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Reversing NAFTA: A Supply Chain Perspective

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Contents

Table of Tables

Table of Figures

Acronyms

BEC	Broad Economic Classification
CPI	consumer price index
GDP	real gross domestic product (nominal only when indicated)
GTAP	Global Trade Analysis Project
IESC	ImpactECON Global Supply Chain
MFN	most favored nation
NAFTA	North American Free Trade Agreement
ROW	rest of world
US	United States
WTO	World Trade Organization

Abstract

Since the North-American Free Trade Agreement (NAFTA) entered into force in 1994, production within the three NAFTA countries has become more specialized as foreign direct investment and trade have been allowed to thrive and firms have taken advantage of economies of scale and lower wages in Mexico. Extensive regional supply chains for producing motor vehicles, chemicals, wearing apparel, among other commodities have emerged. Using a global trade model tailored to include supply chains, we examine the impact of the United States (US) extricating itself from the NAFTA. US tariffs on imports of goods from Canada and Mexico, currently covered under the NAFTA, are assumed to rise to US most favored nation (MFN) rates, compelling Canada and Mexico to reciprocate under World Trade Organisation (WTO) rules. Overall, the results show that the US's reversal of NAFTA leads to a decline in real GDP, trade and investment in the US, Canada and Mexico, with most of the losses resulting from Canada and Mexico's reciprocation. The losses in low skilled employment are most significant, with employment declining by 256,000, 125,000, and 951,000 in the US, Canada and Mexico respectively. Production and specialization of production across the NAFTA region declines, particularly in those sectors with the highest levels of vertical specialization across NAFTA. The motor vehicles and services sectors in all three NAFTA countries decline, along with production of US meat, food, and textiles; Canadian chemicals and metals; and Mexican textiles, wearing apparel, electronics and machinery.

1 Introduction

The North-American Free Trade Agreement (NAFTA) between Canada, Mexico, and the United States (US) entered into force in January 1994. NAFTA eliminated almost all tariffs between the three countries, except for limited tariff rate quotas on sugar, meat, and food products. Since the signing of the agreement, trade between the three NAFTA parties has increased dramatically, from US$ 290 billion in 1993 to over US$ 1.1 trillion in 2013. NAFTA is also believed to have raised investment and productivity, while increasing the variety and reducing the price of goods available to consumers.

NAFTA has also been credited with helping US manufacturing become globally competitive, by encouraging vertical specialization of production, allowing firms to take advantage of economies of scale and lower wages in Mexico (Villarreal and Fergusson, 2013). Hummels, Rapport and Yi (1998) measure the degree of vertical specialization in the motor vehicle industry and show that this has increased substantially since the implementation of NAFTA. Our own data also shows high vertical specialization in motor vehicles between US, Canada and Mexico; chemicals and metals between US and Canada; and wearing apparel, electronics and machinery between US and Mexico (Walmsley and Minor, forthcoming).

Critics on the other hand, blame NAFTA for the loss of US jobs to Mexico, caused by US companies moving production facilities to Mexico to benefit from lower wages. The Economic Policy Institute[3] estimated that about 700,000 jobs were lost to Mexico between 1997 and 2013; although Villarreal and Fergusson (2013) argue that technology and automation, rather than NAFTA, are responsible for most of the job losses over this period. Regardless, the US Chamber of Commerce[4] estimates that about 14 million US jobs depend on trade with Canada and Mexico, with NAFTA being responsible for a net increase of 5 million jobs.

In January 2016, the US Executive Office announced that renegotiating the NAFTA deal is a priority, with the aim of increasing employment for all American's, particularly in the manufacturing industries.[5] With public perception of trade agreements at an all-time low, we examine the impact of increasing US tariffs on imports of goods from Canada and Mexico to most favored nation (MFN) rates. The decision to use MFN rates, as opposed to an arbitrary percent ceiling, reflects the fact that the US is bound to MFN rates under the World Trade Organisation (WTO) Uruguay Round agreement and any tariff assessment above WTO rates would be challenged in the WTO with resulting remedies.

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3 Economic Policy Institute, (March 3, 2014). "NAFTA, Twenty Years After: A Disaster", Blog posted by Jeff Haux in Huffington Post, http://www.huffingtonpost.com/jeff-faux/nafta-twenty-years-after_b_4528140.html

4 https://www.uschamber.com/above-the-fold/the-nafta-the-candidates-haven-t-met

5 https://www.whitehouse.gov/trade-deals-working-all-americans.

According to WTO rules, a free trade agreement is required to cover a substantial amount of trade between the parties—so there is some question over whether Canada and Mexico could maintain tariff preferences on their imports from the US, while the US raises its tariffs to Canada and Mexico on a substantial number of products (GATT: Article XXIV). A legal analysis of the compliance of international trade agreements is beyond the scope of this paper, which focusses on the economic impacts. To address the possibility that Canada and Mexico may choose to retaliate or be forced by the WTO to reciprocate against the US's reversal of NAFTA, we also examine the impact of a potential rise in tariffs by Canada and Mexico on US goods.

The paper uses a new global model and database, the ImpactECON Global Supply Chain (IESC) model and database (Walmsley and Minor, 2016a and 2016b), that takes account of differences in the sourcing of imports by firms, final consumers and the capital goods sector, as well as the differential tariff rates paid by these purchasers. It is the first publicly available database of its kind to take account of differences in tariff rates paid by firms, final consumers and capital goods.[6]

Following the introduction, we provide an outline of the methodology used, including an examination of the model. In section 3, the results are examined, commencing with the impacts of the US's reversal of NAFTA, first on the US economy and then on Canada and Mexico. The results are also separated into those due to the US raising tariffs (no reciprocation) and those due to Canada and Mexico reciprocating (Canada and Mexico's reciprocation); the two results combined are referred to as those due to the reversal of NAFTA (with reciprocation). This is then followed by an analysis of the employment impacts. Section 4 then summarizes and presents the conclusions.

Overall, the results show that the US raising tariffs on NAFTA parties (no reciprocation), back to MFN rates, causes all NAFTA parties to experience declines in real GDP, trade, investment and employment; with the potential for much greater loses should Canada and Mexico reciprocate. The reversal of NAFTA (with reciprocation) leads to 256,000 unemployed low skilled workers in the US in the short to medium run (3-5 years), with thousands more workers having to relocate to other sectors to find employment. If skilled workers are also assumed vulnerable to reversing NAFTA, then US unemployment rises by over 1.2 million. The reversal of NAFTA (with reciprocation) causes US trade with Canada and Mexico to decline significantly, although trade between Canada and Mexico, and with the rest of the world, rises; all three NAFTA countries experience an overall decline in trade.

The largest declines for the US from the reversal of NAFTA occur in meat, food, textiles, motor vehicles and services. There are some small increases in production and employment in selected heavy manufacturing, namely machinery, electronic equipment, metal and chemicals, however

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6 See https://impactecon.com/resources/supply-chains/

the small gains in these sectors are more than offset by the loses in the motor vehicles and services sectors.

For Canada and Mexico, production diminishes in several key sectors because of the reversal of NAFTA, particularly those sectors where production is highly integrated with the US such as chemicals, metals, and motor vehicles for Canada and textiles, wearing apparel, electronics, machinery and motor vehicles for Mexico. Canada and Mexico experience greater declines in production from raising their own tariffs, suggesting that an optimal trade response for these parties would be to do nothing in response to the US raising its tariffs, albeit this may not be an option given WTO rules.[7]

2 Methodology

2.1 The IESC model and database

The ImpactECON Global Supply Chain (IESC) model (Walmsley and Minor, 2016a) and database (Walmsley and Minor, 2016b)[8] is based on the widely used GTAP model (Hertel and Tsigas, 1997) and database (Narayanan et al, 2015).

The main addition to the IESC model is the treatment of imports. The GTAP model uses a nested Armington demand structure (Figure 1) to differentiate between domestic ($QFD_{i,j,r}$) and imported ($QFM_{i,j,r}$) intermediate goods, followed by imports from different source regions ($QXS_{i,s,r}$). As can be seen in the shaded area of Figure 1 (panel 1), the imports of firms ($QFM_{i,j,r}$, including the capital goods sector), private consumers ($QPM_{i,r}$) and government ($QGM_{i,r}$) are aggregated into total imports ($QIM_{i,r}$) before being allocated across sources, s ($QXS_{i,s,r}$). This is done because data on imports by agents – firms, the capital goods sector, private households and government – and source are not available in the GTAP Data Base. This lack of supply chain data on imports also precludes the inclusion of differential tariffs by agent and source.

The IESC model and database are extensions of the GTAP model and database that include the critical information on supply chains and differential tariffs by agent. The main feature of the IESC model are that bilateral trade flows and tariffs are distinguished by the agent purchasing the imported commodity. In Figure 1 (panel 2), this is evidenced by the fact that imports are not aggregated across all agents, instead imports are distinguished by both source and agent ($QFMS_{i,j,s,r}$, firms and investment; $QPMS_{i,s,r}$, private and $QGMS_{i,s,r}$, government) – see shaded area in Figure 1, panel 2.

