significance at the 1%, 5%, and 10% level.

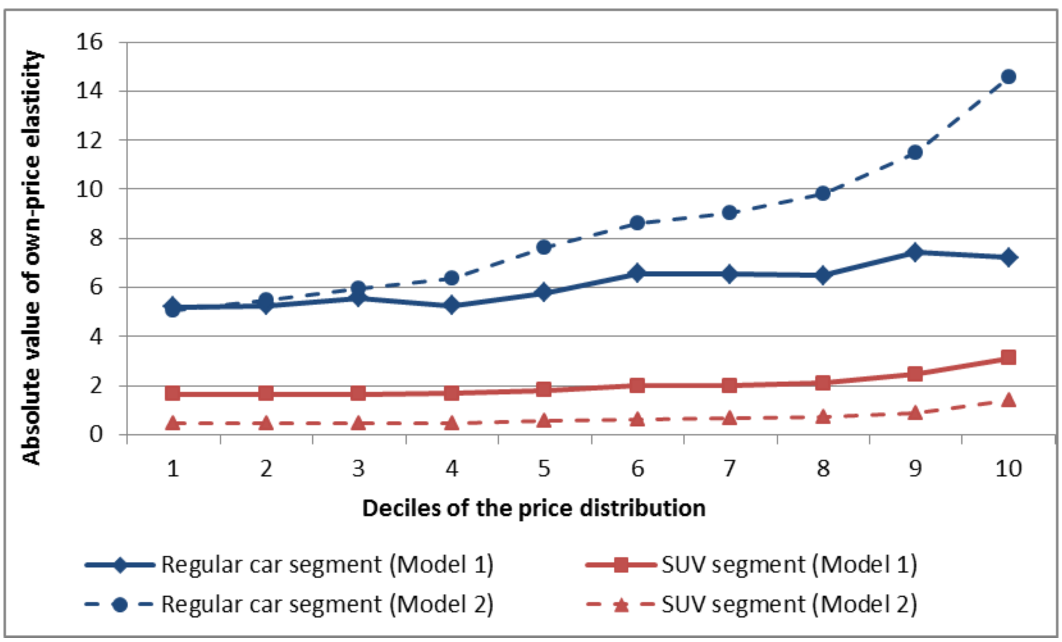
All the nesting parameters are estimated positive and between zero and one, in line with economic theory. The higher the nesting parameter, the more likely it is that consumers will substitute between models in the same nest, rather than across nests. The estimates suggest that substitution for models in the "SUV" or the "minivan" segments is barely higher within the same nest as towards models in other nests. On the other hand, "regular cars" tend to be rather close substitutes. However, to satisfy economic theory, the sub-nest parameters should be larger than the basic nesting parameters. This was violated for the regular cars and the pickup segment and we enforced equality of σ_1 and Sub_σ_1, and between σ_4 and Sub_σ_4.

The crucial take away from the demand estimation are not the coefficients directly, but the own- and cross-price elasticities that they imply. They measure the sales response associated with own price changes or price changes of competing vehicles. They determine the optimal price-cost markup that a firm will charge as well as the optimal response to a price change of a competitor. In the one-level nested logit model, the demand elasticities are given by a simple formula containing only the α and σ parameters, own market share, and the relevant price, see Van Biesebroeck (2007). However, with a heterogeneous price effect in the utility function, the formulas need to integrate over the income distribution.

While elasticities are increasing in the (absolute value of the) price coefficient, it is important to point out that the much lower price coefficient estimate for Model 2 does not automatically imply that the model will feature uniformly lower price elasticities. The elasticities also depend on the σ estimates, and these are estimated higher in four of the five cases in Model 2. It implies that substitution between models in the same nest is stronger, which raises the elasticities above what is implied solely by the price coefficient estimate. Moreover, in Model 1 the actual price coefficient varies across consumers with their income level. Consumers with an above average income level, will be imputed to have a lower absolute value of the price coefficient in their demand equation.

We calculated the own price elasticities for all models and the cross-price elasticities for all model-pairs. In Figure 1 we illustrate how own-price elasticities evolve with price for both demand models for vehicles in the first and third segments, respectively regular cars and SUVs. The absolute value of the elasticities are plotted against the deciles of the price distribution, which rise relatively smoothly from \$15,000 (p1) to \$38,000 (p9), with a much larger jump for the 10th percentile (to \$90,000).

Figure 1: Own-price elasticities for two segments (absolute values)



All elasticities are increasing in price, which is a general feature of the logit model or of the nested logit within a segment. Note that this increase is tempered in Model 1, due to the lower price coefficient for high-income consumers. This is especially vivid in the first segment. The much higher estimate of the nesting parameter in the regular car segment uniformly raises all elasticities. Finally, the extra second-level nesting of domestic and foreign models (based on the nationality of the owning firm) introduces some variation in the elasticities for Model 1, which makes the curve less smooth.

The cross-model elasticities of substitution are higher for models in the same nest and this feature is much more pronounced for segment with high σ_g estimates. Competition within these segments is fiercer. The high σ_g estimates combined with offsetting low α estimates makes substitution towards vehicles in other nests rather low. A final factor that influences the cross-model elasticities is the number of vehicles offered in a segment. In more crowded segments, in particular the luxury and sporty cars segment, will have higher cross-price elasticities, as a price increase of one model leaves consumers with a lot of choices within the segment to substitute towards.

3.4 Counterfactual simulation

When we augment the substitution patterns that the estimated demand system generates with a model of optimal price setting behavior it is possible to uncover the marginal costs that make the observed prices optimal for profit maximizing firms. The standard approach in the literature is to assume differentiated products Bertrand-Nash pricing. It means that firms strategically set prices (rather than quantities) taking into account (i) the above substitution patterns from the demand system and (ii) that their competitors are also setting prices optimally. The Nash equilibrium assumption implies that no firm will be able to raise its profits by unilaterally changing its price. The evidence in Bresnahan (1987) suggests that this is an appropriate assumption for the automobile market.

