REPORT

Estimated Impacts of US Sections 232 and 301 Trade Actions on the US and Global Economies: A Supply Chain Prospective 2018-2030

Impacts of US Section 232 (Steel, Aluminum, and Automobiles) and Section 301 (China) Trade Actions on GDP, Households, Employment, Trade, Production, and Supply Chains

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Estimated Impacts of US Sections 232 and 301 Trade Actions on the US and Global Economies: A Supply Chain Prospective 2018-2030

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Acronyms

CGE	Computable general equilibrium model
CIF (c.i.f.)	Cost, insurance, and freight
DOC	US Department of Commerce
EU	European Union
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GTAP	Global Trade Analysis Project
HS	Harmonized System (tariffs)
IIASA	International Institute for Applied Systems Analysis
IMF	International Monetary Fund
ITC	International Trade Centre (UN)
NAFTA	North American Free Trade Area
OECD	Organization of Economic Cooperation and Development
TPP	Trans-pacific partnership
UN	United Nations
US	United States / American
USMCA	United States-Mexico-Canada Agreement
USTR	United States Trade Representative
WTO	World Trade Organization

1 Executive Summary

In 2018, the United States (US) Administration initiated several trade actions, including aluminum and steel tariffs under Section 232 of the Trade Expansion Act of 1962 and tariffs on China based on Section 301 of the Trade Act of 1974. The Section 232 actions impact all US trade partners with a few exceptions and are based on national security. The Section 301 action addresses China's unfair trade practices as outlined in a US Trade Representative's (USTR) report (USTR, March 2018). The US Department of Commerce (DOC) has initiated a Section 232 investigation into US imports of automobiles and parts threatening a new round of US tariffs on these products. In response, many US trading partners filed requests for consultations with the World Trade Organization (WTO) and have implemented or have threatened to increase tariffs on US products. In this report, the implications of current and proposed US trade actions and current and potential responses of US trading partners on the US and global economy are estimated.

We employ a dynamic version of the widely used Global Trade Analysis Project (GTAP) database and model.[1] Together, current, proposed, and potential trade actions by the US and its trading partners could impact over $1.0 trillion in US imports and exports. Our analysis finds that if all trade actions are implemented, the cumulative impacts on the US would include:

Macroeconomic

- Gross domestic product (GDP) would be reduced by a projected -1.78 percent in 2019 (or $365.1 billion in 2017 dollars) with a long run reduction of -1.25 percent in 2030 (or $331.8 billion in 2017 dollars) (see Figure 1-1).
- GDP losses are projected to cumulate to $2.8 trillion between 2018 to 2030.[2]
- All countries, except the US and China, gain from US trade actions and responses and increase GDP.

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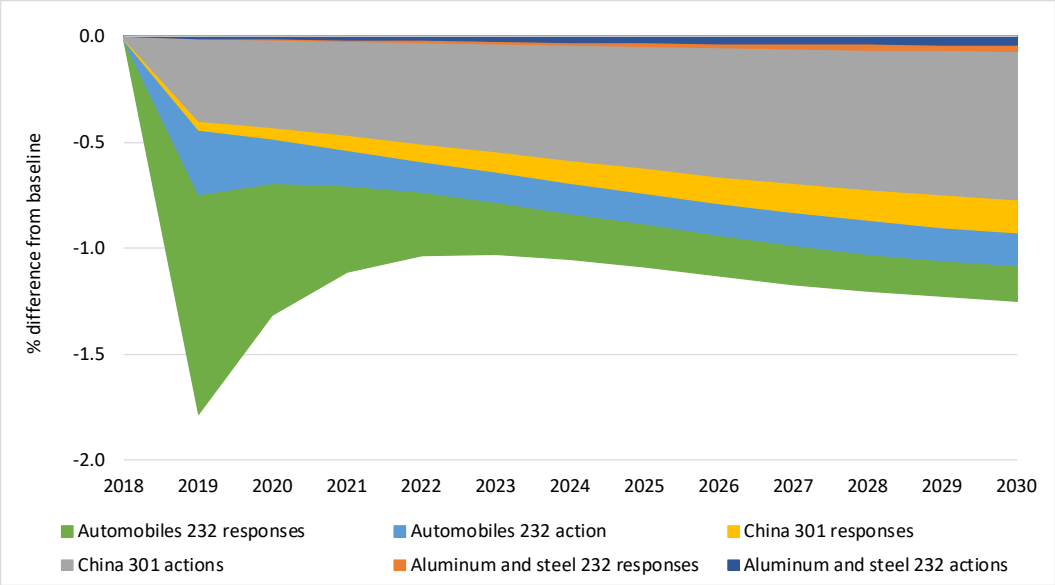
1 The GTAP model and database is employed by the US government and numerous countries to estimate the impacts of trade policies. Most recently the US government employed it in its steel Section 232 report (US DOC 2018a)

2 Discounted to 2017 using a real interest in US of 2.5 percent, based on average of last 10 years (International Monetary Fund (IMF), 2018a).

Figure 1-1: Impact of US trade actions and partners' responses on US real GDP 2018-2030 (percentage differences from baseline)



Source: Authors' calculations.

Households

- In 2019, households suffer losses equivalent to $2,357 per household (or $915 per person) in 2017 dollars.
- When these household losses are cumulated over the period 2018 to 2030 and discounted to 2017 values, each household will have lost the equivalent of $17,276 in spending power, due to lower wages, higher prices, and lower investment returns.

Employment

- High economic growth in the US will initially protect workers from unemployment, however as more trade actions are initiated, and partners respond, increased unemployment could ensue.
- In 2019, we find that 2.75 million workers are likely to become unemployed if all trade actions are implemented concurrently. With the implementation of each additional trade action, underlying wage growth in the economy is diminished, increasing the probability that workers will become unemployed. With such large negative impacts from the combined trade actions, it will be difficult for the US to maintain wage growth and full employment.
- A high proportion of these job losses affect agricultural and low-skilled workers (e.g., workers in manufacturing where activity will slow due to higher costs for intermediate inputs into the supply chain caused by US trade actions and its partners' responses).
- In addition to those unemployed, we also project a further 665,000 workers will be displaced in 2019 but will find employment in new industries. By 2030, 1.07 million workers will be employed in a different sector as a result of the trade actions.