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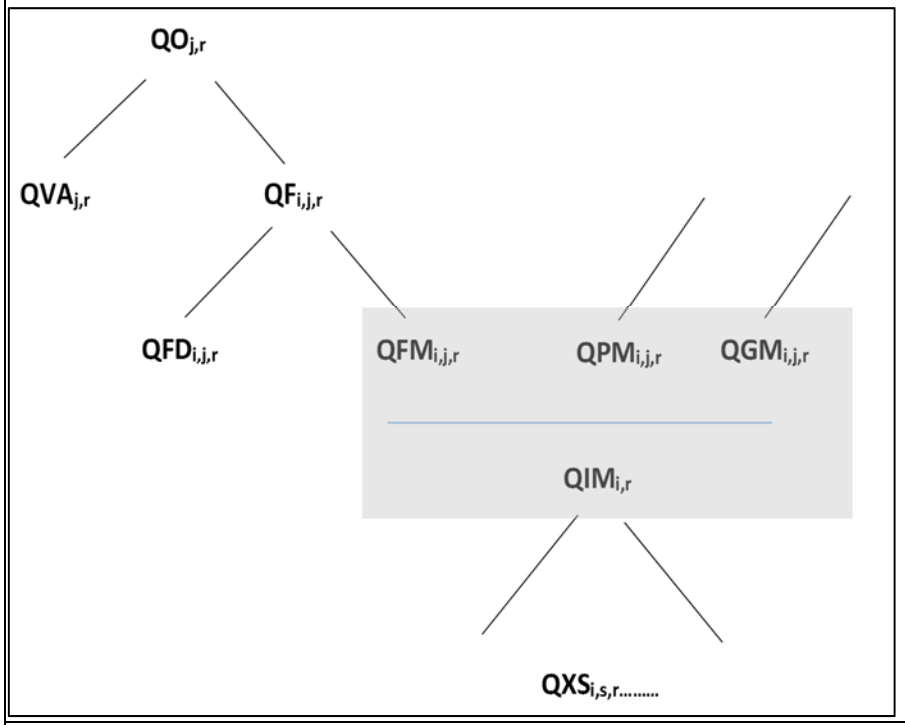
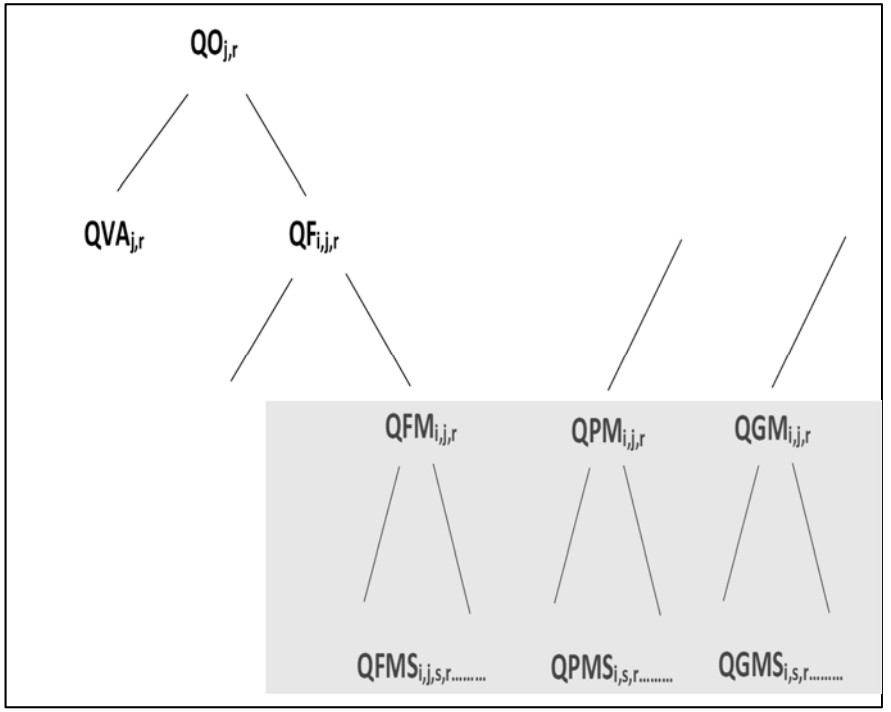
7 Canada and the US had a free trade agreement before the NAFTA. A possibility has been raised that the US and Canada could revive this agreement from its current status. A full legal analysis of this possibility is beyond the scope of this paper.

8 The model is solved using Gempack (Harrison and Pearson, 2007).

Figure 1: Armington structure of the GTAP and IESC Models

GTAP Model	IESC Model
	
Source: Hertel and Tsigas (1997)	*Source: Walmsley and Minor (2016b)*

Where: $QO_{j,r}$ is output of commodity j in region r; $QVA_{j,r}$ is value added used in production of j; $QF_{i,j,r}$ is intermediate (including capital goods sector) demand for commodity i in production of j (domestic ($QFD_{i,j,r}$) and imported ($QFM_{i,j,r}$) intermediate demand); $QPM_{i,r}$ is private consumers demand for imports of commodity i; $QGM_{i,r}$ government demand for imports of commodity i. $QIM_{i,r}$ is aggregate imports of commodity i by all agents; $QXS_{i,s,r}$ is total imports of commodity i by both source and destination; $QFMS_{i,j,r}$, $QPMS_{i,r}$ and $QGMS_{i,r}$ is imports of commodity i by agent (firms (including capital goods sector)) private consumers and government), source and destination.

The ability to capture sourcing of imports and tariffs by agent is possible because of the underlying supply chain database which uses the Broad Economic Classification (BEC) end-use categories to estimate the source of imports by firms, final consumers and the capital goods sector. Further details on the construction of this supply chain database can be obtained in Walmsley and Minor (2016b) and Walmsley and Minor (forthcoming). The database is then aggregated into 15 commodities and 9 regions depicted in Tables A1-1 and A1-2 respectively for this analysis.

2.2 Experiment and closure

The reversal of NAFTA is divided into two parts for the analysis:

— ***US raises tariffs on NAFTA partners (no reciprocation)***: the impact of the US raising tariffs on goods from Canada and Mexico to MFN rates; and

— ***Canada and Mexico reciprocate***: the impact of Canada and Mexico reciprocating by raising tariffs on goods from the US to MFN rates.[9]

Reciprocation by Canada and Mexico could be required by the WTO, since the most favored nation principals do not permit preferential tariffs outside a fully functioning FTA or the Generalized System of Preferences (GSP), which are reserved for developed countries providing preferences to developing countries.

The results are further broken into the implications of raising tariffs on intermediate, consumption and investment goods to further illustrate the supply chain impacts. Although it is impossible to know exactly which tariffs would be renegotiated in a re-examination of NAFTA, we chose to implement MFN rates, since MFN rates represent the maximum legal rates that can be applied by the US, Canada and Mexico, as WTO signatories—without fear of trade remedies.[10]

MFN tariffs by commodity and by BEC end-use category (intermediates, consumption and investment) for the US, Canada and Mexico are obtained to estimate the MFN tariffs applied to each agent (firms, investment and final consumers (including government and private households)). Table 1 illustrates data for motor vehicles. The data for motor vehicles shows that the US MFN tariff rate on (all) motor vehicles from Mexico is 3.5 percent. This is based on a share weighted average of a 6.9 percent MFN tariff rate on motor vehicles for investment (e.g., cranes, semi-trailers and tractors), a 1 percent MFN tariff on intermediates (primarily auto parts) and a 1.3 percent MFN tariff on consumption goods (e.g., passenger cars). With information on imports by agent and source omitted from the GTAP Data Base, the US tariff on

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9 We assume Canada and Mexico continue to meet their NAFTA obligations with regards to each other.

10 WTO rules require compliant developed country FTAs to cover substantially all products in an FTA (GATT: Article XXIV).

imported motor vehicles is simply increased from an initial rate of zero to 3.5 percent. In the supply chain model the rise in tariffs on the capital goods sector can be separately identified from that applied to firms and to final consumers. By doing this the higher MFN rate on cranes, semi-trailers and tractors of 6.9 percent is appropriately applied to the capital goods sector. Rather than changing all motor vehicle tariffs to 3.5 percent, tariffs on capital goods are raised to 5.7 percent, tariffs on firms to 1 percent and tariffs on final consumers to 1.1 percent (Table 1).

Why is the new tariff on the capital goods sector 5.7 percent rather than 6.9 percent? The reason is that the BEC end-use categories are different from agents. The capital goods sector purchases both cranes, semi-trailers and tractors (81%) and auto parts (19%) and hence the average tariff paid by the capital goods sectors is a weighted average of the two with appropriate weights (0.81 x 6.9 + 0.19 x 1); where the weights are obtained from a matrix produced as part of the construction of the IESC database and the reconciliation of the BEC trade data and the GTAP data (see Walmsley and Minor (forthcoming) for further details).

Another benefit of the supply chain model is that policies targeting tariff rates on motor vehicles for investment purposes or any other BEC end-use category can be examined separately.[11] With information on imports by agent and source missing from the GTAP Data Base, the only way to raise the tariffs on cranes, semi-trailers and tractors to 6.9 percent, is to shock the average tariff on (all) motor vehicles to 2.9 percent (or 0.42 x 6.9, since cranes, semi-trailers and tractors account for 42% of trade according to BEC trade data, Table 1). In the supply chain model, however, this can be achieved by targeting the tariff on capital goods to 5.4 percent (or 0.81 x 6.9).

Table 1: MFN tariffs on motor vehicles imported from Mexico by the US

BEC category / agent	MFN Tariff by BEC category	Trade share by BEC category	GTAP Model	MFN Tariff by agent in IESC Model
Investment/capital goods sector	6.9%	0.42	2.9%	5.7%
Intermediate/firms	1%	0.45	0.5%	1.0%
Consumption/final consumers	1.3%	0.13	0.2%	1.1%
Average/total	3.5%	1.00	3.5%	3.5%

Source: International Trade Center (2006) and IESC Database (Walmsley and Minor, 2016a)

In the analysis undertaken in this paper the overall results are categorized into the impacts of raising tariffs on each of the three end-use categories. MFN tariffs by commodity and agent for the US and for Canada and Mexico are depicted in Table 2 and Table 3 respectively along with the applied preferential rate in 2011 (the base year of the data). Initially, preferential tariffs between the NAFTA countries are zero for most commodities, except for sugar, meat and food

11 https://impactecon.com/resources/supply-chains/

products. Table 2 and Table 3 also illustrate that MFN tariffs are lower in the US than in Canada and Mexico, and are also higher on purchases by the capital goods sector and final consumers, than on purchases by firms.