Firms are explicitly modeled as multi-product firms, which take the effect of the price of each model on all the other models in their own portfolio into account.[12] For a derivation of the first order condition, we refer the interested reader to Berry (1994) or Berry, Levinsohn, and Pakes (1995). For vehicle model j it takes the following form:

$$s_j(p) + \sum_{k \in F_j} (p_k - mc_k) \frac{\partial s_k(p)}{\partial p_j} = 0 \qquad j = 1, \ldots J$$

The first term captures that the firm producing model j takes into account that raising p_j raises profits in proportion to the market share of model j. It also takes into account that it

[12] 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 is included in Mazda’s decision making.

lowers the sales of model j and leads to a loss of profits in proportion to the own-price elasticity, $\partial s_j/\partial p_j$, and the mark-up on model j. Finally, the firm also takes into account the spillover effects on all other products it sells, i.e. models in the set F_j, which will see increased sales when p_j rises, i.e. $\partial s_k/\partial p_j>0$ if $k \neq j$.

In total there are J first order condition of this form and each depends on the entire price vector p. Once the demand equation is estimated and all the derivates can be calculated, all elements of these equations are observable except for the marginal costs, mc_j, for all j. This is now a system of J equations in J unknowns and we can use it to calculate the marginal costs that are consistent with observed pricing behavior.

One should bear in mind that the economic concept of marginal cost differs from the accounting cost concept. A large number of costs which accountants treat as variable tend to be fixed from a firm's perspective in the medium to short run. As a result they will not enter optimal pricing decisions. For example, labor contracts in the automotive industry make most of the labor costs fixed rather than variable. Therefore we expect that our demand estimation will impute relatively low level of marginal cost. These only include the expenditures that can be saved if the marginal vehicle is not produced. It excludes most labor costs, marketing and advertising expenditures, tooling and maintaining an assembly plant, design and engineering costs, costs of the dealership network, etc. All of these are largely independent of the number of vehicles sold, at least in the short run.

We now have all the ingredients to conduct the counterfactual analysis, i.e. (i) estimates of substitution patterns generated by a demand system, (ii) imputed marginal costs, and (iii) a market equilibrium assumption. The algorithm for this exercise consists of the following three steps:

1. For each vehicle model that benefits from a FTA, the landed marginal cost in Canada is reduced by 5.75%. Marginal costs of all other models are unchanged.

2. Given the new vector of marginal costs, the system of first order conditions above will not hold anymore with equality at the observed prices. We calculate the new equilibrium price vector using a contraction mapping and the estimated derivatives (which are themselves a function of all prices). The directly affected firms will again take into account not only the direct effect on the models that benefit from an FTA, but also the cross-price elasticities on their other products. The indirectly affected firms will also adjust their prices as the derivatives of their market shares with respect to their own price $\partial s_j(p)/\partial p_j$ are a function of the entire price vector. Hence, their original first order conditions will not hold anymore even if their own marginal cost is unchanged.

3. When we use the new equilibrium price vector in the estimated demand system holding all vehicle characteristics constant, including the ξ_j vector, we calculate new equilibrium market shares for all models. The market share for the outside good is also updated and given the overall price decline it will translate into higher overall sales.

For each model, we have thus calculated a new marginal cost (if it is directly affected by the FTA), a new price, and a new sales quantity. We can aggregate this over all models by import status to calculate new import volumes, new average prices, new price-cost margins, etc. These results will be discussed in the next section.

3.5 Effects for different trade agreements

We compare the expected outcome for each trade policy simulation with the actual situation in 2010. In that year, total new passenger vehicles sold in Canada stood at 1.52 million for the models included in our sample, cars and light trucks combined. Only 305,631 vehicles, exactly 20.0% of the total, were assembled domestically and the rest are imported. The primary sources of imports are the NAFTA trading partners, the U.S. and Mexico, responsible for 53.9% of total sales. All of these vehicles are assumed to enter the country duty free.[13]

The remainder of the vehicles sold in Canada are imported from Japan (11.6%), South Korea (7.9%), and the E.U. (6.7% in quantity, but much higher in value). Currently, Canada imposes a 6.1% import duty on finished vehicles. In the different trade liberalization scenarios that we consider, we calculate how the market equilibrium would have changed if vehicles imported from one or more of these countries would have been exempt from import tariffs.

A first thing to note is that Canada produces many more vehicles than those that are sold domestically. Total new vehicle production in 2010 stood at 2.06 million and the vast majority of them (85.2%) are sold abroad. There is no reason to expect these Canadian exports to be affected by any of the Canadian trade policy changes we consider here. However, in the next section we look at the expected effects of the FTA between Korea

[13] I did not succeed to find out which vehicles assembled in the United States or Mexico currently satisfy the NAFTA domestic content requirements and are eligible for duty-free import into Canada. I assume all do, but some models might still incur import tariffs in which case they could benefit from a new FTA. The problem is that some models might satisfy the requirement for their base model, but not for higher-end varieties with imported engines. In 2008, only three models did not satisfy the requirements at all and incurred duties when imported into Canada (BMW X5 and Mercedes-Benz G-class and M-class). Under an FTA with Europe it would be reasonable to assume these vehicles would also become exempt from duty. We have considered all vehicles assembled in the U.S. or Mexico as unaffected by any trade policy change, but note that this underestimates the FTA effects slightly (the number of vehicles involves is bound to be very small, certainly less than 0.5% of the total Canadian market).

and the U.S., which is likely to exceed the impact on the domestic industry of a possible FTA between Korea and Canada.

For models that are affected by one of the trade policy simulations, their landed marginal cost in Canada is reduced by 5.75%, which is the fraction of costs that the importing firm saves. The firm will split this into a higher profit margin and a lower price for consumers. Competitors will respond, also lowering their prices slightly, at the expense of profit margins and a new market equilibrium will result. We keep model offerings and production locations constant in this analysis, but allow prices to adjust fully. The results should thus be interpreted as medium-term effects.

The results of the different simulations are reported in Table 7 in absolute changes from the 2010 benchmark and in Table 8 in percentage changes. These results rely on the demand estimates from Model 1, assuming a two-level nested logit model with heterogeneous price effects.

In panel (a) of Table 9 we include a robustness check using the demand estimates from Model 1, i.e. one-level nested logit with homogenous price effect. In panel (b) of Table 9 we use an alternative assumption of firm behavior. Rather than assuming that firms set prices to maximize profits, we assume here that they choose prices to maximize sales. This assumption might for example be relevant for the entry-level segment of vehicles, as firms have an incentive to tie new customers to their brands, hoping that loyalty will bind new customers in subsequent years. The potential of repeat purchases by customers that first enter the car market can make firms compete extremely aggressively in this segment.