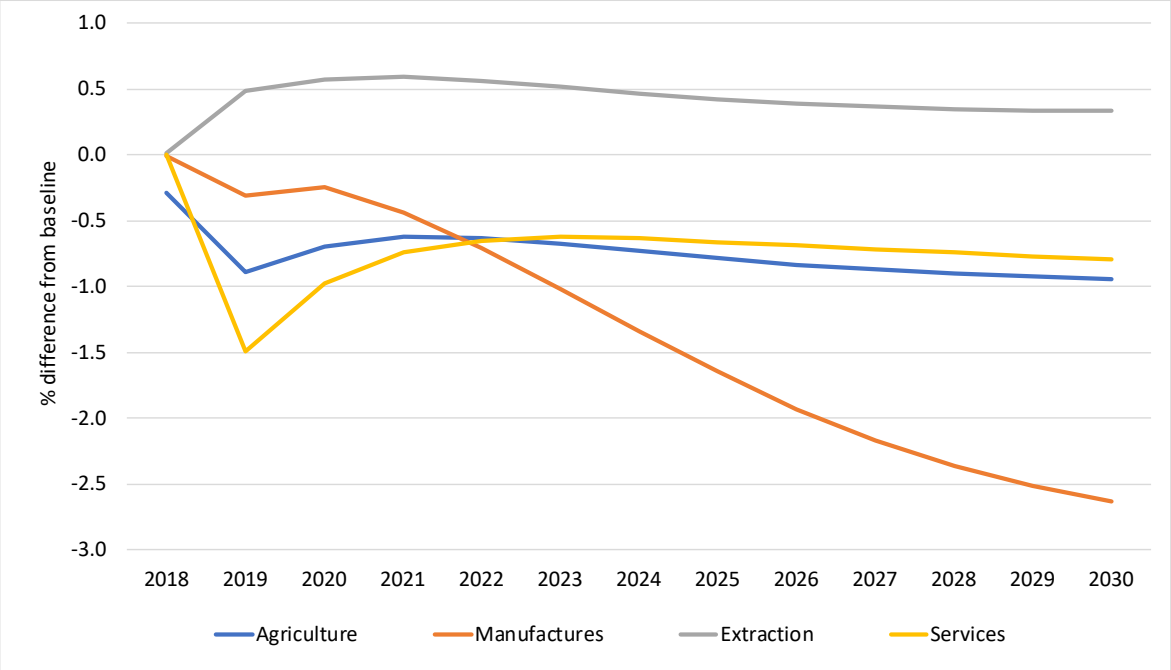
Trade

- US exports to non-NAFTA countries fall as the price of US goods rises and trading partners' raise their tariffs in response to the US actions. The rise in the price of US goods stems from the importance of imported intermediate inputs, which become more expensive when tariffs are increased, in the US supply chain, particularly manufactured goods.
- Even with Canada and Mexico exempted from the potential automobile Section 232 tariffs, the potential trade action threatens an additional $177 billion in US imports and $155 billion in US exports, more than three times the trade impacted by the aluminum and steel Section 232 tariffs.

Production

- The immediate impact of the trade actions is a decrease in US production of agriculture, manufactures, and services in 2019.
- By 2030, production of the agricultural and services sectors has declined approximately one percent from baseline; while manufacturing production has declined by 2.5 percent from baseline (see Figure 1-2).
- Agricultural sectors leading the decline include: oil seeds (soybeans), meats (pork and beef), and coarse grains (corn, oats, sorghum).
- Manufactures leading the decline include transport equipment (other than automobiles); chemicals, rubber, plastics, and pharmaceuticals; textiles; and non-ferrous metals (aluminum).
- The extraction sector expands based on strong growth in US lumber and forestry product sectors.

Figure 1-2: Change in production by broad economic sectors, 2019-2030, all actions (percent change)



Source: Authors' calculations.

2 US Trade Actions and Responses

On March 8, 2018, the US Executive Office issued two Presidential Proclamations citing Section 232 of the Trade Expansion Act of 1962 in the application of tariffs on aluminum and steel products in the interest of national security.[3] Applied tariffs ranged from 10 to 25 percent on aluminum and steel products, respectively. Tariffs took effect on March 23, 2018. Temporary exemptions were granted to several countries including North American Free Trade Area (NAFTA) members, the European Union (EU), Australia, Japan, South Korea, Brazil, and Argentina. Exemptions for NAFTA members, the EU, and Japan expired in June of 2018 while South Korea, Brazil, Australia, and Argentina were granted long-term exemptions.[4] Many of the largest suppliers of these products to the US have announced, and put into force, retaliatory tariffs on a range of US exports including whisky, motor boats, motorcycles, and aluminum and steel products.[5]

On March 22, 2018, USTR released a report identifying Chinese unfair trade practices that restrict US commerce.[6] On June 15, 2018, USTR announced tariffs of 25 percent on approximately $50 billion in US imports from China in response to alleged unfair trade practices related to US technology and intellectual property.[7] On July 10, 2018, USTR announced a process for applying additional duties of 10 percent on a list of $200 billion in imports from China (for a total of approximately $250 billion in US imports from China).[8] The US government then announced its intention to raise the tariff rate from the announced rate of

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3 Federal Register, Vol. 83, No. 51 March 15, 2018 Proclamation 9704 and 9705.

4 South Korea, Brazil and Argentina agreed to quotas which effectively reduced and fixed US imports of steel from these sources.

5 US trade partners have notified the World Trade Organization (WTO) of their intention to apply retaliatory tariffs, as permitted by General Agreement on Tariffs and Trade (GATT) Article 19, but under the assumption the US trade actions are based on safeguards in contrast to national security grounds. Furthermore, GATT Article 19 limits retaliation to "equivalent" actions and further prohibits retaliation for the first three years if there is clear evidence of rising import volumes. A legal analysis of the WTO agreements is beyond the scope of this research—we assume all announced retaliation tariffs will remain in place, as intended by the parties, regardless of legal remedies.

6 https://ustr.gov/sites/default/files/Section%20301%20FINAL.PDF.

7 https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/june/ustr-issues-tariffs-chinese-products.

8 https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/july/statement-us-trade-representative

10 percent to 25 percent on the proposed list of $200 billion in imports from China.[9] The Government of China has initially applied retaliatory tariffs on approximately $50 billion in US imports; products have ranged from soybeans, to motor vehicles, parts, and cranes in response to the US's initial lists.[10] With the application of US tariffs on the additional $200 billion in Chinese imports with an initial tariff level of 10 percent, the Chinese government announced the imposition of tariffs on an additional $60 billion in imports from the US and restated its intention to increase their response if the US further raises duties or expands the product lists.[11] On September 7, 2018, President Trump announced that his administration had drawn up a list of additional tariffs on US imports from China of $267 billion which would be applied if the Chinese government does not cease its practices as outlined in the Section 301 report (USTR, March 2018) or if it continues to retaliate against US trade actions.[12] Since President Trump's September announcement and the application of tariffs on $200 billion in US imports from China, the US government has indicated it is willing to keep increasing tariffs until China changes its approach to trade with the US.