Another issue of importance in this analysis is the implication of raising tariffs on employment, particularly in manufacturing where one of the aims of revisiting the NAFTA agreement is the revival of manufacturing jobs in the US. Real wages of low skilled workers (clerks, service and shop workers and low skilled workers) are assumed to be fixed in all three NAFTA countries, causing unemployment. The inclusion of numbers of workers employed by occupation, sector and region enables detailed analysis of how many jobs are created or lost and in which sectors – thereby illustrating the flow of workers between sectors and into unemployment. Finally, combining the quantity (number of workers) and value (input-output) data permits analysis of the wages, which differ across sectors.

Other than unemployment of low skilled labor, the closure represents the short to medium run (3-5 years) with labor and capital assumed to be mobile across sectors. US imports of sugar from non-NAFTA regions are also fixed to reflect quotas. Finally, trade balances are determined endogenously by the fixed domestic savings rate and investment that responds to rate of return differentials across regions.

3 Analysis

3.1 Macroeconomic impacts

3.1.1 MACROECONOMIC IMPACTS ON US ECONOMY

As expected US raising tariffs (no reciprocation) on imports from Canada and Mexico to MFN rates is detrimental to the US economy – real GDP, trade and investment fall (column II, Table 4). The negative impacts of the reciprocation by Canada and Mexico are more detrimental to the US than the rise in the US tariffs on NAFTA members (compare columns II and III, Table 4). This is not surprising since the US supplies a large share of Canada and Mexico's imported intermediates and Canada and Mexico have higher MFN tariffs (Table 2). While the changes in real GDP are relatively small, the unemployment impacts show that almost 256,000 people become unemployed because of the US's reversal of NAFTA, of which 68,000 is due to the US raising tariffs on Canadian and Mexican goods (column II, Table 4).

Table 2: US tariffs on Canadian and Mexican imports (preferential and MFN)

	US Tariffs on imports from Canada*					US Tariffs on imports from Mexico*				
	Initial preferential tariffs	MFN tariffs by agent				Initial preferential tariffs	MFN tariffs by agent			
		Sector average**	Firms	Final consumer	Capital		Sector average**	Firms	Final consumer	Capital
	I	II	III	IV	V	VI	VII	VIII	IX	X
Crops and Forestry	0.0	2.0	2.1	1.9	2.2	0.0	3.8	3.8	3.9	4.1
Livestock and Fishing	0.0	0.2	0.2	0.2	0.2	0.0	0.6	0.6	0.5	0.5
Sugar	3.8	7.4	7.4	7.4	7.4	0.0	28.9	28.9	28.4	28.4
Extraction	0.0	0.5	0.5	2.1	0.6	0.0	5.6	5.6	6.5	6.7
Meat Products	0.0	5.2	5.1	5.4	5.4	0.0	6.2	6.1	6.2	6.2
Food	1.9	9.2	9.1	9.4	9.4	0.2	8.4	7.9	8.6	8.6
Textiles	0.0	6.6	6.6	6.8	6.8	0.0	7.2	7.1	8.4	8.4
Wearing Apparel and Leather	0.0	12.5	11.3	12.5	12.5	0.0	9.7	8.7	9.9	9.9
Chemicals	0.0	2.2	2.5	0.9	1.2	0.0	2.6	2.9	2.1	2.1
Metals	0.0	1.2	1.2	1.4	1.3	0.0	1.3	1.3	0.9	1.7
Electronic Equipment	0.0	0.3	0.2	1.5	0.1	0.0	0.8	0.2	1.3	0.1
Machinery	0.0	0.9	1.1	1.5	0.7	0.0	1.2	1.3	0.7	1.0
Motor Vehicles	0.0	1.3	1.1	1.2	1.6	0.0	3.5	1.0	1.1	5.6
Other Manufactures	0.0	0.3	0.3	0.8	0.1	0.0	0.9	0.9	1.0	0.4
Services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: GTAP Data Base (Narayanan, Aguiar et al., 2016) and International Trade Center (2006).

**Trade weighted averages of HS6 commodity detail by the share of US imports of the respective party. But for the difference in trade weights, the US MFN rates are the same for all WTO members, including Canada and Mexico.*

***The sector average is equal to the trade weighted average of the IESC tariffs by agent (firms, final consumer, capital). This average is also the value which would be applied to all agents equally in the GTAP database and model, since the GTAP framework does not make any distinction of goods by purchasing agent.*

Table 3: Canadian and Mexican tariffs on US imports (preferential and MFN)

	Canadian tariffs on US Imports					Mexican tariffs on US Imports				
	Initial preferential tariffs	MFN tariffs by agent				Initial preferential tariffs	MFN tariffs by agent			
		Sector average**	Firms	Final consumer	Capital		Sector average**	Firms	Final consumer	Capital
	I	II	III	IV	V	VI	VII	VIII	IX	X
Crops and Forestry	0.0	7.2	7.2	7.2	8.0	0.6	11.6	11.6	12.0	12.3
Livestock and Fishing	6.0	4.8	1.7	14.9	0.1	0.0	7.0	6.9	8.7	6.0
Sugar	0.0	3.7	3.9	0.9	0.9	0.0	43.2	43.2	43.2	43.2
Extraction	0.0	0.4	0.4	0.3	0.4	0.0	4.0	3.6	4.9	4.4
Meat Products	35.7	41.6	40.4	43.9	43.9	0.0	57.8	51.7	63.5	63.5
Food	13.2	64.3	51.2	76.6	76.6	1.4	32.1	45.9	28.3	45.9
Textiles	0.0	7.0	6.1	12.8	12.8	0.2	14.8	14.6	24.8	24.8
Wearing Apparel and Leather	0.0	11.5	9.8	12.1	12.1	0.0	23.7	20.8	26.9	26.9
Chemicals	0.0	2.5	2.4	3.2	3.2	0.1	6.7	6.3	9.7	5.0
Metals	0.0	0.7	0.6	1.8	0.9	0.0	5.9	5.9	9.9	7.3
Electronic Equipment	0.0	0.2	0.1	1.0	0.3	0.0	3.8	3.5	16.7	1.4
Machinery	0.0	0.6	0.4	2.0	0.4	0.1	6.5	5.7	10.0	7.0
Motor Vehicles	0.0	4.5	3.1	4.9	6.0	0.0	12.9	10.1	16.3	28.7
Other Manufactures	0.0	2.4	2.1	3.3	2.1	0.6	8.3	7.7	11.1	9.7
Services	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.0

Source: GTAP Data Base (Narayanan, Aguiar et al., 2016) and International Trade Center (2006).

**Trade weighted averages of HS6 commodity detail by the share of US imports of the respective party. But for the difference in trade weights, the US MFN rates are the same for all WTO members, including Canada and Mexico.*

***The sector average is equal to the trade weighted average of the IESC tariffs by agent (firms, final consumer, capital). This average is also the value which would be applied to all agents equally in the GTAP database and model, since the GTAP framework does not make any distinction of goods by purchasing agent.*

Table 4: Macroeconomic impact of US reversing NAFTA on US (percent change unless otherwise noted)

	Total	US raises Tariffs	Reciprocation	Raising Tariffs on:					
				Intermediate goods		Consumption goods		Investment goods	
				US raises Tariffs	Reciprocation	US raises Tariffs	Reciprocation	US raises Tariffs	Reciprocation
	I	II	III	IV	V	VI	VII	VIII	IX
Real GDP	-0.09	-0.03	-0.06	-0.02	-0.03	-0.01	-0.01	0.00	-0.01
Exports	-0.92	-0.57	-0.34	-0.34	-0.23	-0.28	-0.12	0.05	0.01
to NAFTA	-16.42	-2.29	-14.13	-1.32	-7.54	-0.66	-4.71	-0.31	-1.87
to ROW	3.53	-0.08	3.61	-0.06	1.92	-0.17	1.23	0.15	0.46
Imports	-2.18	-0.40	-1.78	-0.19	-0.98	-0.07	-0.61	-0.14	-0.19
from NAFTA	-8.03	-3.77	-4.26	-2.24	-2.43	-0.93	-1.73	-0.60	-0.10
from ROW	-0.53	0.55	-1.08	0.39	-0.57	0.18	-0.29	-0.01	-0.22
Change in Trade Balance (US$ Millions)	28,366	4,926	23,440	1,469	12,890	-1,504	8,299	4,961	2,251
Investment	-0.91	-0.20	-0.72	-0.05	-0.40	0.05	-0.25	-0.19	-0.06
Terms of trade	-0.55	0.21	-0.75	0.12	-0.41	0.08	-0.27	0.01	-0.08
Consumer price index (CPI)	-0.43	0.07	-0.50	0.02	-0.25	0.06	-0.18	-0.01	-0.07
Employment (number of persons)	-255,678	-67,726	-187,952	-42,465	-97,468	-31,949	-53,420	6,689	-37,063

Source: Authors' calculations.

When the US raises tariffs on imports from Canada and Mexico (no reciprocation), US consumers substitute towards imports from the rest of the world (ROW in Column II, Table 4); and US exports to both NAFTA and the rest of the world fall, as the rise in tariffs causes the price of US goods rise (Column II, Table 4). When Canada and Mexico reciprocate, US exports to the rest of the world increase and imports from the rest of the world fall. Overall, exports fall less than imports and hence the trade balance rises (i.e., the deficit falls); although this is fundamentally caused by a fall in investment, as foreigners chose to invest their savings outside the US.