To pin down prices under the sales maximization assumption, we assume that firms apply a fixed mark-up of 20% to cover fixed costs. If we express the results in percentages, all changes would be identical for any mark-up we apply, as long as it is a fixed percentage of the underlying costs. Note that firms that maximize sales will choose to pass on the entire tariff cut to consumers. This holds their profit margins constant and the only source of increased profits are the increased sales. On the other hand, firms that are only indirectly affected will not be able to respond to a price change of their competitors. As a result, this behavioral assumption yields maximum changes in market shares and those results should be considered as upper bounds on the possible effects of any trade policy change.

Before we turn to a detailed discussion of the results, we summarize the different forces that are at play in all the trade policy scenarios:

- Prices for models affected by a FTA will fall, but by less than 5.75% as some of the cost decline is taken as higher profit margin, i.e. not passed on to consumers.
- The extent of tariff pass-through is increasing in the elasticity of the model. Holding all else fixed, models with higher prices and in segments with higher nesting parameters will see larger price declines.

- A FTA will make firms that are affected directly more competitive in all segments, but they will be particularly prone to lower their prices in segments where they are not well represented as they do not need to worry about cannibalizing their own profits.
- Producers that are only indirectly affected will tend to lower their prices. These competitive responses are relatively minor, but most pronounced for firms that produce many vehicles in the same segments as those affected by the FTA.
- Price responses will translate directly into market share changes according to the estimated demand models.

Table 7: Trade policy simulations for the preferred demand model (Absolute changes)

FTA of Canada with…	E.U.	Korea*	Japan	EU, Korea, Japan	EU & Japan	EU & Korea
Canadian consumption (unit)	+7,527	+5,730	+9,796	+21,249	+17,050	+11,795
Total imports	+10,917	+10,211	+16,792	+35,656	+27,241	+19,790
Imports from US/Mexico	-5,602	-6,221	-12,577	-23,895	-17,715	-12,395
Imports from EU	+21,829	-898	-3,603	+16,484	+17,801	+20,370
Imports from Japan	-3,820	-4,553	+37,936	+27,938	+33,479	-8,425
Imports from Korea	-1,491	+21,883	-4,964	+15,130	-6,325	+20,240
Domestic production	-3,390	-4,482	-6,996	-14,407	-10,191	-7,995

Notes: * FTA Korea includes GDP effect.

Table 8: Trade policy simulations for the preferred demand model (Percentage change)

FTA of Canada with…	E.U.	Korea*	Japan	EU, Korea, Japan	EU & Japan	EU & Korea
Canadian consumption	+0.49%	+0.37%	+0.64%	+1.39%	+1.11%	+0.77%
Total imports	+0.89%	+0.83%	+1.37%	+2.91%	+2.22%	+1.61%
Imports from US/Mexico	-0.68%	-0.75%	-1.52%	-2.90%	-2.15%	-1.50%
Imports from EU	+21.30%	-0.88%	-3.52%	+16.08%	+17.37%	+19.87%
Imports from Japan	-2.15%	-2.57%	+21.39%	+15.75%	+18.88%	-4.75%
Imports from Korea	-1.24%	+18.17%	-4.12%	+12.56%	-5.25%	+16.81%
Dom. production sold in Canada	-1.11%	-1.47%	-2.29%	-4.71%	-3.33%	-2.62%
Total domestic production	-0.16%	-0.22%	-0.34%	-0.70%	-0.49%	-0.39%

The results for the different trade policy simulations are discussed below in separate sections while the tables contain the estimates for all simulations in different columns. We focus on the quantity responses—domestically produced and imported—and discuss the effects on other variables in Section 3.5.5 at the end.

3.5.1 European Union

The simulations for a FTA between Canada and the European Union are reported in the first column of the three tables with results. For this first set of results, we will describe the changes in some detail.

The price declines that the FTA would set in motion are estimated to lead to higher total sales in Canada of 7,527 additional vehicles. This implies that market share is taken away from the outside good. Among active firms, the FTA would also reshuffle market shares quite a bit. Total imports are estimated to increase by 10,917 and domestic production to decline by 3,390 units. The import changes would be very asymmetric as well, imports from the E.U. are estimated to increase by 21,829 vehicles, while all other trading partners would see their sales decline. The NAFTA trading partners would bear the brunt of the adjustment, selling 5,602 fewer vehicles in Canada, followed by lower imports from Japan of 3,820 vehicles and 1,491 fewer imports from Korea.

Note that the statistics in the table are not the firm totals, but the totals by country of assembly. E.U. firms will also see their sales decline for models that they currently produce within the NAFTA area and these effects are included in the US/Mexico total. Japanese and Korean firms will have also loose sales on the vehicles they produce in North America, in addition to those on models shipped from their home countries that are listed separately in Table 7.

In Table 8, these same changes are expressed as a fraction of total observed output in 2010. While imports from US/Mexico saw the largest decline in absolute terms, the percentage decline is the smallest of the four regions that lose sales. There are several reasons for this.

First, given that the firms that sell the bulk of the vehicles made in the E.U.—Volkswagen, BMW, and Daimler—also operate assembly plants in the U.S. or Mexico, they will not benefit from the FTA for these models. They will be especially reluctant to lower prices and start a downward price spiral in the segments where they sell the vehicles that they assemble in North American vehicles. This is a standard effect for multi-product firms and strongly favors other producers in the US/Mexico area which tend to produce similar vehicles (e.g. SUVs).

Second, the price decline is extremely high, on averaging -5.06%, as many of the models imported from the E.U. are in the luxury and sporty vehicle segment where prices are higher and the number of vehicle offerings is larger. These same factors also make the price response of other firms larger as they raise the cross-price elasticity. As a result, market share changes are muted, but variable profits decline to a greater extent.

Third, the price decline will be highest in segments where vehicles imported from the E.U. are most prominent and this is by far the luxury and sporty cars segment. The Japanese firms own most of the competing vehicles in this segment and they see a market share decline for models imported from Japan that is three times as high as for models produced in US/Mexico.