While the US and its trading partners have been coming to terms with existing Section 232 aluminum and steel tariffs and Section 301 tariffs on China (including the threat of future tariffs), the US Department of Commerce initiated a third Section 232 action on automobiles and auto parts on May 23, 2018.[13] The administration has not concluded its automobile investigation; however, the administration has cited the potential application of tariffs on major trading partners including the EU and has encouraged them to come to an agreement limiting US imports of automobiles and parts before tariffs are applied. With the conclusion of the US-Mexico-Canada (USMCA) Agreement negotiations, USTR announced proposed exemptions for Canada and Mexico regarding any future Section 232 tariffs on automobiles.[14] Even with Canada and Mexico exempted from the potential Section 232 tariffs on automobiles and parts, the potential trade action threatens an additional $177 billion in US imports and $155 billion in US exports, more than three times the trade impacted by the Section 232 aluminum and steel tariffs (Table 1).

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9 https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/august/statement-us-trade-representative

10 Total amount varies depending on if US exports or Chinese imports are used for reporting purposes. In this report, official Chinese imports at the Harmonized System (HS) 8-digit level are employed since Chinese product lists are reported at the HS 8 level and do not correspond to the US export schedules.

11 The US has chosen to phase in its 25 percent tariffs on $200 billion in imports from China. Rates start at 10 percent in September 2018 and increase to 25 percent in January 2019.

12 https://www.wsj.com/articles/trump-says-hes-preparing-tariffs-on-further-267-billion-in-chinese-imports-1536340041.

13 https://www.commerce.gov/news/press-releases/2018/05/us-department-commerce-initiates-section-232-investigation-auto-imports.

14 https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement/united-states-mexico. At the same time the US provided side letters for US imports of autos from Mexico and Canada it announced any exemption from aluminum and steel tariffs would be handled under a separate process.

Table 1: Summary of trade actions trade values and tariffs (2017 imports US$ millions and percent)

Actions	US actions (Imports)		Partners' response (Exports)	
	Value	Tariffs	Value	Tariffs
Aluminum and steel 232	46,342.2 (b)	17%	28,969.2	17%
Aluminum	17,266.8	10%	(a)	(a)
Steel	29,075.5	21%	(a)	(a)
China 301 (applied and prospective actions)	497,786.9	25%	149,660.8	21%
Automobile 232 (estimated)	177,177.2	25%	155,823.0	25%
Total	721,306.3 (c)	24%	334,453.0	22%

Source: Authors' calculations. US trade and tariffs as reported in Table 2, Table 5, and Table 7. Reciprocal trade and tariffs from Table 4, Table 6, and Table 9.

(a) Reciprocal trade responses were often not divided between aluminum and steel.

(b) Includes approximately $ 4 billion in imports from Argentina and Korea which do not have tariffs applied but are subject to quotas. Excludes Australia, which is exempt from both tariffs and quotas (Table 3).

(c) Approximately $16 billion in US imports from China have tariffs applied with multiple actions and are included in total.

Collectively, these trade actions have constituted the most prominent features of US trade policy and have impacted or threaten to impact over $1 trillion in US exports and imports with tariffs averaging over 20 percent (Table 1). It is important to use a robust quantitative approach when analyzing trade policy, since raising tariffs for one sector may provide benefits to selected industries or sectors, but could increase costs to US consumers and upstream industries. These costs could exceed industry or sector benefits when comparison is made to national employment, production, and real income: few sectors of the US economy work independently from one another. Moreover, US industry, agriculture and services are integrated into global supply chains, relationships developed over 50 years, which are threatened with ongoing disruptions and the increasing tariff costs of US goods. Any reduction in the integration of US producers from global supply chains threatens the competitiveness of US goods and services since they become less competitive at home and in global markets. Finally, retaliatory tariffs reduce demand for US exports, be they part of global supply chains or wholly produced in the US as is the case with soybeans, meat, and dairy products.

To measure the potential economy-wide impacts of current US trade actions, a global model of trade and production is required to capture the linkages between sectors and countries to estimate "net" impacts of these new tariffs (and quotas).[15] This report uses a computable general equilibrium (CGE) model of global production, supply chains, trade, and

[15] This report does not include current or potential subsidies which could be distributed to consumers or producers to mitigate impacts. Like tariffs and quotas, subsidies should be considered in a comprehensive framework, as in this paper, which include their impacts on prices, income, production, trade and trade balances.

macroeconomic accounts to estimate the net impacts of US tariffs and reciprocal trade actions on the US and global economy.[16] The model includes supply chain linkages to capture the impact of increasing costs of intermediate goods, such as steel and aluminum, on using industries, such as automotive production and machine parts, among others.

The remaining sections of Chapter 2 outline in greater detail the products, tariffs, and trade summarized in Table 1. US aluminum and steel tariffs have been in place for several months and are well defined. China Section 301 actions are a mix of existing tariffs (well defined) and potentially new tariffs (estimated). US action on automobiles and parts could occur after the US DOC completes its investigation, but we have included estimates of this prospective action, including product scope. Readers interested in the impacts of US trade actions can skip to Chapter 3, where key features of the model are reviewed and the economic impacts including real GDP, production, trade, and employment are estimated. Appendices contain greater detail on partner response tariffs, impacts by action and partner response, and estimates of impacts with alternative assumptions on projected GDP growth.

2.1 Section 232 Actions

In two reports, issued by the US DOC, it was concluded that imports of steel and aluminum products are "weakening our internal economy" and "threaten to impair national security as defined by Section 232."[17] [18] The US DOC recommended tariffs and quotas be put in place to allow the US steel and aluminum industries to operate at an 80 percent or better capacity utilization rate (including any exceptions granted) based on available capacity in 2017.[19] The US has chosen a combination of tariffs and quotas to achieve this ends. In its reports, the US DOC provides detailed "lists" of products, which are replicated in the US Presidential Proclamations implementing the tariffs. Sub-sections 2.1.1 through 2.1.3 summarize the aluminum and steel products affected and the level of protection applied in our analysis (including reciprocal tariffs).

On May 23, 2018, the US DOC announced the initiation of Section 232 investigation into automobile imports (including parts) and their potential to impair research into automobiles and parts.[20] The conclusion of the automobile investigation was scheduled for August 2018, but has been extended by the DOC. The President has repeatedly threatened tariffs of between

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16 A summary of the model and its assumptions are contained in Appendix II.

17 "The Effect of Imports of Aluminum on the National Security: An Investigation Conducted Under Section 232 of the Trade Expansion Act of 1962, as Amended" US Department of Commerce, January 17, 2018.

18 "The Effect of Imports of Steel on the National Security: An Investigation Conducted Under Section 232 of the Trade Expansion Act of 1962, As Amended" US Department of Commerce, January 11, 2018.

19 Page 8 of the US DOC Steel Report references the GTAP Model when calculating tariff rates of 24 percent on US imports of steel to obtain the requisite reduction in steel imports to achieve 80 percent capacity utilization rates in the steel sector. The White House ultimately announced a 25 percent tariff on steel.