Prices, wages and the terms of trade fall with the reversal of NAFTA as the depreciation due to Canada and Mexico's reciprocation offsets the appreciation experienced when the US raised tariffs (column II, Table 4). Exports to the rest of the world rise slightly to partly compensate for the loss of trade with the other NAFTA countries, although overall exports still fall.

The decomposition of the results (Table 4, columns IV-IX) by end-use reveals differences in how the US economy responds to the higher tariffs on imports from NAFTA parties for intermediate, consumption and investment goods. For instance, higher US tariffs on investment goods increases real GDP (0.002), exports (0.05) and employment (6,689) slightly (Column VIII, Table 4) because the US is a large player in global trade, and has a bias towards exporting investment goods (i.e., there is an optimal tariff). Nevertheless, raising tariffs on investment goods raises the cost of investment goods, significantly reducing investment and causing long run economic growth to decline.

Table 4 (columns IV-VII) illustrates that higher tariffs on intermediate and consumption goods reduce GDP, employment, exports, and imports although the mechanism through which they impact the economy differs. For instance, when a country raises tariffs on intermediate inputs this raises the costs of production causing firms to substitute towards domestic goods and final consumers away from domestic goods (Column IV, Table 4). Raising US tariffs on final consumption goods causes a real appreciation[12]; US final consumers substitute Canadian and Mexican goods with domestically produced goods or imports from the rest of the world (Column VI, Table 4). In both cases, prices rise and exports fall. Overall US GDP falls, as the negative impact of raising tariffs on intermediate and consumption goods outweigh the very small gains from raising tariffs on investment goods.

One notable difference between the intermediate and consumption tariff (Columns IV and VI, Table 4) results is their respective impacts on investment. The differences stem from how the rise in tariffs alters the rate of return. Increasing tariffs on intermediate goods raises a firms' costs, lowering the return to capital and hence the rate of return, causing investment to fall. When tariffs on consumption goods are raised, there is increased demand for domestic goods, as consumers substitute towards the domestic good, causing the return on capital and hence

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12 Note that the model does not contain a real or nominal exchange rate, however "real appreciation" effects are apparent in the model and can be seen in the general rise in factor prices.

investment to rise. As noted previously, tariffs on investment goods raise the cost of capital goods, causing the rate of return and investment to decline. When the investment impacts due to raising tariffs on all three BEC end-use categories are combined, investment is projected to fall by 0.19 percent; this is largely driven by the higher cost of imported investment goods from Canada and Mexico reducing rates of return in investment. With savings fixed as a portion of income, changes in investment subsequently drive the changes seen in the trade balance – hence the decline in the trade balance when tariffs are raised on consumption goods.

Columns V, VII and IX (Table 4) illustrate that the negative impact on the US economy of Canada and Mexico reciprocating is mostly due to the raising of tariffs on intermediates goods by Canada and Mexico, despite MFN tariffs being lower on intermediate goods. This is not surprising since the US is an important source of imported intermediates, particularly for the Mexican economy, and Canada and Mexico's reciprocation raises the costs of their production, resulting in a more detrimental impact on their production, which in turn reduces their demand for US intermediates.

3.1.2 MACROECONOMIC IMPACTS ON CANADA AND MEXICO

The impact of reversing NAFTA on Canada and Mexico are displayed in Table 5 and Table 6 respectively. The results show declines in real GDP, investment, trade and employment in both countries, with exports to NAFTA (most notably the US) declining as Canada and Mexico seek to export to countries other than the US.

When the US raises its tariffs, there is a decline in demand for Canadian and Mexican goods by the US, that causes a real depreciation (or a fall in factor returns) in Canada and Mexico that assists in raising their exports to other countries, including to each other. This real depreciation can be seen in the decline in the terms of trade (column II of Table 5 and Table 6). Canada and Mexico's reciprocation is particularly detrimental (column III of Table 5 and Table 6) due to the heavy reliance of Canadian and Mexican firms on imported intermediate goods from the US for production and on US demand for their exports, as well as the higher MFN tariffs levied by Canada and Mexico. Real GDP falls by a further 0.69 percent in Mexico of which -0.39 percent is due to raising tariffs on intermediate goods and -0.31 percent from raising tariffs on final goods. Trade within NAFTA falls and exports to the rest of the world also fall. Prices rise in Canada and Mexico, although the rise does not fully offset the initial depreciation in the real exchange rate experienced by Mexico when the US raises its tariffs (column II of Table 6) – terms of trade rise by 1.11, giving a net fall of 0.52.

Table 5: Macroeconomic impact of reversing NAFTA on Canada (percent change unless otherwise noted)

	Total	US raises Tariffs	Reciprocation	Raising Tariffs on:					
				Intermediate goods		Consumption goods		Investment goods	
				US raises Tariffs	Reciprocation	US raises Tariffs	Reciprocation	US raises Tariffs	Reciprocation
	I	II	III	IV	V	VI	VII	VIII	IX
Real GDP	-0.48	-0.15	-0.33	-0.09	-0.09	-0.04	-0.23	-0.01	-0.01
Exports	-2.37	-0.40	-1.97	-0.27	-0.78	-0.05	-1.25	-0.07	0.06
to NAFTA	-4.61	-2.69	-1.92	-1.63	-0.86	-0.83	-1.07	-0.23	0.02
to ROW	1.71	3.85	-2.14	2.24	-0.65	1.38	-1.61	0.23	0.13
Imports	-3.00	-0.74	-2.26	-0.19	-0.98	-0.47	-1.03	-0.07	-0.25
from NAFTA	-7.58	-1.25	-6.33	-0.82	-1.94	-0.47	-3.70	0.03	-0.69
from ROW	2.34	-1.76	4.10	-1.07	1.14	-0.48	2.64	-0.22	0.33
Change in Trade Balance (US$ Millions)	5,121	2,287	2,834	1,429	740	925	557	-67	1,537
Investment	-1.49	-0.76	-0.72	-0.47	-0.17	-0.30	-0.09	0.01	-0.46
Terms of trade	0.06	-0.59	0.65	-0.35	0.28	-0.23	0.35	-0.02	0.01
Consumer price index (CPI)	0.69	-0.20	0.89	0.08	0.17	-0.24	0.71	-0.03	0.01
Employment (number of persons)	-125,078	-41,202	-83,875	-25,394	-23,670	-13,328	-56,368	-2,481	-3,838

Source: Authors' calculations.

Table 6: Macroeconomic impact of reversing NAFTA on Mexico (percent change unless otherwise noted)

	Total	US raises Tariffs	Reciprocation	Raising Tariffs on:					
				Intermediate goods		Consumption goods		Investment goods	
				US raises Tariffs	Reciprocation	US raises Tariffs	Reciprocation	US raises Tariffs	Reciprocation
	I	II	III	IV	V	VI	VII	VIII	IX
Real GDP	-0.88	-0.19	-0.69	-0.17	-0.39	0.00	-0.31	-0.02	0.01
Exports	-6.05	-0.65	-5.39	-0.35	-3.54	-0.08	-1.87	-0.22	0.01
to NAFTA	-9.80	-4.23	-5.57	-2.48	-3.66	-0.84	-1.90	-0.91	0.00
to ROW	6.12	10.99	-4.87	6.56	-3.17	2.41	-1.76	2.02	0.06
Imports	-8.46	-2.69	-5.77	-1.34	-4.03	-0.65	-1.76	-0.71	0.02
from NAFTA	-25.05	-3.05	-22.00	-1.48	-14.08	-0.92	-4.94	-0.65	-2.99
from ROW	14.94	-2.55	17.49	-1.08	11.10	-0.73	3.07	-0.73	3.31
Change in Trade Balance (US$ Millions)	5,565	669	4,897	-145	2,927	435	389	379	1,580
Investment	-3.29	-1.05	-2.24	-0.41	-1.28	-0.34	-0.10	-0.30	-0.86
Terms of trade	-0.52	-1.62	1.11	-0.94	0.71	-0.39	0.37	-0.29	0.03
Consumer price index (CPI)	-0.55	-1.64	1.09	-0.86	0.39	-0.43	0.69	-0.35	0.01
Employment (number of persons)	-951,002	-137,587	-813,415	-45,225	-530,634	-42,809	-296,984	-49,553	14,204

Source: Authors' calculations.

Employment falls by almost 1 million jobs in Mexico; most of which occur from raising tariffs on intermediate goods, despite MFN tariffs being lower on intermediate goods. This is not surprising since the US is an important source of imported intermediates, particularly for the Mexican economy, and raising tariffs on intermediates raises the costs of production, resulting in a more detrimental impact on Mexican production and hence employment. Employment falls more in Mexico than in the US or Canada due to the higher use of low skilled labor in production. This reduction in employment undoes one of the original intentions of NAFTA – to improve employment prospects in Mexico to help reduce migration flows. Reciprocation is clearly not the preferred option for Canada and Mexico, however, given WTO rules this may be unavoidable.