The estimated decline of domestic production for Canada of 3,390 vehicles, amounts to a 1.11% decline in the number of vehicles that are produced and sold in Canada. Given that only 15% of domestic output is also sold in Canada, it means a decline in total domestic production of only 0.16%. The first statistic is comparable to the import declines reported for the other countries and is relevant to gauge the change in market equilibrium. The second statistic is the most relevant one for the domestic industry.

For an idea what the potential employment impact of this decline would be, we can multiply the percentage change with total employment in the Canadian assembly industry of 32,406 (NAICS industry 3361 "Motor Vehicle Manufacturing). For a more pessimistic scenario, we could even multiply it with total employment in the entire Canadian automotive production sector, including parts production, which would add 61,771 more jobs at stake (adding NAICS industry 3362 "Motor Vehicle Body and Trailer Manufacturing" and 3363 "Motor Vehicle Parts Manufacturing). [14] These calculations suggests a possible impact of 52 or at most 151 jobs.

Of course, total employment at an automobile plant does not fluctuate smoothly with the production level. Most employment is relatively fixed, especially in the short run, and employment only really declines when a plant is eventually closed down. These numbers are only intended to express the production decline in terms of employment, using the average worker-per-vehicle conversion factor for the industry.

In Table 9 we provide two alternative simulations to verify the robustness of the earlier estimates. In panel (a) we use a more restrictive demand model that is only slightly more flexible than the one used in Van Biesebroeck (2007). It predicts a smaller increase in total vehicle purchases and a smaller increase in imports, but a slightly larger decline in the domestic production. In this demand model, the cross-price elasticities vary much less across different vehicle models. In particular, the models produced in Canada are still considered relatively good substitutes for the E.U. models, which was not the case in the preferred model. In each of the subsequent trade simulations that involve the E.U., we

[14] These employment statistics are taken from the Industry Canada web site and the most recent statistics available there are for 2009. Note that several sub-sectors that produce parts for the automotive industry, such as engines, glass, rubber, etc., are not listed in NAICS 3363. On the other hand, parts producers are unlikely to supply only Canadian assembly plants.

Table 9: Trade policy simulations: robustness analysis (Percentage changes)

FTA of Canada with…	E.U.	Korea	Japan	All three	EU & Japan	EU & Korea
(a) Alternative demand model						
Canadian consumption	+0.19%	+0.13%	+0.21%	+0.50%	+0.39%	+0.30%
Total imports	+0.56%	+0.53%	+0.95%	+1.94%	+1.47%	+1.06%
Domestic production sold in Canada	-1.32%	-1.51%	-2.76%	-5.27%	-3.95%	-2.77%
Total domestic production	-0.20%	-0.22%	-0.41%	-0.78%	-0.59%	-0.41%
(b) Assuming sales maximizing behavior						
Canadian consumption	+0.45%	+0.47%	+0.60%	+1.38%	+1.03%	+0.81%
Total imports	+0.86%	+0.94%	+1.29%	+2.91%	+2.12%	+1.72%
Domestic production sold in Canada	-1.23%	-1.42%	-2.17%	-4.76%	-3.34%	-2.83%
Total domestic production	-0.18%	-0.21%	-0.32%	-0.71%	-0.50%	-0.42%

estimate larger effects on Canadian production with this more restrictive model. At the same time, the more restrictive model predicts a smaller decline in sales by Japanese luxury models, as they are now also only average substitutes.

In panel (b) of Table 9 we make the extreme assumption that firms are maximizing sales rather than profits, but use again the more flexible demand Model 1. As discussed before, this will lead to full pass-through of the tariff cut to consumer prices for affected vehicles, while indirectly affected models will not see a price change anymore. This will unambiguously lead to the maximum gain in sales for the benefitting country and the maximum reduction in Canadian production. We see that in this case the decline in domestic production for Canada is only slightly higher than in Table 8, at 1.23%, or 0.18% of total production of the sector.

The benchmark effects in Table 8 tend to be in between the results for the two more extreme models in Table 9. The underlying reason is that the estimated pass-through of tariff cuts in the benchmark model is not as large as in the case of sales maximizing behavior, but stronger than in the more restrictive demand model without random coefficients.

3.5.2 South Korea

Given the above explanations for the nature of the effects and the detailed discussion of the changes in the case of a FTA with the E.U., we can let the results speak for themselves in the following simulations. One thing that is different in the calculation of a FTA with Korea is that we include the predicted increase to Canadian GNP from the FTA in the counterfactual calculation. This was estimated to be a 0.15% boost to Canadian GNP by Ciuriak and Chen (2008) and this raises overall vehicle sales slightly.

Given that total initial imports from Korea are more than one third larger than imports from the E.U., it is not surprising that the impact of this FTA is estimated to be larger. The impact on Canadian production is estimated at 4,482 units or 0.22% of the total, which is less than proportional to the initial level of Korean imports. Estimated own-price elasticities for vehicles imported from Korea are slightly lower than for E.U. imports which leads to smaller pass-through and a smaller gain in market share. This is driven by the presence of some SUVs and minivan imports, which have markedly lower σ_g estimates, and the lower prices of Korean vehicles, while price elasticity is slightly increasing in price. Imports from Japan are estimated to be particularly affected by a FTA between Canada and Korea. In the more restrictive demand model, the decline of Canadian production is more pronounced.

It is instructive to compare the results in this case with those obtained in Van Biesebroeck (2007), where the focus was on a FTA with Korea. The absolute impact on Canadian production was estimated at 2.137 in the earlier calculations, while the increase in Korean imports was estimated at 13,160.

Much of the difference can be explained by the different base year, 2005 before against 2010 now. In the earlier study, total Korean imports stood at 124,135. While sales by Hyundai and Kia increased markedly in the following five years, their opening of assembly plants in North America as well as the production shift of several GM vehicles to North America, left total Korean imports virtually unchanged at 120,437 vehicles five years later. Moreover, in 2005 almost 30% of vehicles imported from Korea were sold by GM, which as market leader had much less of an incentive to lower prices. GM had a total Canadian market share of 28.1% at the time. In 2010, all of the imports from Korea were sold by Hyundai-Kia. A final factor to explain the difference is that the more flexible and more robustly estimated demand system has produced higher total elasticities in general. This can be seen by comparing the predicted overall increase in vehicle consumption due to a FTA with Korea, which was estimated at +3,927 for 2005 and at +5,730 for 2010 now.