20 https://www.commerce.gov/news/press-releases/2018/05/us-department-commerce-initiates-section-232-investigation-auto-imports

20 and 25 percent.[21] Sub-section 2.1.4 of this report (following) provides estimates of US imports of automobiles and parts based on a DOC questionnaire and government working documents. Sub-section 2.1.5 also provides estimates of reciprocal trade actions by the largest US trading partners.

2.1.1 ALUMINUM AND STEEL ACTIONS

Table 2 includes the top exporters of aluminum and steel to the US in 2017 and includes the tariff rates applied to each product and the calculated revenue collected by the US government (tariff x import value).[22] Calculated tariff revenue from Section 232 aluminum and steel actions exceeds $7.9 billion annually on $46.8 billion in imports of these products. Canada and the EU are the leading sources of aluminum and steel, making up forty-two percent of US imports. Several countries, including Argentina, Brazil, and South Korea, have agreed to limit their exports of these products to the US under a system of quotas, and are therefore exempt from US tariffs (see Table 3 for an overview aluminum and steel quotas). Australia has been exempted from both tariffs and quotas.

Aluminum and steel are imported almost exclusively as intermediate goods in the US supply chain, to be processed and converted into goods for investment and consumption. Major industries using aluminum and steel include automobiles, heavy machinery, aviation, and construction, in addition to scores of smaller industries such as canning, parts, and machine tools. This underscores the importance of the aluminum and steel sectors to supply chains, since for downstream industries to be competitive, it is important they have access to competitively priced materials and parts. In the case of aluminum and steel using sectors, much of the $7.9 billion in calculated tariff costs will be passed along to businesses and ultimately, final consumers in the US or abroad (exports).

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21 https://www.wsj.com/articles/trump-administration-weighs-new-tariffs-on-imported-vehicles-1527106235.

22 Calculated revenue will differ from actual revenue, since when tariffs are applied, trade will likely decline. US trade partners use calculated revenues when determining reciprocal tariffs (retaliation).

Table 2: US aluminum and steel 232 actions, imports, tariffs, and revenue (2017 imports US$ millions and percent)

Country	Aluminum 232 (US$ millions and percent)			Steel 232 (US$ millions and percent)			Total estimated revenue (US$ million 2017)
	US imports 2017	Tariff rate	Tariff revenue	US imports 2017	Tariff rate	Tariff revenue	
Argentina	548	(a)	(a)	225	(a)	(a)	--
Australia	216	Exempt	Exempt	210	Exempt	Exempt	Exempt
Brazil	140	10.0%	14	2,443	(a)	(a)	14
Canada	7,013	10.0%	701	5,194	25.0%	1,299	2,000
China	1,708	10.0%	171	991	25.0%	248	419
EU	1,252	10.0%	125	6,245	25.0%	1,561	1,686
India	397	10.0%	40	760	25.0%	190	230
Japan	174	10.0%	17	1,658	25.0%	415	432
Korea	125	10.0%	13	2,799	(a)	(a)	13
Mexico	463	10.0%	46	2,501	25.0%	625	672
Russia	1,598	10.0%	160	1,413	25.0%	353	513
Taiwan	115	10.0%	12	1,265	25.0%	316	328
Turkey (b)	51	20.0%	10	1,192	50.0%	596	606
UAE	1,373	10.0%	137	217	25.0%	54	192
Others	2,307	10.0%	231	2,171	25.0%	543	774
Total	17,483	9.6%	1,677	29,286	21.2%	6,200	7,877

Source: Authors' calculations. US Department of Commerce, Bureau of the Census, Imports of Merchandise Trade 2017. Products included in Presidential Proclamations 9704 and 9705.

(a) Granted exemption to 232 tariffs, quota applies.

(b) Effective August 13, 2018, US 232 tariffs on steel will be double on Turkey, increasing from 25 to 50 percent. An increase in aluminum tariffs by double was also announced, but it is unclear when it will be implemented https://www.cbp.gov/trade/programs-administration/entry-summary/232-tariffs-aluminum-and-steel.

2.1.2 ALUMINUM AND STEEL QUOTAS

South Korea (third largest supplier of steel), Brazil (fifth largest supplier of steel) and Argentina have agreed to limit their exports of steel to the US under a quota system.[23] The quota system is based on the prior export history for each country as measured in over fifty categories. Table 3 summarizes the average reduction in US imports of aluminum and steel from each of these sources under the quota system. On average, imports from these sources will be reduced by between 13 and 46 percent in volume terms. Reductions of these amounts will likely result in restricted supply conditions and higher prices in the US market. Revenue derived from these restricted supply conditions (higher prices) in the US will likely return to the suppliers (exporters), in contrast to tariff revenues, which are collected by the US government.

[23] Quota limits can be found at: https://www.cbp.gov/trade/quota/bulletins#.

Table 3: Summary of US aluminum and steel quotas (kilograms and percent)

Country	KG (2017 US Imports)		Fill rate
	Limit total	2017 imports	
ALUMINUM 232			
Argentina	180,938,568	264,173,838	146%
STEEL 232			
Korea	2,630,724,171	3,433,494,517	131%
Brazil	4,141,387,494	4,680,616,113	113%
Argentina	169,851,392	213,490,162	126%

Source: Authors' calculations. US Department of Commerce, Bureau of the Census, Imports of Merchandise trade. Quota limits are an aggregation of individual categories posted by US Customs and Border Protection (CBP).

An important question remaining on the aluminum and steel quotas is if they will be subject to growth rates to allow for increases in US consumption. The administration has not indicated any such growth rate; therefore, these quotas will become more restrictive in relative terms as the US economy grows.

2.1.3 ALUMINUM AND STEEL RESPONSES

US trade partners have taken steps to retaliate in response to aluminum and steel Section 232 actions. The major suppliers except for Taiwan and the exempt countries, who have agreed to quotas, have filed requests for consultations with the WTO (see Appendix I). Most have characterized the Section 232 actions as "safeguards" and therefore, under General Agreement on Tariffs and Trade (GATT) Article XIX have taken steps to put in place roughly equivalent tariffs on US goods entering their markets. The definition of "equivalent" response taken by most WTO members has been to apply tariffs on imports from the US roughly equal to the calculated tariff revenues estimated in Table 2.[24] Table 4 summarizes reciprocal tariffs applied to US trade partners' US imports (i.e., US exports to them). The reciprocal tariff revenues in Table 4 ($5.5 billion) are approximately 70 percent of the calculated US tariff revenues on aluminum and steel ($ 7.9 billion; Table 2).[25]

While most of the responding countries have prioritized reciprocal tariffs on iron, steel, and aluminum products, they have not limited their reciprocation to these products (nor are they required to by WTO rules). Machinery and equipment products are second to iron and steel. Chemicals (pharmaceuticals included), beverages and tobacco (whisky and wine included); meat (beef and pork); vegetables, fruit, and dairy products are all affected by reciprocal tariffs. Oil seeds (soybeans), a product which has garnered significant press for retaliation is not a

[24] Most countries in the "other" country category have not requested WTO consultations, or applied retaliatory tariffs.