3.2 Sectoral impacts

3.2.1 SECTORAL IMPACTS FOR US ECONOMY

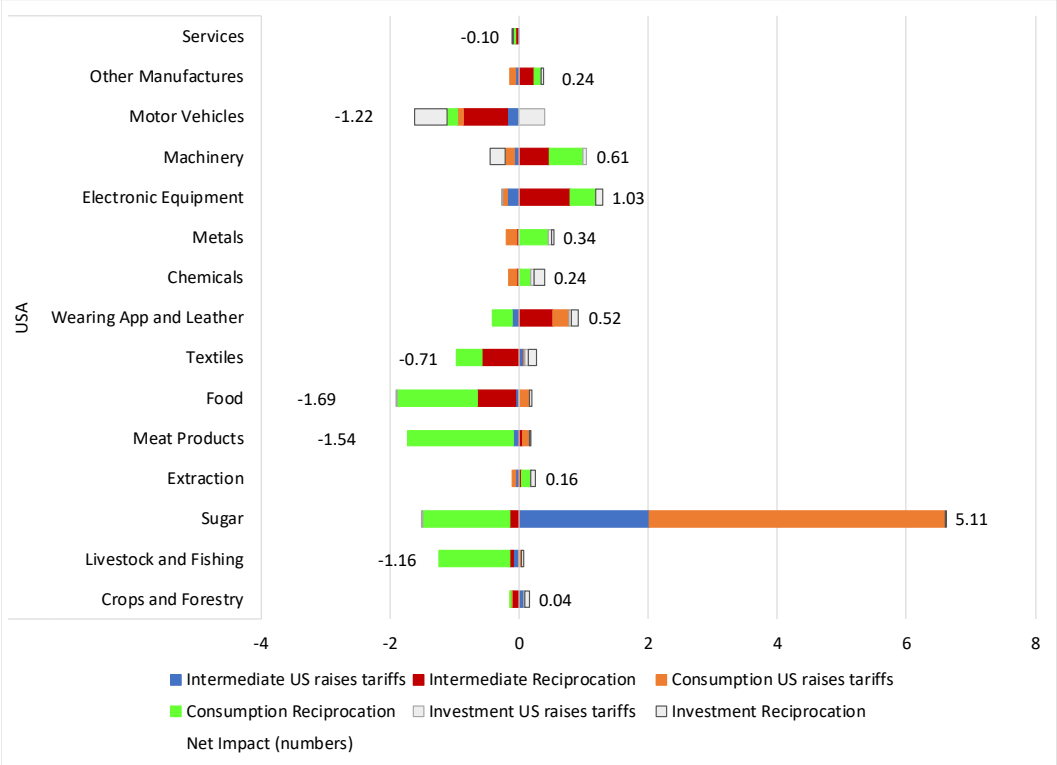
Figure 2 summarizes the sectoral impacts of reversing NAFTA on US production. The figures apportion the impacts on sectoral production into those due to the US (i.e., US raises tariffs), and those due to Canada and Mexico (i.e., reciprocation) raising tariffs. Each of these is further decomposed into those due to increased tariffs on intermediate, consumption and investment goods, as defined by BEC. The figure shows that the implications for sectoral production differ depending on whether tariffs are raised on intermediate, consumption or investment goods and on whether the tariff was raised by the US itself, or its NAFTA partners. As in the macroeconomic impacts, most of the losses occur from Canada's and Mexico's reciprocation rather than from the initial rise in tariffs by the US.

Several mechanisms are identified to explain the sectoral impacts of reversing NAFTA.

Tariffs on intermediates goods

An increase in own tariffs on intermediates will tend to raise the cost of producing final goods, causing demand and production to fall. While imports of intermediates declines, imports of final goods rise, resulting in a potential increase in exports and production for the partner. An example of this is US production of electronic equipment: an increase in the US's own tariffs (Figure 2) raises costs and reduces US production; while reciprocation by Canada and Mexico (Figure 2), raises Canadian and Mexican costs of production, increasing their imports from the US (or US exports), raising US production. Other examples where the fall in intermediate exports from the reciprocation is outweighed by a rise in final exports include other manufactures, machinery and wearing apparel (Figure 2). Alternatively, the fall in intermediate exports outweighs the rise in final exports in US motor vehicles and food production (Figure 2).

Figure 2: Impact of reversing NAFTA on US production (percent changes)



Source: Authors' calculations.

If the good is primarily an intermediate input itself then its own costs are less affected by the increase in tariffs on intermediates, instead there is an increase in demand and hence production as domestic firms substitute away from intermediate imports towards domestic intermediate inputs. Examples include sugar, crops and forestry, and textiles where the impacts of intermediates (Figure 2) are reversed.

Tariffs on Final goods (investment or consumption goods)

An increase in tariffs on final goods may result in a rise or fall of production depending on: a) the extent to which consumers substitute imports for the domestic good, and b) the importance of exports. For instance, in the case of wearing apparel, meat and food production the rise in US tariffs on final consumption goods (orange, Figure 2) causes final consumers to switch from imports to domestic goods causing production of the domestic good to rise. Exports play a minor role since the US does not export a lot of these products relative to domestic demand. The reverse occurs when Canada and Mexico reciprocate (green, Figure 2).

In the case of US heavy manufactures (e.g., chemicals, metals, electronics, machinery, and other manufacturing) the impact of the rise in tariffs on exports plays a greater role – offsetting any change in domestic sales. This will depend on the importance of exports and the extent to which prices adjust. When the US raises tariffs on its NAFTA partners, exports of chemicals, metals, electronics, machinery, and other manufacturing fall due to the real appreciation, offsetting any increase in domestic sales (orange, Figure 2). The reverse is true for the reciprocation by Canada

and Mexico (green, Figure 2), exports rise with the real depreciation causing production to rise. Overall production of US heavy manufactures (e.g., chemicals, metals, electronics, machinery, and other manufacturing) rise slightly as the rise in exports from reciprocation by Canada and Mexico outweigh the fall in exports from the US raising its own tariffs.

Two additional factors that dampen the final outcome on production: first, the extent to which domestic sales rise may be reduced if final consumers tend to substitute more towards other imported sources than towards domestic goods. Second, the extent to which the US supplies intermediate inputs to its partners (Canada and Mexico) for production (i.e., high vertical specialization). For instance, the US raising tariffs on final goods reduces Canadian and Mexican production of motor vehicles, which also reduces demand for US intermediates.

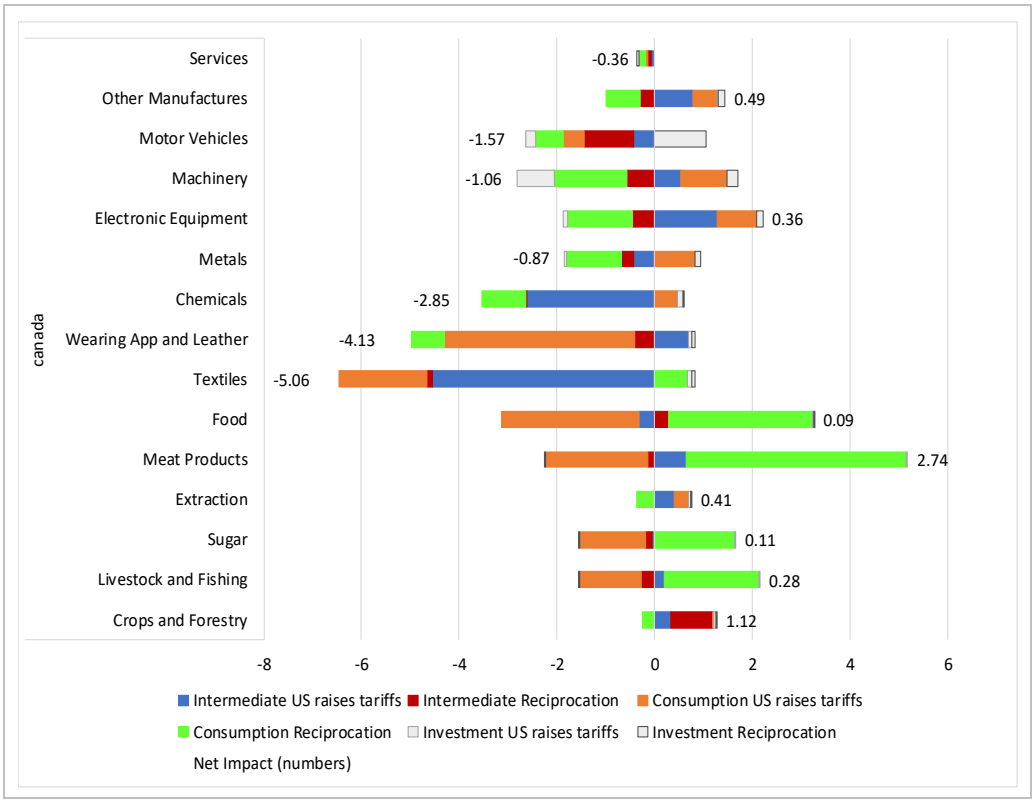
The resulting change in sectoral production depends on the relative importance of each of these mechanisms. In general, the results show that the US does obtain some small gains in sugar, wearing apparel, chemicals, metals, electronic equipment and machinery, however the losses in motor vehicles, textiles, meat, food and services far exceed these small gains. Three examples – sugar, motor vehicles and wearing apparel – are discussed below to illustrate how these mechanisms interact; but first, we outline the sectoral impacts on Canada and Mexico.

3.2.2 SECTORAL IMPACTS OF CANADA AND MEXICO

The impact of reversing NAFTA on domestic production in Canada and Mexico is illustrated in Figure 3 and Figure 4, respectively. As described above, sectoral production of final goods decline when tariffs on intermediate inputs are raised; while the impact on sectoral production of a rise in tariffs on final goods (consumption and investment) is mixed, depending on the size of the tariff change and the importance of trade between Canada and Mexico, and the US. Overall production in Canada and Mexico tends to increase in agriculture, food production and textiles, and fall in manufacturing and services.