3.5.3 Japan

The last FTA we simulate is between Canada and Japan. The results indicate that this would have by far the largest impact on all of the market participants. It would lead to a decline in Canadian production of 6,996 vehicles or 0.34% of total domestic production (2.29% of current output destined for the domestic market). The increased imports from Japan would be also far larger than in the case of the other two FTAs, estimated at an additional 37,936 vehicles. However, this is mostly the result of the much larger market share of Japanese vehicles as the percentage increase in imports would be smaller than for E.U. models under a FTA with the E.U.

It is instructive to compare the differential impact of the various FTAs on each country group. Looking horizontally in the first three columns for the domestic production line in Table 8 shows that the percentage impact on the Canadian industry is gradually increasing for FTAs with the E.U., Korea, and Japan, in this order. However, we have to keep in mind that initial import levels also differ. While imports from Japan are 73% higher than from the E.U. and 47% higher than from Korea, the effect of an FTA with Japan is fully 106% larger than with the E.U. and 56% larger than with Korea. Controlling for these initial differences, Canadian plants seem to compete most closely with imports from Japan.

This differs from the effects on plants in the U.S. and Mexico, which would suffer far more from a Canadian FTA with Japan, both in absolute numbers and proportionately. Japanese imports would decline more from an FTA with Korea than with the E.U. The largest difference would be for E.U. imports. A Canadian FTA with Korea would cost them only 898 unit sales, while one with Japan 3,603. Even though Korea attains more than two thirds of the Japanese import volume, the effect on E.U. imports from a Korean FTA would be only one quarter of the effect of a Japanese FTA.

These last results are not surprising for anybody familiar with the product offerings of the different firms, but it highlights the importance of working with a rich and flexible demand model. This can also be seen from the results with the alternative demand model and alternative behavioral assumption in Table 9. The estimated effects tend to differ a lot less over the first three FTAs.

3.5.4 Simultaneous FTAs with several trading partners

In the final three columns of the different tables we also report results for simultaneous FTAs with several trading partners: E.U., Korea, and Japan in columns (4), E.U. and Japan in columns (5), and E.U. and Korea in columns (6).

The one general finding is that the effect of simultaneous FTAs are slightly lower than the sum of the individual FTAs. This is reasonable as firms that do not benefit from a FTA will already strategically respond to the price declines of other firms by lowering their own prices somewhat as well. The benefit of an additional FTA for these firms will not have full impact on their prices anymore as they already start from a lower level. Note that under the sales-maximizing assumption, the sum of the effect on domestic production is very close to the effect of simultaneous FTAs.

In addition, given that other firms are now responding more aggressively to price declines, each firm that benefits from a FTA will experience a smaller boost to its import sales. Especially Korean firms are estimated to only increase their imports by 12.6% if Canada would form FTAs with all three trading partners. This is a lot lower than the 18.2% higher sales estimate in the case of an exclusive FTA.

3.5.5 Effects of FTAs on tariff revenue, consumer surplus, and prices

The effects of the different FTAs on quantities—domestically produced or imported—have been discussed extensively in the previous sections. We already alluded to pricing effects in some instances, but in Table 10 we bring together all effects on prices, consumer surplus, and government revenue. We use the benchmark model throughout and break down the effects by production region, as before.

The first line of statistics illustrates how much tariff revenue would fall as a result of the different FTAs. The total revenue for 2010 of $424m is based on the imputed marginal costs by the model. The results indicate that a FTA with the E.U. would have a disproportionately large effect on tariff revenue. The predicted reduction in revenue of $167 million (40%) is almost as large as for a FTA with Japan even though the number of vehicles imported is only slightly more than half as large. It is, of course, the result of the high price of the vehicles imported from the E.U.

Calculating the tariff revenue as 5.75% of the marginal cost is not entirely correct as the tariff rate should be applied to the market value of the imported vehicles. This should include the firm's mark-up, but not the distribution costs that will be incurred in Canada. The exact base cannot be known without detailed information on distribution costs, but the second line in Table 10 shows an alternative calculation applying the tariff rate to the consumer price. This produces higher numbers and the true amount should be somewhere in between.

At this point it is useful to point out that we did not consider changes in indirect tax revenues. For example, the results in Table 7 indicated that a FTA with the E.U. would boost total Canadian vehicle sales by 7,527 units. At an average price of $25,376, a 13% HST on these sales would result in a tax revenue $24.8m. Of course, this does not represent a net gain for Canada, but merely redistribute money from consumers to the government. It does highlight that the budgetary impact of any change in trade policy would be not as severe as the statistics in the first line of Table 10 suggest.[15]

The following statistics in Table 10 show the average price change by model, using the ex post sales quantities as weights. In the first FTA, E.U. firms are predicted to lower the prices on the models that are directly affected by the tariff reduction by 5.06%. Given that their landed marginal cost in Canada would go down by 5.75%, this amounts to a pass-through rate of 88% of the tariff cut. Korean and Japanese firms are predicted to lower prices by respectively 4.44% and 4.90% when they benefit from a FTA, but Korean producers would increase the pass-through rate when there is a simultaneous FTA with the E.U. or Japan.

[15] Moreover, some of this increased sales is likely to come at the expense of second hand vehicle transactions, reducing indirect tax revenue there.

Table 10: Effect of trade policy simulations on prices and markups by production location

FTA of Canada with…	E.U.	Korea	Japan	EU, Korea, Japan	EU & Japan	EU & Korea
Tariff revenue (based on MC)	-$167m (-39.5%)	-$87m (-20.6%)	-$169m (-39.9%)	-$424m (-100%)	-$336m (-79.4%)	-$255m (-60.1%)
Tariff revenue (based on price)	-$218m	-$127m	-$238m	-$584m	-$456m	-$345m
Consumer surplus	$215m (0.50%)	$170m (0.40%)	$231m (0.54%)	$526m (1.24%)	$440m (1.03%)	$302m (0.71%)
Average price change by model						
Canada	-0.07%	0.03%	-0.01%	-0.07%	-0.07%	-0.06%
US/Mexico	-0.01%	0.04%	0.00%	0.01%	-0.01%	0.01%
E.U.	-5.06%	0.05%	0.01%	-5.02%	-5.05%	-5.03%
Japan	-0.06%	0.06%	-4.90%	-4.96%	-4.99%	-0.02%
Korea	-0.07%	-4.44%	-0.02%	-4.78%	-0.29%	-4.51%
Change in average price across all models						
Canada	-0.06%	0.03%	-0.02%	-0.08%	-0.08%	-0.06%
US/Mexico	-0.02%	0.04%	-0.02%	-0.01%	-0.03%	0.00%
E.U.	-4.86%	0.05%	-0.06%	-4.90%	-4.93%	-4.83%
Japan	-0.02%	0.07%	-4.72%	-4.74%	-4.76%	0.02%
Korea	-0.13%	-3.86%	-0.32%	-4.43%	-0.43%	-4.03%