[25] Smaller suppliers to the US market may not apply reciprocal tariffs, since the US is not a major destination for their exports and requesting consultations with the WTO may be perceived as burdensome.

major target as it relates to the 232 actions—those products are the subject of China Section 301 actions and are reported in a following section.

Table 4: Trade partners' aluminum and steel 232 response (2017 imports US$ million and percent)

Commodity	Total value	Average tariff	Tariff revenue
Iron and steel	6,182.2	25%	1,534.0
Machinery and equipment nec	3,562.9	17%	589.8
Manufacturing nec	1,984.1	23%	454.9
non-Ferrous metals (aluminum)	2,836.1	16%	442.8
Beverages and tobacco products	1,538.5	24%	369.3
Meat nec (pork etc.)	1,750.0	20%	343.8
Chemicals, rubber, and plastics (pharmaceuticals)	1,744.5	16%	280.9
Transport equipment nec	1,206.6	23%	276.8
Fabricated metal products	1,873.5	14%	256.3
Processed food nec	1,591.8	15%	231.4
Cattle and sheep meat	873.8	25%	218.5
Vegetables and fruit	1,860.7	9%	169.4
Dairy products	383.4	22%	85.1
Paper and paper products	673.6	11%	73.5
Lumber and forestry	312.1	16%	49.7
Coarse grains (corn, sorghum, millet etc.)	142.2	25%	35.5
Wearing apparel and leather	80.4	33%	26.3
Textiles	127.1	18%	23.4
Motor vehicles and parts	166.9	10%	16.7
Processed rice	39.6	25%	9.9
Agriculture nec	38.8	5%	2.1
Sugar	0.5	10%	0.1
Total	28,969.2	19%	5,490.1

Source: Authors' calculations. See Appendix I, Table A 1 for country and product specific data and sources.

2.1.4 AUTOMOBILES ACTION

On May 23, 2018, the US DOC announced a Section 232 investigation into US imports of automobiles and parts.[26] While the conclusion of this investigation is yet to be issued, the potential scope of products under investigation threatens approximately $177 billion in US imports of automobiles and parts—three times more trade than US aluminum and steel actions, even when accounting for prospective exemptions for Canada and Mexico. The EU and Japan

26 https://www.commerce.gov/news/press-releases/2018/05/us-department-commerce-initiates-section-232-investigation-auto-imports. On May 30, 2018, the investigation was listed in the Federal Register starting a 270-day clock by which time (February 2019) the DOC must produce the results of its investigation.

comprise over two-thirds of US imports of non-exempt shippers and only China ships more automobile parts (though fewer automobiles) than these two leading suppliers ($17.1 billion in US imports of automobile parts).

Table 5: Estimated automobiles 232 imports, tariffs, and revenue (2017 imports US$ millions and percent)

country	Auto parts			Automobiles			Total (non-exempt)	
	Imports	Tariff	Revenue	Imports	Tariff	Revenue	Imports(a)	Revenue
Mexico	54,705.9	Exempt	Exempt	47,141.8	Exempt	Exempt	Exempt	Exempt
EU	13,725.0	25%	3,431.3	46,203.3	25%	11,550.8	59,928.30	14,982.1
Canada	16,299.4	Exempt	Exempt	42,859.7	Exempt	Exempt	Exempt	Exempt
Japan	13,394.6	25%	3,348.7	42,782.4	25%	10,695.6	56,177.00	14,044.3
Korea	8,169.2	25%	2,042.3	15,701.9	25%	3,925.5	23,871.10	5,967.8
China	17,133.2	25%	4,283.3	1,538.2	25%	384.5	18,671.40	4,667.8
Thailand	3,195.7	25%	798.9	213.2	25%	53.3	3,408.90	852.2
Taiwan	3,112.3	25%	778.1	4.5	25%	1.1	3,116.80	779.2
South Africa	300.4	25%	75.1	1,180.9	25%	295.2	1,481.30	370.3
India	1,412.2	25%	353.1	67.5	25%	16.9	1,479.70	369.9
Turkey	467.5	25%	116.9	890.2	25%	222.5	1,357.70	339.4
Brazil	1,141.1	25%	285.3	141.1	25%	35.3	1,282.20	320.5
VietNam	1,148.6	25%	287.1	0.0	25%	0.0	1,148.60	287.1
Indonesia	1,133.9	25%	283.5	0.0	25%	0.0	1,133.90	283.5
Philippines	838.7	25%	209.7	0.1	25%	0.0	838.80	209.7
Other	3,084.7	25%	771.2	196.7	25%	49.2	3,281.40	820.3
Total	139,262.5	12%	17,064.3	198,921.5	14%	27,230.0	177,177.10	44,294.3

Source: Authors' calculations based in US Imports of Merchandise Trade, Department of Commerce, Bureau of the Census. Motor vehicles includes light trucks and passenger cars capable of carrying less than ten people listed in HS code 8703 (used autos, golf carts and ATVs excluded); light trucks classified in HS 8704210000, 8704310020, and 8704310040. Auto parts are as defined by US Office of Transportation and Machinery Automotive Parts Product Listings Revised 07.26.2018-- https://www.trade.gov/td/otm/assets/auto/APcodes.pdf.

(a) Total does not include imports from exempt countries – Canada and Mexico.

President Trump has indicated that tariffs on automobiles could be set at between 20 and 25 percent.[27] Tariffs set at 25 percent on non-exempt (excluding Canada and Mexico) imports would result in calculated tariff revenues by $17.1 billion annually on automobile parts and $27.2 billion annually on automobiles for an additional $44.3 billion in calculated tariffs should these tariffs be applied.

[27] https://www.wsj.com/articles/trump-administration-weighs-new-tariffs-on-imported-vehicles-1527106235.

2.1.5 AUTOMOBILE RESPONSES

As in the case of aluminum and steel Section 232 actions, it is expected that major US trade partners will apply reciprocal trade actions (tariffs) in response to US tariffs on automobile and parts. To estimate reciprocal tariff actions, calculated tariff revenues for significant trade partners in Table 5 are used as a target amount for reciprocal tariffs by trade partner.[28] Each of the major trading partners' imports from the US are ordered first by automobiles and parts and a 25 percent tariff is applied to those imports. If the total revenue target is not met with automobiles and parts, the remaining imports (less coal, oil, gas and petroleum product imports) from the US are sorted by trade value and tariffs are applied at the 25 percent rate until the calculated revenue target is met (or just under it). [29] The estimated tariff responses and calculated tariff revenues are presented in Table 6.