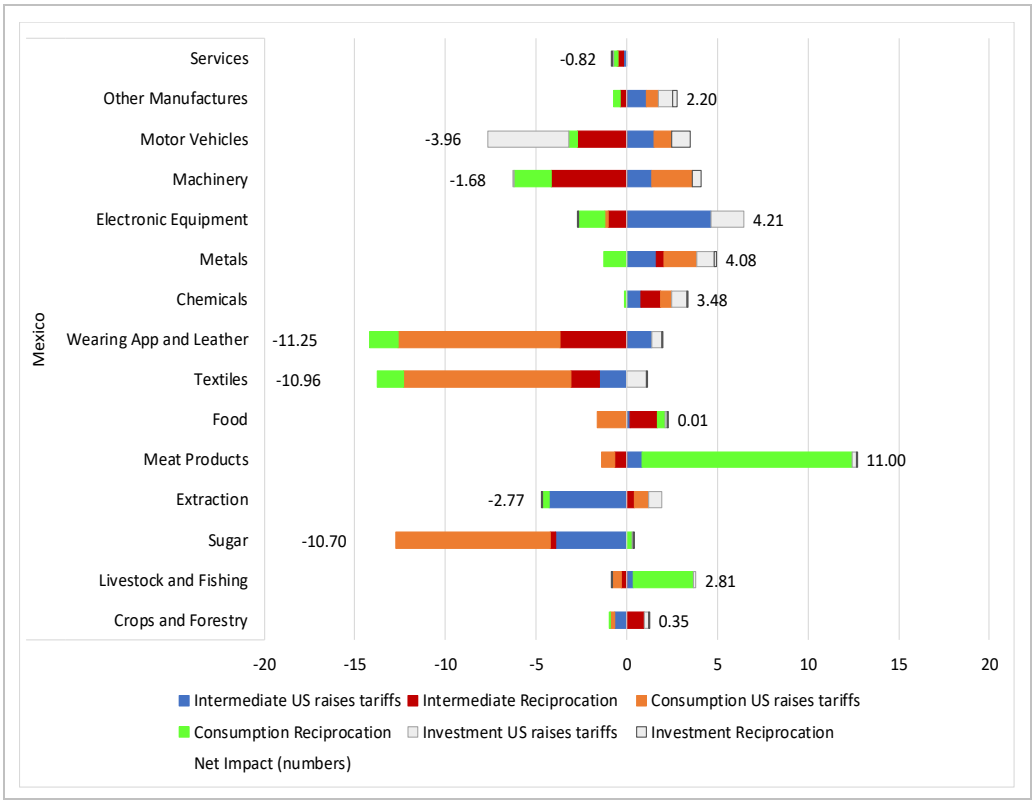
Canadian and Mexican production tends to rise when the US raises tariffs on intermediate goods, as US goods get more expensive due to the increased cost of imported Canadian and Mexican intermediates. While US producers substitute away from intermediate inputs from Canada and Mexico, final consumers tend to substitute towards imported goods, including Canadian and Mexican final goods. The real depreciation in Canada and Mexico reinforces demand for their exports, particularly by non-NAFTA countries, and production rises. This is the case for most processed manufactured goods in Figure 3 and Figure 4 (blue). When Canada and Mexico reciprocate by raising tariffs on intermediate imports from the US, their costs also rise and there is a negative impact on production of manufactures goods.

Figure 3: Impact of reversing NAFTA on Canadian production (percent changes)



Source: Authors' calculations.

Figure 4: Impact of reversing NAFTA on Mexican production (percent changes)



Source: authors' calculations.

When US tariffs are raised on final goods, US demand and hence production in Canada and Mexico falls. The extent of this fall depends on the extent to which tariffs are raised (livestock, electronics, machinery and other manufactures have lower MFN tariffs, Table 2), and the extent to which the depreciation can offset the rise in the US tariff and raise exports. Overall, Canada and Mexico increase production of manufactures, while agriculture and textiles decline. Again, these impacts are reversed when Canada and Mexico reciprocate.

Overall, production declines, particularly in those sectors there is a high level of integration with US production and trade – textiles, wearing apparel and machinery in Mexico; chemicals and metals in Canada; and motor vehicles in both Canada and Mexico. Although not shown here, we find that production is most affected by changes in Canada and Mexico's own tariffs and in the US tariffs on their goods. That is, Mexico is most affected by Mexico raising tariffs on the US and by the US raising tariffs on Mexico. Raising tariffs on Mexican goods often results in a positive outcome for Canada. For instance, when US tariffs on Mexican motor vehicles for investment are raised or Mexican sugar – Canada benefits.

3.2.3 THREE EXAMPLES

As mentioned previously, three examples are investigated in greater depth below.

Sugar

In the case of sugar, 40 percent of US imports of sugar come from Mexico and another 6 percent from Canada. Most of this imported sugar is sold to US firms, namely the sugar, food and services sectors, where it is processed or packaged and sold to final consumers. Imports of sugar are governed by a system of tariff rate quotas that are established on an annual basis.[13] The US tariff on imported sugar from the NAFTA countries is raised as part of the experiment, while imports from other countries are restricted through quotas. This causes final consumers and the food and services sectors to substitute away from Canadian and Mexican sugar towards sugar produced domestically. This rise in production occurs regardless of whether tariffs are imposed on intermediate or final consumption of imported sugar – US production rises by 6.7 percent (Figure 2) and the domestic price of sugar rises by 3.2 percent.

The rise in US production creates around 1,660 new jobs – a small gain when compared to the 68,000 people who become unemployed because of the US's raising of tariffs. Canadian and Mexican production of sugar falls, although the reduction in Canadian sugar is substantially less than the decline in Mexican production, as Canada supplies a smaller share of the US market and benefits from the US imposing tariffs on Mexico that offset most of the decline caused by the US raising tariffs on Canadian goods. Canada and Mexico raising tariffs on sugar

13 https://www.fas.usda.gov/programs/sugar-import-program

in reciprocation tends to offset the rise in production in the US and the decline in Canadian production, although has little impact on Mexico's domestic production.

Motor vehicles

Intra-NAFTA trade of motor vehicles is a significant portion of motor vehicle exports and imports for all three NAFTA countries. This is in part due to rules of origin which requires a tariff change in heading and specific value-content requirements for eligible autos, trucks, and tractors.[14] The data indicates that the US supplies primarily auto parts (intermediate goods) to both Canada and Mexico, which these countries then process and export back to the US in the form of final goods (investment goods in the case of Mexico). Overall the impact of raising tariffs between the US, and Canada and Mexico is to raise costs and reverse the benefits of specialization afforded by the NAFTA; production falls in all three NAFTA countries. To understand this result we take each of the components illustrated in turn:

- A large rise in the US tariff on motor vehicles for investment purposes (e.g., cranes, semi-trailers and tractors etc.) from Mexico, raises the cost of Mexican cranes, semi-trailers and tractors considerably, causing US consumers to substitute towards domestic cranes, semi-trailers and tractors, as well as those from other countries. US production rises, while Mexican production falls substantially. Canadian production also falls although only slightly. When Canada and Mexico reciprocate by raising tariffs on imported US cranes, semi-trailers and tractors, US production falls and Mexico's production rises slightly, although it is not sufficient to offset the initial fall. In Canada, the rise from the reciprocation on investment goods is sufficient to offset the slight fall resulting from the US raising tariffs on investment goods and production of motor vehicles rises.

- The increase in US tariffs on intermediate motor vehicle parts from Canada and Mexico, raises the cost of producing motor vehicles in the US, lowering domestic sales of passenger cars, as well as US production and exports to the rest of the world. Mexican exports (US imports) and Mexican production of motor vehicles rises as Mexican cranes, semi-trailers and tractors (investment goods) and passenger cars (consumption goods) become relatively less expensive than the US variety. Canadian production on the other hand falls slightly as the rise in demand for its passenger cars fails to outweigh the decline in demand for its intermediate auto parts by the US. Canada and Mexico's reciprocation raises costs in the region even further reducing production in Canada and Mexico. As a major supplier of intermediate auto parts to Canada and Mexico, production in the US also falls.

- Finally, the increase in US tariffs on passenger cars (consumption) lowers US production of motor vehicles as the fall in US exports outweigh any rise in domestic sales. US exports fall due to the real appreciation of the exchange rate. The rise in

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[14] The NAFTA rules of origin in the motor vehicles category have varied over time and are complex. At the entry into force, the value-content requirements were 50 percent of the products cost. That value was raised to over 60 percent in approximately eight years (2002). See https://www.cbp.gov/trade/nafta/guide-customs-procedures/provisions-specific-sectors/automotive-products

domestic sales is also subdued as US consumers substitute away from Canadian and Mexican final passenger cars towards those produced in the rest of the world, rather than buying the more expensive domestic passenger cars. Moreover, while Canada and Mexico export less passenger cars, exports of intermediates and investment goods rise. US imports of Canadian and Mexican motor vehicles therefore rise. Mexican exports and production also rise because of the increase in exports of intermediates and investment motor vehicles. When Canada and Mexico reciprocate trade and production fall across all three countries. In Mexico, the fall due to the reciprocation on consumption goods is not sufficient to offset the rise resulting from the US raising tariffs; and production rises, but only slightly.

The impact of reversing NAFTA on the US motor vehicles sector is therefore likely to be nuanced. Any potential benefits from specialization of production across NAFTA are reversed. Overall production of motor vehicles falls in all three NAFTA countries as costs rise, exports fall and the benefits of vertical specialization disappear.

Wearing apparel and textiles

The US is an important market for Mexican wearing apparel, purchasing 90 percent of Mexico's exports of these goods. The market is also highly integrated with the US supplying textiles and intermediate wearing apparel to Mexican firms. Rules of origin require eligible apparel from NAFTA members to contain NAFTA yarn forward and is a contributor to the high levels of textile and apparel integration between the regions. From the US's perspective, most wearing apparel supplied by the domestic market or imported from the rest of the world; US imports of Mexican wearing apparel and US exports are small.