One surprising result already alluded to earlier is that competing producers would increase their prices in response to a FTA with Korea and declining Korean prices. This pattern can only arise in the flexible model that incorporates heterogeneous price responses for consumers in different income classes. Because Korean models are predominantly purchased by households in lower income brackets, the set of households remaining for the other producers become richer on average and have a lower price elasticity. As a result, the optimal response for them is to increase prices slightly. The change is minor, but most pronounced for Japanese producers who compete most directly with Koreans. It is an unusual pattern and only arises because of the extreme concentration of Korean models at the cheaper end of the market in each segment.

In virtually all other cases, the optimal competitive response to a FTA that benefits one's competitors is to lower one's own prices. This effect is strongest for the FTA with the E.U. Because E.U. models are expensive and relatively more popular with richer households, it generates the opposite compositional changes from the FTA with Korea. A larger market share for E.U. producers lowers the average income of consumers available to other producers, which raises the average price elasticity they face. As a result they have a large incentive to lower prices. Note however, that even in this case the indirect price effects are substantially smaller than the direct price effects.

Because the marginal costs for producers that do not benefit directly from a FTA are unchanged, price changes translate directly into changes in price-cost mark-ups. For producers that do benefit from a FTA, the mark-ups increase if the pass-through rates is incomplete, i.e. less than 5.75%. The difference between the 5.75% cost reduction and the average price decline in the table represents an increase in profit margin.

The final statistics in Table 10 show the change in average price by origin across all models. This differs from the above price change statistics because model-prices are aggregated first before we calculate the change. The change in the composition of sales in response to the different FTAs also affects the average price. In each case, the reduction in the average price for a country benefitting from a FTA is larger than the average price decreases at the model-level discussed earlier. Following price reductions, sales respond more strongly for cheaper models, further lowering the average price. In several cases under simultaneous FTAs, the resulting average price declines even approach 5.75%.

Table 11: Breakdown of U.S. sales by type of vehicle and origin (2010)

	Cars		Light trucks	
U.S./Mexico	3,216,335	(28.6%)	3,712,620	(33.0%)
Canada	1,014,836	(9.0%)	978,518	(8.7%)
E.U.	558,696	(5.0%)	112,085	(1.0%)
Japan	801,217	(7.1%)	354,854	(3.2%)
Korea	404,558	(3.6%)	107,454	(1.0%)
Total	5,995,642	(53.2%)	5,265,531	(46.8%)

4 Effect of Korea-U.S. FTA on the Canadian auto industry

We now perform a similar analysis to study the effect of the recently signed FTA between the U.S. and Korea on Canadian plants.[16] The nature of the analysis is the same as in the previous section, with a few caveats.

First, the current U.S. import tariff on passenger vehicles differs from the Canadian rate. For cars, the rate is only 2.5%, but for light trucks the rate is 25%. This discrepancy has provided strong incentives for foreign producers to start producing their light trucks in the U.S. before their passenger cars. While domestic production consists of more light trucks than cars, the reverse is true for imports. This is clear from Table 11 which lists 2010 U.S. sales of passenger vehicles broken down by type of vehicle and origin.

Total sales of cars in the U.S. market outstrips sales of light trucks, with a breakdown of 53.2% versus 46.8%. The corresponding breakdown for production in the three NAFTA countries, however, goes the other way. Only 47.0% of local duty-exempt production consists of cars and 53.0% light trucks. The primary reason is that import volumes are even more lopsided in the other direction as foreign producers avoid the steep tariffs on light trucks. Across the three import origins—E.U., Japan, and Korea—only 24.6% of imports consists of light trucks and 75.4% are cars.

It is thus not immediately obvious which way the FTA comparison will go. On the one hand, the tariff cut for light trucks is four times larger than the possible Canadian tariff cut. On the other hand, imported light trucks consist of only 5.2% of the market. Moreover, the market share of imports (outside of NAFTA) in the U.S., at 20.9%, is also quite a bit lower than the corresponding share in Canada, which was 26.2%.

[16] The agreement was signed in 2007, but subsequently re-negotiated on some points. It finally passed U.S. congress in October 2011 and the Korean parliament in November 2011.

Table 12: US-Korea FTA simulation (2010)

	Local sales Total prod. (1)	Preferred demand (2)	Restrictive demand (3)	Sales-maximization (4)
Canadian plants after Canada-Korea FTA	305,631 2,062,559	-4,482 (-1.47%) (-0.22%)	-4,611 (-1.51%) (-0.22%)	-4,331 (-1.42%) (-0.21%)
Canadian plants after U.S.-Korea FTA	1,794,509 2,062,559	-20,175 (-1.12%) (-0.98%)	-15,923 (-0.89%) (-0.77%)	-19,063 (-1.06%) (-0.92%)

Note: The first statistic in column (1) refers to Canadian sales of vehicles produced in Canada, and the second statistic to U.S. sales of vehicles produced in Canada. The terms in brackets in the subsequent columns are the changes expressed as percentage of the corresponding totals in column (1). Note that the results for the Canada-Korea FTA include a boost to total GDP of 0.15%, which cushions the decline in Canadian production slightly. In the case of the U.S.-Korea FTA we have no estimate of the effect on aggregate GDP.

The second caveat in our analysis is that we were unable to obtain all the necessary data for the U.S. market that we used to estimate the Canadian demand system. We obtained U.S. sales information for 2010 from the online data center of Automotive News which allows us to construct the proper 2010 benchmark. However, we have to rely on the estimated Canadian demand system for the required price elasticities in our analysis. As the model offerings in the two countries are virtually identical and also the structural parameters in the demand system are likely to be similar this should provide a close approximation.[17]

The way we proceeded is to uncover a market-specific unobserved quality term for each vehicle by fitting the U.S. market shares to the Canadian demand equation. This new ξ_j term is then held constant in the remainder of the analysis, which is otherwise identical as in the Canadian case. We calculate a new counterfactual equilibrium that reflects new equilibrium prices and quantities if Korean importers would not be subject to the 2.5% import tariff on cars and the 25% tariff on light trucks. Note from Table 11 that more than 80% of Korean imports are cars.