In all cases, tariff responses on automobile imports account for less than half of trading partners' response—i.e., there are not enough imports of automobiles from the US to fulfill the calculated response revenue targets. This indicates there is significant potential for reciprocal tariffs to "spillover" into sectors other than automobiles. Experience with the aluminum and steel Section 232 response tariffs (Table 4) confirms that US trading partners applied tariffs on products such as paper and paper products, meat, and processed foods and beverages in response to US aluminum and steel tariffs. In total, US exporters could face nearly $39.0 billion in calculated tariffs when exporting to key markets on $155.8 billion in exports.[30]

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28 Most countries are estimated to apply reciprocal tariffs less than the limit, depending on the mix of products and the trade volumes imported since it is unlikely any country will find the exact combination of traded products and trade values to exactly match the target amount. Countries which reciprocated under US aluminum and steel actions were assumed to respond to tariffs on US automobile imports.

29 Specifically, imports from the US are summed to the HS 6-digit level and are selected until tariff revenues are less than or equal to the target amount.

30 Actual tariff costs will vary depending on tariffs applied and any change in trade volumes.

Table 6: Projected automobiles 232 responses (2017 imports US$ million 2017 and percent)

Commodity	Total value	Average tariff	Total revenue
Transport equipment nec	46,279.9	25%	11,570.0
Motor vehicles and parts	32,380.2	25%	8,095.0
Machinery and equipment nec	29,560.5	25%	7,390.1
Chemicals, rubber, and plastics (pharmaceuticals)	13,716.1	25%	3,429.0
Electronic equipment	8,333.1	25%	2,083.3
Manufacturing nec	3,475.2	25%	868.8
Coarse grains (corn, sorghum, millet etc.)	3,331.1	25%	832.8
Processed food nec	3,177.7	25%	794.4
Cattle and sheep meat	3,002.8	25%	750.7
Agriculture nec	2,324.0	25%	581.0
Meat nec (pork etc.)	2,092.8	25%	523.2
Oil seeds (soybeans, sunflower, flax)	1,386.8	25%	346.7
Fabricated metal products	1,304.6	25%	326.2
Lumber and forestry	1,158.7	25%	289.7
Vegetable and fruit	995.0	25%	248.8
Paper and paper products	956.1	25%	239.0
non-Ferrous metals (aluminum)	904.7	25%	226.2
Beverages and tobacco products	548.2	25%	137.1
Textiles	357.2	25%	89.3
Processed rice	197.8	25%	49.5
Dairy products	166.1	25%	41.5
Vegetable oils	114.2	25%	28.5
Iron and steel	31.7	25%	7.9
Cattle and sheep	28.4	25%	7.1
Total	155,823.0	25%	38,955.7

Source: Authors' calculations. See Appendix I, Table A 2 for country specific details and data sources.

2.2 Section 301 Actions and China's Unfair Trade Practices

Section 301 of the Trade Act of 1974 was designed to address a range of unfair trade acts, policies, and practices. On March 22, 2018, USTR released a report listing policies and practices undertaken by China related to technology transfer, intellectual property, and innovation that hinder US trade and investment (USTR 2018). The President instructed that an appropriate response to China's acts, policies, and practices would be to raise tariffs. On June 15, 2018, USTR released the first two (impacting approximately $50 billion in imports) of three lists detailing tariffs on US imports from China and announced initial 25 percent duties. The first list was made effective on July 6, 2018 and the second list, after a review processes and minor modifications, was made effective August 23, 2018. The third list, announced on July 10, 2018, included additional tariffs on $200 billion in trade. After the initial publication of the $200 billion list, President Trump announced his intention to increase duties, initially set to 10

percent, to 25 percent. USTR subsequently announced in September 2018 that the July 10, 2018 list, with modifications would be put into effect on September 24, 2018 with initial duties of 10 percent rising to 25 percent on January 1, 2019.[31]

China announced reciprocal tariff actions in response to each of USTR's three lists. On June 15, 2018, the Chinese Ministry of Finance issued product lists for the application of duties on China's imports from the US (effective on the same dates as the US lists).[32] In response to the US President's announcement to increase duties on its "List-3" from 10 percent to 25 percent, the Chinese Ministry of Finance released a list of products for which tariffs would be increased in a range of five to 25 percent. [33]

On September 7, 2018, President Trump announced that he had ordered the creation of a list of $267 billion in US imports from China for additional duties to be applied if China did not change its approach to trade.[34] The administration has not released the list, but has threatened, as recently as October 30, 2018,[35] additional tariffs if China does not cease its trade practices as outlined in the China Section 301 report (USTR, March 2018).

2.2.1 CHINA 301 ACTIONS

Table 7 (column II) summarizes the three official China Section 301 "lists," which include specific HS codes and cover $233.9 billion in 2017 US imports from China. Column III includes US imports from China not included in the three official US product lists and totals $263.9 billion, slightly less than the US President's statement of additional duties on $267 billion in US imports from China.

Column III, US imports from China, are assumed to make up the remaining trade, which is projected to have Section 301 tariffs applied. Since all trade on the official lists have been set (or are set to increase) to 25 percent, it is assumed for the purposes of this analysis that the administration will continue to apply duties up to this amount on US imports from China. If the US places 25 percent duties on these imports from China, the US government will collect additional calculated tariff revenue of $124.5 billion to be paid by US business and consumers.

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31 https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/september/ustr-finalizes-tariffs-200

32 http://www.mofcom.gov.cn/article/ae/ai/201806/20180602756389.shtml

33 http://www.mofcom.gov.cn/article/ae/ai/201808/20180802772616.shtml.

34 The $267 billion amount is approximately the value of US imports from China which do not currently have Section 301 tariffs applied to them. Therefore, the threat of additional tariffs amounted to putting Section 301 tariffs on all US imports from China.

35 https://www.cnbc.com/2018/10/30/trump-says-he-expects-great-deal-with-china-but-more-tariffs-if-not.html

Table 7: China 301, US imports from China, tariffs, and revenue (2017 imports US$ million and percent)