Considering the US raising tariffs on Canada and Mexico (no reciprocation), the increase in tariffs on US imports of intermediate wearing apparel and textiles from Mexico causes US domestic production of wearing apparel to fall, as the US costs of production rise. Canadian and Mexican production of wearing apparel rise as US consumers substitute towards the cheaper imported final goods. As an intermediate input into US and Mexican wearing apparel, US production of intermediate wearing apparel and textiles rises as the US wearing apparel sector substitutes toward domestic intermediates and as the Mexican wearing apparel sector expands its demand for intermediate inputs. Despite the increase in demand for intermediate wearing apparel, US production of wearing apparel falls as the negative implications on demand from the rise in the costs of production outweigh the increased demand for wearing apparel intermediates by Mexico and the US. Production of US textiles, on the other hand, rises as the intermediate impacts dominate.

When Canada and Mexico reciprocate by raising tariffs on intermediates, production in Canada and Mexico declines with increasing costs, while production in the US rises as there is less substitution by US consumers towards cheaper foreign goods.The rise in tariffs on final consumption (and investment) wearing apparel from Mexico, and to a lesser extent Canada, raises US production as US consumers' preferences for Canadian and Mexican final wearing apparel decrease and move towards domestic and imported final wearing apparel from the rest

of the world. Mexican production of final wearing apparel also falls, as demand by the US falls. Since exports are relatively small, the decline in US exports caused by the decline in exports of intermediate inputs to Mexico and the real appreciation, do not outweigh the increase in domestic sales for final wearing apparel and US production rises. When Canada and Mexico reciprocate by raising tariffs on final goods, production falls in all three NAFTA countries as demand for Mexican final goods and US intermediates falls and consumers purchase more wearing apparel from the rest of the world.

3.2.4 VERTICAL SPECIALIZATION

To examine the extent to which vertical specialization amongst North American firms has changed we calculate Hummels, Rapoport and Yi's (1998) vertical specialization indexes for US-Mexico trade before and after the reversal of NAFTA:

$$VertSpec_{i,r,s} = \frac{\frac{X_{i,s}}{C_{i,s}} . M_{"\text{int}",i,r,s} . 2}{X_{i,s} + M_{i,s}} . 100 \qquad (2)$$

Where: $VertSpec_{i,r,s}$ is the portion of region s's trade in commodity i with region r that is imported from region r, processed and re-exported (as a final consumer good, capital good or as intermediate);

$M_{"\text{int}",i,r,s}$ are imports of intermediate goods from region r, used in the production of commodity i in region s; and

$C_{i,s}$ are the total costs of producing commodity i in region s.

$\frac{X_{i,s}}{C_{i,s}}$ is therefore the share of output that is exported, making $\frac{X_{i,s}}{C_{i,s}} . M_{"\text{int}",i,r,s}$, the value of imports from region r that are processed and re-exported, back to region r or on to another country.[15]

If a country (s) imports a large share of intermediates from region r as a share of their total production costs, which it then exports – vertical specialization is high. This value is calculated relative to total trade (exports plus imports) of the commodity to provide the portion of trade that relates to vertical specialization.[16]

Table 7 provides the results for the Hummels et al.'s (1998) vertical specialization measure before and after the reversal of NAFTA assuming the US is the exporter of intermediates and Mexico processes and exports the final commodity. In the case of motor vehicles, the initial level of vertical specialization is 21.1 percent, meaning that 21.1 percent of Mexico's trade were imported intermediates from the US that were processed and exported. All the values in this table are considerably higher than the level of vertical specialization between other countries

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15 Note that this is slightly different from the analysis undertaken in the agent RCA index, in that case we were looking at exports back to the US.

16 This also explains why the numerator is multiplied by two, since these trade flows are both imports and exports.

and in the other direction. Table 7 shows that the US's reversal of NAFTA reduces the extent of vertical specialization between the US and Mexico in all commodities by between 59 percent (wearing apparel) and 14 percent (chemicals).

Table 7: Vertical specialization between US (producer of intermediates) and Mexico (producer of final goods) (percent)

	Initial	After reversal of NAFTA
Crops and Forestry	4.2	3.5
Livestock and Fishing	11.6	9.6
Sugar	6.1	3.8
Extraction	8.3	6.9
Meat Products	4.1	1.9
Food	8.6	6.7
Textiles	11.5	7.1
Wearing App and Leather	14.6	6.0
Chemicals	7.9	6.8
Metals	8.6	7.2
Electronic Equipment	11.4	9.8
Machinery	14.0	11.7
Motor Vehicles	21.1	17.3
Other Manufactures	10.0	8.3

Direction of the vertical specialization is that US produces the intermediates, while Mexico process and export the final commodity.

Source: Authors' calculations using IESC Database (Walmsley and Minor, 2016a).

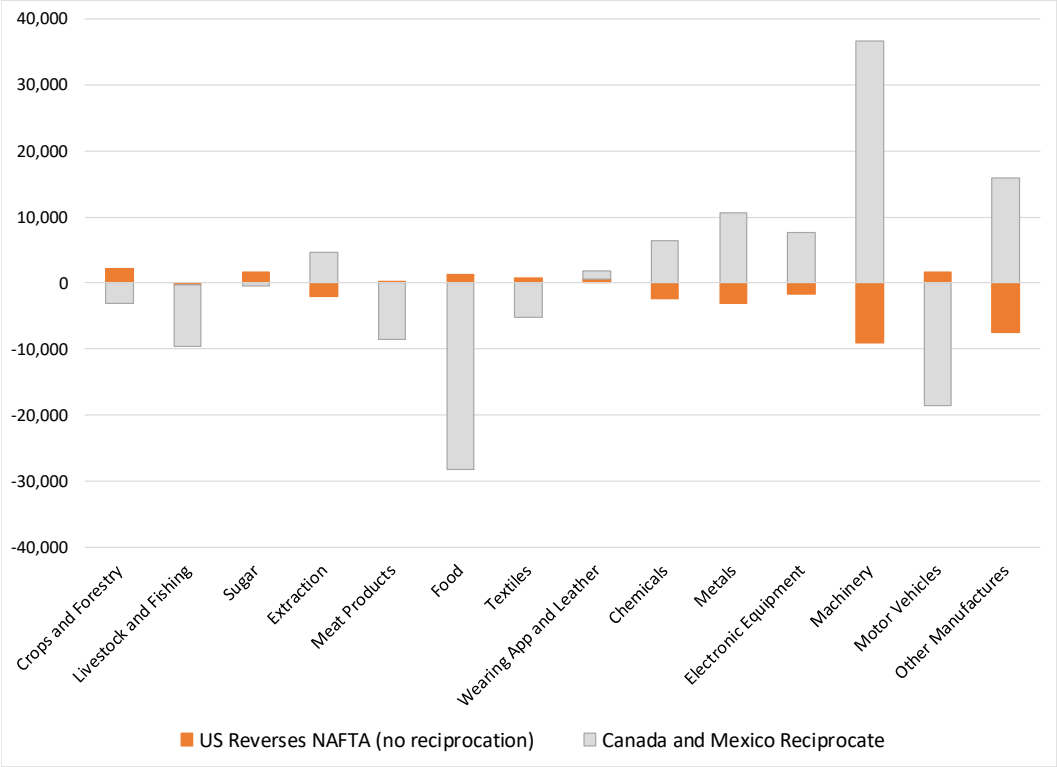
3.3 Employment impacts

Changes in the distribution of employment across sectors decomposed into the two parts, US raising tariffs on NAFTA partners and Canada and Mexico reciprocate, are provided in Figure 5. The impact of the US raising tariffs is a decline in employment in heavy manufacturing, extraction and services. In those sectors where employment declines 80,000 jobs are lost and 12,000 new jobs are created in the crops, sugar, food, textiles, wearing apparel and motor vehicles (primarily cranes, semi-trailers and tractors) sectors. Hence there is a movement of 12,000 workers from heavy manufacturing and services into crops, sugar, food, textiles, wearing apparel and motor vehicles (primarily cranes, semi-trailers and tractors). Based on data on the wages paid by sectors, these 12,000 displaced workers are moving from sectors with high wages (heavy manufactures and services) to sectors with lower wages (crops, sugar, food, textiles, wearing apparel), thereby reducing their average wage. The remaining 68,000 people become unemployed.

When Canada and Mexico reciprocate, US heavy manufacturing (chemicals, metals, electronic equipment, machinery and other manufactures) employment is expected to rise (with production), more than offsetting the fall in employment in heavy manufacturing due to the US raising tariffs. 95,000 new positions are created in those heavy manufacturing and extraction

sectors where employment rises. Overall, however, the expansion in jobs is not sufficient to offset the loss of 270,000 jobs in services, crops and livestock, meat, food and textiles. Employment falls by another 188,000 people, leading to a total loss in employment of 256,000 jobs from the US's reversal of NAFTA and Canada and Mexico's reciprocation. For those 95,000 able to find employment other sectors, the average wage rises as the heavy manufacturing sectors generally pay higher wages than the services and agricultural sectors, where they were originally employed.

Figure 5: Impact on employment of US reversing NAFTA (number of workers)



The impact on employment in services from US reversal of NAFTA and Canada and Mexico's reciprocation are not included, due to their larger size. Employment in services fall by 45,000 and 241,000, respectively.

Net impact of US's reversal of NAFTA with reciprocation is the sum of the two parts.

Source: Authors' calculations.

In terms of the composition of the 68,000 people that become unemployed from the US raising its tariffs on its NAFTA partners, 31,000 are low skilled workers. Service and sales workers, and clerks experience decreases in employment of 21,000 and 15,000 people respectively. The high proportion of low skilled workers reflects the fact that these workers account for more than 50 percent of workers in the manufacturing sectors. The composition of the 256,000 unemployed from the US's reversal of NAFTA with reciprocation, includes 89,000 low skilled workers, 97,000 service and sales workers and 70,000 clerks. The rise in importance of sales and service workers in the unemployment figures when Canada and Mexico reciprocates (compared to the US raising tariffs (no reciprocation) case), reflects their relatively high level of employment in the contracting services sector.