The results for the two different demand models that we used before and the alternative market clearing assumption are reported side-by-side in Table 12. In the first line we repeated the earlier results for the Canada-Korea FTA simulations for comparison.

[17] The one area where there might be discrepancies is in the pattern of prices. U.S. customers on average tend to buy larger vehicles than Canadians and also have a stronger preference for light trucks. The differences in market shares between the two countries are accounted for, but we cannot rule out that manufacturers have adjusted their pricing to exploit these differences in preferences.

The absolute changes for Canadian plants are always estimated to be larger in the case of the FTA with the U.S. In the benchmark demand, we estimate that U.S. sales of vehicles produced in Canada would be reduce by 20,175. This is almost four times as large as the effect estimated for the Canadian FTA with Korea and amounts to 0.98% of the total Canadian production volume.

The more restrictive demand model now leads to much smaller effects, results in column (3) of Table 12, while the sales-maximization assumption leads to similar effects, reported in column (4). Given that this exercise is only an approximation as we could not estimate a new demand model for the U.S. market, we take the two extreme estimates as upper and lower bounds to the expected results which should lie in the [-20,175 -15,9232] interval. In all three models that we estimated, the effect of U.S. trade policy is more important for Canadian plants than Canadian trade policy.

The larger total effects are solely the result of the much higher sales of Canadian plants in the U.S. than domestically. The changes expressed as a percentage of local sales tend to be lower in the U.S. market. They can be explained by the following factors: (i) a lower share of U.S. sales is imported from Korea; (ii) the vast majority of Korean imports are cars that only attract a 2.5% tariff currently; (iii) Canadian sales in the U.S. are more geared towards trucks than Canadian sales and to a large extent they avoid direct competition with models that benefit from the FTA.

Using the most pessimistic scenarios, we predict a 0.98% sales decline for Canadian plants in the U.S. market and a decline of 0.22% of total production caused by the Canada-Korea FTA. In total, we thus estimate that the Canadian industry could have to lower output by about 1.20% of sales as a result of trade liberalization with Korea – summed over the effects in both countries. Scaled to the total employment of the automotive industry, assembly and parts, this is the equivalent to 1,150 jobs.

5 Impact of tariff elimination on auto assembly plant investment in Canada

A possible advantage of import tariffs, in addition to raising government revenue and shielding domestic producers from competition, is the incentive it provides to foreign firms to establish local production capacity to avoid import duties. This is a general feature of import tariffs and to gauge its importance for the automotive sector in particular, we need to consider several subjective factors.

At least two factors suggest that this is probably not an important issue. First, the current 6.1% import tariff levied by Canada on new vehicles is unlikely to be sufficiently large to materially affect such an important investment decision as the establishment of a new assembly plant. Markups over variable cost necessary to cover fixed costs are several times this percentage, especially for the more niche models currently imported.

Second, given that the U.S. automotive market is several times the size of Canada's, U.S. trade policy is a lot more important as a determinant of North American investment decisions. Location decisions of foreign automakers are made for the entire integrated NAFTA market. The Canadian tariff has no bearing on which NAFTA country a carmaker would select for its plant when it decides to assemble locally. The incentive for local production that the Canadian import tariff provides is only proportional to its share in NAFTA sales, which in 2010 was only 11.1%.

The decision where in the NAFTA area to base a new plant is not driven by each country's individual trade policy, but establishing good relationships with policy makers in general will enter a firm's calculation. In that respect, it is a concern that successfully completing ongoing FTA negotiations would make it possible that both Korean and European manufacturers gain duty-free access to the Canadian automobile market. In that case, only models assembled in Japan would still attract an import duty. This would be unfortunate as Honda and Toyota are the firms with the largest share of their Canadian sales that are produced domestically.

A third important consideration is that investment decisions in automobile assembly plants are intrinsically indivisible. The likelihood that a particular firm will expand its production capacity in North America can be assessed rather well from its current import volumes. Historically, foreign firms have established a new assembly plant in North America when they could expect to reliably sell at least 200,000 vehicles annually over the entire NAFTA region with one to three models that can be assembled together in a single plant.

Current import statistics by firm in Table 13 are informative in this respect. In the first column we report gross import volumes from outside NAFTA into the Canadian market. Hyundai, combining its Hyundai and Kia brands, was by far the largest importer into

Table 13: Vehicle imports from outside NAFTA area by firm (2010)

	Canada (gross)	NAFTA (net)	Top 1-3 similar models (gross)
HYUNDAI	120,437	612,720	190,576
TOYOTA	27,267	525,449	N/A
MAZDA	64,735	288,176	191,066
NISSAN	28,790	163,620	183,096
BMW	23,834	148,094	169,412
DAIMLER	20,995	137,056	137,143
SUBARU	17,599	134,105	147,391
HONDA	11,743	123,641	99,663
VOLKSWAGEN	43,017	113,561	N/A

Note: Only firms with at least 100,000 net imports into the NAFTA area are included in the table.

Canada and its lead has grown considerably over the 2008-09 crisis. This explains the relatively large effects we estimated for the Canada-Korea FTA even though only one firm is materially affected.

Predicting future import levels for Hyundai-Kia is not straightforward because in 2010 its second U.S. plant was still ramping up to full production. The Elantra was added to the U.S. production lineup in November 2010 and only by the start of 2011 the company announced it was now ready to operate at full capacity of 600,000 vehicles in the U.S. In 2010, the firm sold 172,389 vehicles in Canada and 120,437 of them (69.9%) were imported. However, once its top-selling Elantra model will be sourced from within NAFTA, it would only need to import 86,508 units, or 50.1%, at unchanged sales. On the other hand, it is unlikely that the firm's North American sales have topped out. Its market share has surged over the recession and the indication is that this will continue to grow.

The statistics in the second column indicate that Hyundai has also become the largest net importer into the entire NAFTA area—firms in Table 13 have been sorted along this dimension. This is a recent phenomenon given the recent North American capacity additions of Toyota and Honda. It also holds only for net imports. Toyota still imports more vehicles in total, but also exports some models from its North America assembly plants, while all Hyundai-Kia production is sold locally.