Commodities	I Tariffs	II Listed US products (a)	III Estimated (remainder)	Total	
				IV Imports	V Revenue
Agriculture nec (b)	25%	391.7	586.1	977.8	244.5
Vegetable and fruit	25%	265.4	63.5	328.9	82.2
Oil seeds (soybeans, sunflower, flax)	25%	37.1	0.0	37.1	9.3
Vegetable oils	25%	35.5	25.1	60.6	15.1
Meat nec (pork etc.)	25%	27.1	0.0	27.1	6.8
Processed rice	25%	9.2	0.0	9.2	2.3
Cattle and sheep meat	25%	4.2	0.0	4.2	1.1
Sugar	25%	3.6	2.8	6.4	1.6
Coarse grains (corn, sorghum, millet etc.)	25%	2.0	0.0	2.0	0.5
Dairy products	25%	0.1	0.3	0.4	0.1
Agriculture	25%	775.8	677.9	1,453.7	363.4
Machinery and equipment nec	25%	73,136.7	31,818.9	104,954.8	26,238.7
Electronic equipment	25%	60,432.7	111,492.9	171,925.0	42,981.2
Chemicals, rubber, and plastics (pharmaceuticals)	25%	18,653.4	16,440.9	35,093.1	8,773.3
Fabricated metal products	25%	13,646.1	5,205.9	18,851.2	4,712.8
Motor vehicles and parts	25%	13,253.2	30.9	13,283.1	3,320.8
Manufacturing nec (c)	25%	12,113.0	51,442.9	63,555.4	15,888.9
Processed food nec	25%	4,467.7	954.9	5,421.6	1,355.4
Textiles	25%	3,376.1	16,656.9	20,032.1	5,008.0
Paper and paper products	25%	2,992.0	2,550.9	5,542.3	1,385.6
Transport equipment nec	25%	2,870.8	539.9	3,409.7	852.4
Wearing apparel and leather	25%	1,865.7	20,716.9	22,581.7	5,645.4
Iron and steel	25%	912.4	1,016.9	1,928.2	482.1
non-Ferrous metals (aluminum)	25%	558.1	1,998.9	2,556.0	639.0
Beverages and tobacco products	25%	40.5	26.9	66.5	16.6
Manufactures	25%	208,318.5	260,882.9	469,201.9	117,300.2
Coal, oil, gas and petroleum products	25%	278.2	127.9	405.4	101.4
Lumber and forestry	25%	24,540.0	2,187.9	26,727.2	6,681.8
Extractive	25%	24,818.1	2,314.9	27,132.6	6,783.1
Total	25%	233,912.4	263,874.9	497,786.9	124,446.7

Source: Authors' calculations.

(a) Product lists from: List-1-Federal Register /Vol. 83, No. 119 June 20, 2018; List-2- Federal Register /Vol/ 83, No. 159 August 16, 2018; List-3-https://ustr.gov/sites/default/files/301/2018-0026%20China%20FRN%207-10-2018_0.pdf. Trade values from US Department of Commerce, Bureau of the Census, Imports of Merchandise Trade 2017. Trade under Harmonized Schedule Chapters 98 and 99 are excluded as are bullion, personal imports, and military equipment.

(b) Includes hides and skins, forage (hay and clover), raw tobacco, wheat, muslin, animal guts and bladders, down, ginseng root, seeds, medicinal herbs, honey, live reptiles etc.

(c) Other minerals, non-metallic minerals, and manufactures.

2.2.2 CHINA 301 RESPONSES

Table 9 summarizes China's Section 301 responses. Table 9 includes China's official responses (column I) based on lists published by the Chinese Ministry of Finance. Column II includes projected Chinese responses to the US raising tariffs, effectively on all US imports from China, and assumes China will apply tariffs on all remaining imports from the US (approximately $50 billion). Agricultural products make up 13.4 percent of China's response tariffs, with oil seeds (soybeans) being the largest single agricultural product category. Machinery and equipment (19.2 percent) and chemicals and pharmaceuticals (16.0 percent). Total taxes (tariffs) collected on China are estimated to be $31.0 billion.

2.3 Supply Chains and Action Summary

Overall, $700.4 billion in US imports (approximately 31.3 percent of total 2017 imports, Table 8) are projected to be affected by Section 232 and 301 tariffs and quotas. When US imports are classified as capital, intermediate, or final consumption goods, it becomes clear that imports play an important role in US supply chains and production. Combined, intermediate and capital goods comprise 72 percent of total US imports. Likewise, Section 232 and 301 trade actions threaten to impact nearly half a trillion dollars in US imports of capital and intermediate goods trade with the remaining imports of $212.2 billion on US final consumer goods. The potential for Section 232 and 301 tariffs to disrupt supply chains is, therefore, significant. While most direct impacts of higher cost imports will be directly felt by intermediate and capital good using industries, final consumers will also experience higher prices for imported goods.

Table 8: US imports, business intermediate and capital goods (2017 US$ millions and percent)

Type of import	All US imports		Imports with 232 and 301 actions	
	Value	Percent	Value	Percent
Capital goods	545,553.1	24%	227,131.7	32%
Intermediate goods	1,059,212.3	47%	261,000.9	37%
Final consumer goods	632,445.2	28%	212,227.1	30%
Total	2,237,210.6	100%	700,359.7	100%

Source: US Department of Commerce, Bureau of the Census, Imports of Merchandise Trade. Classification of imports based on the United Nations (UN) Broad Economic Classification (BEC) system Rev4. Authors' calculations.
(a) Imports incurring multiple trade actions, as in the case of China, are counted once.

Table 9: China 301 response, imports from the US and revenue (2017 US$ millions and percent)

Commodity	Chinese lists as of September, 2018		Estimated (remainder)		Total		
	I Imports	II Tariffs	III Imports	IV Tariffs	V Imports	VI Tariff	VII Revenue
Oil seeds (soybeans, flax, etc.)	14,030.0	25%	3.4	25%	14,033.4	25%	3,500.1
Agriculture nec (a)	2,016.7	16%	161.1	25%	2,177.8	17%	359.4
Coarse grains (corn, sorghum, millet etc.)	1,116.1	25%	2.8	25%	1,119.0	25%	279.7
Cattle and sheep meat	26.8	25%	873.8	25%	900.6	25%	225.1
Vegetable and fruit	25.3	25%	760.6	25%	785.9	25%	196.5
Dairy products	490.7	23%	0.0	25%	490.7	23%	113.5
Meat nec (pork etc.)	161.4	11%	285.6	25%	447.0	20%	89.7
Vegetable oils	112.4	24%	0.0	25%	112.4	24%	27.4
Cattle and sheep	0.0	25%	15.8	25%	15.8	25%	3.9
Sugar	0.5	22%	0.0	25%	0.5	22%	0.1
Rice	0.0	25%	0.0	25%	0.0	25%	0.0
Agriculture	17,979.9	24%	2,103.1	25%	20,083.0	24%	4,795.6
Machinery and equipment nec	21,318.1	13%	7,454.0	25%	28,772.1	16%	4,606.3
Chemicals, rubber, and plastics (pharmaceuticals)	18,767.4	17%	5,201.4	25%	23,968.8	19%	4,502.4
Transport equipment nec	311.5	8%	18,104.8	25%	18,416.3	25%	4,550.7
Motor vehicles and parts	13,569.7	24%	1,991.2	25%	15,560.9	24%	3,765.7
Electronic equipment	2,929.8	19%	9,321.3	25%	12,251.1	24%	2,890.8
Paper and paper products	3,043.5	6%	2,716.9	25%	5,760.5	15%	872.1
Manufacturing nec	4,140.2	15%	68.0	25%	4,208.2	15%	628.7
non-Ferrous metals (aluminum)	1,164.3	14%	2,243.8	25%	3,408.0	21%	726.4
Processed food nec	2,462.6	20%	165.6	25%	2,628.2	20%	525.1
Textiles	1,816.4	21%	1.8	25%	1,818.2	21%	374.4
Fabricated metal products	1,392.5	14%	261.4	25%	1,653.9	15%	254.5
Iron and steel	484.6	15%	178.0	25%	662.6	18%	116.3
Beverages and tobacco products	119.4	24%	81.9	25%	201.3	25%	49.7
Wearing apparel and leather	29.1	24%	0.0	25%	29.2	24%	6.9
Manufactures	71,549.1	17%	47,790.1	25%	119,339.2	20%	23,870.1
Coal, oil, gas and petroleum products	6,988.5	25%	0.0	25%	6,988.5	25%	1,747.1
Lumber and forestry	2,996.0	17%	254.1	25%	3,250.1	18%	577.6
Extractive	9,984.5	23%	254.1	25%	10,238.7	23%	2,324.7
Total	99,513.5	19%	50,147.4	25%	149,660.8	21%	30,990.4