While skilled workers are generally considered to be more mobile and resilient to trade shocks, we also consider the possibility that skilled workers may also become unemployed with the reversal of NAFTA. Figure 6 illustrates that if the wages of both skilled and unskilled workers do not fall in response to the reversal of NAFTA then real GDP declines considerably and the change in unemployment rises by a factor of almost 5 from 255K to 1.2 million in the US. The potential loss of skilled jobs in the US economy from the reversal of NAFTA is substantial, reflecting the specialization of production across NAFTA that has led the US to produce skill-intensive products, while Mexico produces low skill-intensive products. The additional loss of skilled jobs, namely of managers and other professionals, also raises unemployment of low skilled workers, particularly other low skilled workers. As in the original unemployment of unskilled workers only (closure), the loss of US jobs is greatest in the services sectors. Even if these skilled workers are more resilient and do not become unemployed, their real wages will decline because of the reversal of NAFTA.

Canada also experiences a substantial decrease in employment and real GDP when the possibility of unemployment of skilled workers is taken into account (Figure 6), while Mexico's unemployment rises by a relatively smaller amount due to the greater importance of low skilled workers in production and NAFTA trade.

Figure 6: Impact on employment of US reversing NAFTA (number of workers) under alternative unemployment assumptions

		Unskilled unemployment only	Skilled and unskilled unemployment
US	Real GDP	-0.08	-0.64
	Employment	-255,678	-1,245,324
Canada	Real GDP	-0.48	-1.81
	Employment	-125,078	-462,967
Mexico	Real GDP	-0.87	-1.48
	Employment	-951,002	-1,228,830

Source: Authors' calculations.

4 Conclusions

The results show that the reversal of NAFTA leads to a decline in real GDP, trade, investment and employment in the US, Canada and Mexico, with most of the losses arising from Canada and Mexico's reciprocation, required under the WTO. To say this another way, the US, Canada and Mexico have more to lose from Canada and Mexico reciprocating than from the US raising its own tariffs. 256,000 low skilled workers in the US become unemployed due to the reversal of NAFTA, with 95,000 workers having to relocate to other sectors and possibly other locations within the US to find employment. If we allow for the possibility of unemployment of skilled

workers, then employment falls by over 1.2 million, mostly skilled workers. Canadian and Mexican employment of low skilled workers also decline by 125,000 and 951,000 respectively. US trade with Canada and Mexico declines significantly, although trade between Canada and Mexico, and with the rest of the world, rises. Overall all three NAFTA countries experience a decline in trade, with imports by final consumer in the US and Mexico experiencing the largest decline.

In terms of sectoral production, US agriculture, food processing, motor vehicle and services decline, while there are small increases in production of other manufactures. Production in Canada and Mexico falls most in those sectors where there is a high level of integration with US production and trade – textiles, wearing apparel and machinery in Mexico; chemicals and metals in Canada; and motor vehicles in both Canada and Mexico. While the results show that the US does obtain some small gains in manufacturing production and employment in the chemicals, metals, electronic equipment and machinery sectors, the losses in their motor vehicles, textiles, meat, food and services sectors far exceed these small gains leading to less jobs for Americans overall. Mexicans and Canadian. The overall fall in production and rise in costs is also accompanied by a decline in vertical specialization across NAFTA in all commodities.

The IESC database and model's ability to differentiate tariffs between intermediate, consumption and investment goods improved analysis of the mechanisms through which the tariffs acted, as well as the supply chain interactions (changes in demand by agent). The motor vehicles and wearing apparel supply chains were examined in detail to provide a clearer picture of the likely outcomes of reversing NAFTA on production. The analysis found that there is some potential for growth in production of cranes, semi-trailers and tractors (motor vehicles purchased for investment), as domestic production replaces Mexican imports of these goods when the US raises tariffs, however, this outcome is reversed if Canada and Mexico reciprocate. Overall, motor vehicle production (passenger cars, auto parts and cranes, semi-trailers and tractors) fall throughout NAFTA as the benefits of vertical specialization are reversed.

Considering the data, the potential loss of 256,000 low-skill jobs in the US suggests that the US's withdrawal from NAFTA will not achieve the stated policy goal of increasing employment in the US. With Canada and Mexico's reciprocation causing most of the fall in employment, reciprocation is clearly not the preferred option for Canada and Mexico, although given the WTO rules this may be unavoidable.

Bibliography

Harrison, W. J. and K. R. Pearson (2007). GEMPACK User Documentation Release 8.0. Melbourne, Australia, Centre of Policy Studies and Impact Project, Monash University.

Hertel, T. and M. Tsigas (1997). Structure of GTAP. Global Trade Analysis Modeling and Applications. T. Hertel, Cambridge University Press**:** 13-73.

Hummels, D. L., Rapport, D. and Yi, K. M. (1998), "Vertical Specialization and the Changing Nature of World Trade", *Economic Policy Review*, *Federal Reserve Bank of New York*, Iss. June, pp. 79–99.

International Trade Center (2006). User Guide - Market Access Map: Making Tariffs and Market Access Barriers Transparent. Geneva, Market Analysis Section, Division of Product and Market Development, International Trade Center.

Narayanan, G. B., et al. (2015). Global Trade, Assistance, and Production: The GTAP 9 Data Base. West Lafayette, Indiana, Center for Global Trade Analysis, Purdue University.

The New York Times**,** January 24, 2017, "Mexico's Potential Weapons if Trump Declares War on NAFTA", https://www.nytimes.com/2017/01/24/business/economy/nafta-mexico-free-trade.html?_r=0

Villareal, M. A. & Fergusson, I. F. (2013). NAFTA at 20: Overview and trade effects. Washington, DC: Congressional Research Service

Walmsley T. L., and P. Minor, (2016a). "ImpactECON Global Supply Chain Database: Documentation of data sources and the construction process of IE-SC_v2.0", Data and Model documentation—002 REV-2, ImpactECON: Boulder, CO, USA

Walmsley T. L., and P. Minor, (2016b). "ImpactECON Global Supply Chain Model: Documentation of Model Changes", ImpactECON Working Paper No. 06, ImpactECON: Boulder, CO, USA

Walmsley T. L., and P. Minor, (forthcoming). "Do Supply Chains Matter? Illustrative results for the reversal of NAFTA", ImpactECON: Boulder, CO, USA

Appendix I Aggregation

Table A1- 1: Sectoral aggregation

Aggregated sector	Mapping to GTAP sectors
Crops and Forestry	Paddy rice; wheat; cereal grains not elsewhere classified (nec); oil seeds; sugar cane; vegetables, fruit and nuts; plant-based fibers; crops nec; Forestry
Livestock and Fishing	Bovine cattle and sheep; other animal products nec; raw milk; wool, silk-worm cocoons; fishing
Sugar	Sugar
Extraction	Coal; oil; gas; and minerals nec; petroleum and coal products; and mineral products nec
Meat Products	Bovine cattle and sheep products; and other meat products
Food	Vegetable oils and fats; dairy products; sugar; food products nec; and beverages and tobacco products; processed rice
Textiles	Textiles
Wearing Apparel and Leather	Wearing apparel and leather products
Chemicals	Chemical, rubber & plastic
Metals	Ferrous metals; metals nec; and metal products
Electronic Equipment	Electronic equipment
Machinery	Machinery and equipment
Motor Vehicles	Motor vehicles and parts
Other Manufactures	Lumber and wood products; transport equipment nec; paper products and publishing; and manufactures nec
Services	Construction; insurance; finance; and other business services; electricity; gas manufacture and distribution; water; recreational and other services; and ownership of dwellings; transport nec; water transport; and air transport; trade; and communications; public administration and defense

Source: Authors' aggregation of the GTAP Data Base

Table A1- 2: Regional aggregation

Aggregated regions	Mapping to GTAP Regions	Allocation to World Bank categories
USA	USA	High income economies
Canada	Canada	High income economies
Mexico	Mexico	Upper-middle incomes economies
China	China	Upper-middle incomes economies
Europe	Europe: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Switzerland, Norway, Rest of EFTA	High income economies
Rest High Income Economies	Australia, New Zealand, Hong Kong, Japan, Korea, Taiwan, Singapore, Chile, Russia, Rest of North America, Uruguay, Croatia, Rest of Europe, Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Rest of the World	High income economies
Rest upper-middle incomes economies	Malaysia, Thailand, Peru, Argentina, Brazil, Colombia, Ecuador, Venezuela, Costa Rica, Panama, Rest of Central America, Caribbean, Albania, Bulgaria, Belarus, Romania, Kazakhstan, Azerbaijan, Iran Islamic Republic of, Turkey, Tunisia, Rest of North Africa, Mauritius, Botswana, Namibia, South Africa	Upper-middle incomes economies
Rest low-middle income economies	Vietnam, Indonesia, Philippines, India, Rest of Oceania, Mongolia, Pakistan, Sri Lanka, Bolivia, Paraguay, Rest of South America, Guatemala, Honduras, Nicaragua, El Salvador, Ukraine, Rest of Eastern Europe, Kyrgyzstan, Rest of Former Soviet Union, Armenia, Georgia, Rest of Western Asia, Egypt, Morocco, Cameroon, Cote d'Ivoire, Ghana, Nigeria, Senegal, Zambia, Rest of Eastern Africa, Rest of South African Customs	Low-middle income economies
Rest lower income economies	Cambodia, Lao People's Democratic Republic, Rest of Southeast Asia, Rest of East Asia, Bangladesh, Nepal, Rest of South Asia, Benin, Burkina Faso, Guinea, Togo, Rest of Western Africa, Central Africa, South Central Africa, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zimbabwe	Lower income economies

Source: Authors' aggregation of the GTAP Data Base