One should bear in mind that total import volumes are only part of the picture. Imports are made up of individual models and scale economies are important in production. It is no coincidence that the four vehicles that Hyundai-Kia assembles in North America are exactly the four with highest sales in the region. Total sales of the one to three similar models with highest import volumes provide a better gauge than total imports for the ability of a firm to operate a new plant efficiently in North America.

In the third column of Table 13 we show for each firm what the total 2010 North American sales are for the one to three ‘similar’ vehicles, with similarity obviously a subjective concept. A firm like Honda claims that it can assemble any two models in the same plant, but most firms limit themselves to models based on the same platform. A first thing to note is that not a single firm right now sells 200,000 units of just a few imported models, making it unlikely that any new assembly plant will be announced soon—irrespective of the import tariff.

On the other hand, the sales volumes in Table 13 are for 2010 when aggregate industry sales in North America was only 14 million. This was only 10.4% above the low point of 2009, but it is difficult to predict how far or how quickly sales will recover towards the 19 million average over the 2006-2007 period.

If the recovery continues to be strong this seems to be the order in which firms might be able to efficiently deploy local assembly capacity in North America:

- Hyundai-Kia stands in first place with combined 2010 sales for the Hyundai Accent, Kia Forte, and Kia Rio almost reaching 200,000. However, declining sales on the older Rio model has lead to 2011 sales of only 140,000 units in the first 11 months of 2011. On the other hand, sales of the Kia Soul will surely break 100,000 units in 2011 and that model is of a similar size.
- The only other firm that would be able to fill a plant with just two models is Mazda which imported 191,000 units of the Mazda3 and Mazda5 models. They are conveniently based on the same platform, so assembling them in a single plant should be easy. Its collaboration with Ford has been dialed back in recent years and Ford has trimmed its own overcapacity aggressively, leaving Mazda to chart its own course in North America. Still, it is unlikely to start a new plant any time soon as it is very dependent on a few models and its sales in 2010 for these two models are still 7% below their 2008 sales. On the other hand, Canadian sales account for almost 30% of the total for these two models.
- For Nissan the combined sales of the Murano and Rogue models are close to the 200,000 mark, but sales of 160,000 in the first 11 months of 2011 do not show the upward trend needed to make North American production viable. Moreover, the predecessor of the Rogue, the Xterra used to be assembled in Smyrna, TN and Nissan’s truck line in Canton, MS produced less than 60,000 vehicles in 2010, below full capacity. It makes it extremely unlikely Nissan will be looking for new North American production capacity any time soon.

For Toyota, future expansion in North America will be foremost directed to finish the Blue Springs, MS assembly plant where the Prius will be assembled. Production was planned to start already in 2010, but this has been postponed due to the downturn in the industry. The Volkswagen Chattanooga, TN assembly plant just started producing the Passat in May 2011.

The statistics for BMW refer to the 3-series and the Mini and it would be hard pressed to produce these two models on the same assembly line. The same holds for Honda, where the Acura TSX and Honda Fit together barely break the 100,000 units mark and the company is unlikely to produce these vehicles together anyway. For Daimler (Mercedes-Benz) the statistics in the last column of Table 13 are for the C-class and E-class, which again are no good matches for joint production. All its other models sell in very small numbers in North America. For Subaru the sales refer to the Forester and Impreza. However, to operate its Lafayette, IA plant at full capacity it has had to turn to Toyota and it is collaborating with Toyota in several areas as well, ruling out a new assembly plant for sure.

6 Conclusions

We have used a state-of-the-art demand model to simulate the impact of various trade liberalizing policy options on the Canadian automobile market. The model is estimated using model-level information for the 1998-2010 period. It features market segments that differ in the strength of within and between segment substitution to accommodate asymmetries in substitution patterns between vehicles. It also features a heterogeneous price effect in the utility function that varies with income to accommodate lower price elasticities for richer households. As a result, the demand model allows for rich and flexible patterns of substitution between vehicles.

The nature of the counterfactual exercise is to calculate what the 2010 market equilibrium would have looked like, if an alternative trade policy had been in place. We keep the product offerings and assembly locations constant, but allow all firms to adjust their prices. Firms with models that are directly affected by a trade policy change will decide how much of the tariff cut to pass on to consumers. Firms producing competing models will decide how to respond to their competitors' price cuts.

Taking the results of a possible Canada-Korea FTA as an example, our preferred estimates suggest that the elimination of the 6.1% import tariffs on vehicles assembled in Korea would expand Korean imports by 21,883 units and decrease local production by Canadian plants by 4,482 units. The total market would expand by 5,730 units as a result of the average price declines.

In this particular simulation, we find that almost all of the price decreases would be concentrated in the models benefitting directly from the tariff elimination, and that many other firms would even respond by raising their prices. This is an unexpected effect that is relatively small, the average price change is +0.01%, and results from the isolation of Korean vehicles at the lower end of their market segments and the concentrated ownership of vehicles assembled in Korea. Similar analysis of FTAs with Japan and the E.U. find that competitors respond by lowering their prices, on average by 0.02% and 0.04% respectively. The price increases in response to the Korean FTA heightens the market share changes for local producers, but cushions the effects on variable profits.

The decline of Canadian production in response to the FTA with Korea represents 1.47% of vehicle production that is sold in Canada. Because 85% of Canadian output is exported, it only amounts to 0.22% of total Canadian new vehicle production. When we performed a similar analysis of the recently signed FTA between Korea and the U.S., the estimates suggest a likely decline in Canadian production of 20,175 vehicles, or 0.98% of total output.

As a sensitivity analysis, we conducted the same analysis using an alternative, more restrictive demand system and using a different price-setting assumption for the automobile producers. We always find a larger effect on Canadian production for the

Korea-US FTA than for the Korea-Canada FTA. The highest effect we ever find for Canadian trade policy is the result of full unilateral elimination of tariffs with all three trading partners and assuming the restrictive demand system. Even in this scenario, total loss of production is estimated to be at most 14,407 vehicles, or 0.70% of domestic production. Using the average jobs-per-vehicle ratio for the entire Canadian automotive industry, this translates into 660 jobs.

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