Source: Authors' calculations. Import data from official sources as reported by Trade Data Monitor. List 1 and List2 http://www.mofcom.gov.cn/article/ae/ai/201806/20180602756389.shtml. List 3 http://www.mofcom.gov.cn/article/ae/ai/201808/20180802772616.shtml.

(a) Includes hides and skins, forage (hay and clover), raw tobacco, wheat, muslin, animal guts and bladders, down, ginseng root, seeds, medicinal herbs, honey, live reptiles etc.

3 Projected Impacts

3.1 Summary of Model and Data

A global applied general equilibrium model, named the ImpactECON Dynamic Global Supply Chain (IESC-Dyn) model, is used for this analysis.[36] The global nature of the model allows us to examine both the impact of the initial US actions on the US and other economies, as well as the responses of the other countries. Some of the features of the model include:

- input-output relations, allowing us to examine the impact of policy changes on production and consumption throughout the world;[37]
- trade and transport margins, and tariffs;
- supply chains, allowing us to track the source of imported intermediates and final and investment goods;
- adaptive expectations, for determining the allocation of savings across investment world-wide;
- dynamics and the accumulation of capital, allowing us to examine the impact of the trade policies over time;
- the ownership of foreign and domestic capital and foreign income flows;
- unemployment of labor and the movement of labor across sectors; and
- the supply of labor by education level and the movement of educated labor across occupations.

The impact of the US trade actions and partners' responses are examined relative to a global baseline scenario, that shows how the world economy might have evolved over time, without the US trade actions and subsequent partners' responses. The baseline scenario assumes strong

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36 The model is solved using GEMPack (Harrison and Pearson, 1996).

37 Forward and backward linkages.

US growth and continued global growth of production, trade, and investment over the period, combined with stagnant or declining populations and increasing education rates.

Appendix II contains a description of the model and database as well as the data sources applied in the construction of the baseline.

3.2 Macroeconomic Impacts

The following sections report the projected impacts of US trade actions, cumulatively, on GDP, investment, trade, employment, and household income.

3.2.1 GROSS DOMESTIC PRODUCT

Impact on US economy

In Figure 3-1, we examine the changes in US real GDP under the baseline and compare these with the changes expected with the implementation of the Section 232 and 301 actions, combined with the partners' responses to these actions, over time. In the baseline, US real GDP is expected to grow at an average of 2.46 percent per year over the period 2018 to 2030, equivalent to 37.2 percent growth over the entire period. The Section 232 and 301 actions plus the partners' responses to these actions reduce this growth in real GDP to an average of 2.36 percent per year, equivalent to 35.5 percent over the entire period 2018 to 2030. This means that by 2030, real GDP is 1.25 percent[38] less than it would have been had the US not undertaken these actions, i.e. relative to the baseline. While this may seem small in percentage terms, in 2017 US GDP was $19.4 trillion so this 1.25 percent decline in 2030 GDP is equivalent to a loss of $331.8 billion in 2017-dollars for that year.[39] Those losses cumulate between 2018 to 2030 to a considerable $2.8 trillion in discounted present value terms.[40]

To appreciate this magnitude of change, it is worth contrasting these estimates of real US GDP with those obtained under multiparty free trade agreements, such as those estimates from the Trans-Pacific Partnership (TPP) on US real GDP. The USITC estimated real US GDP would increase by 0.15 percent (USITC, 2016) and the Petersen Institute estimated an increase in US real GDP of 0.07 percent (Petri, Plummer and Zhai, 2012)—eight to seventeen times less in absolute terms than the 1.25 percent decline due to the US trade actions and partners' responses estimated here. The TPP was formulted to be phased in over 15 to 20 years, while the trade actions considered in this report are expected to be fully in place by the end of 2021. Such large, rapid, changes in an economy can be disruptive, regardless or whether they are positive or

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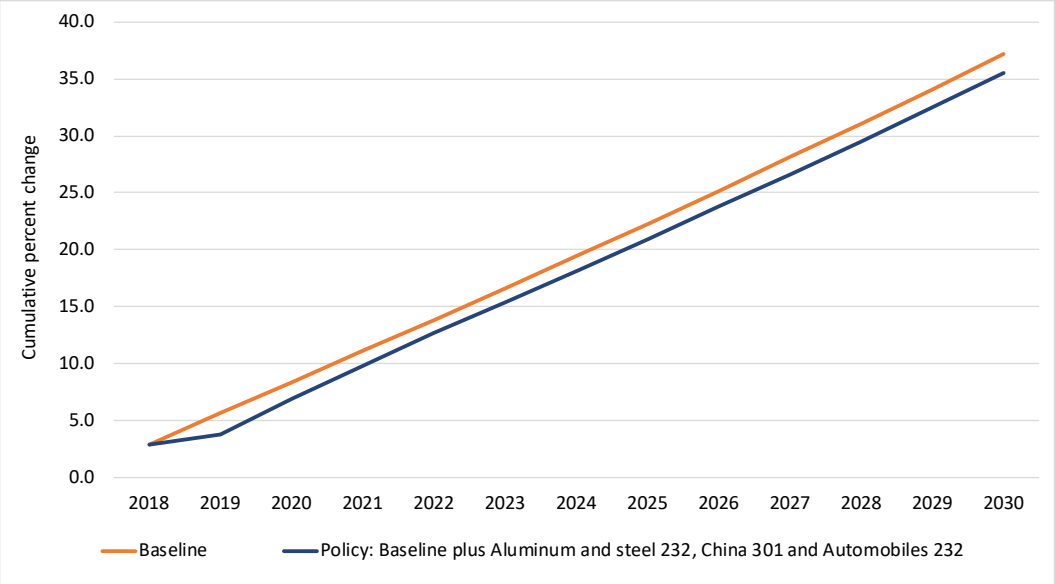
38 (((1+0.355)/(1+0.372) – 1) * 100)

39 19.4 trillion multiplied by (1.372 – 1.355). The GTAP database used in this analysis has a base year of 2011, with an historical simulation used to update the data to 2017. We use official 2017 GDP estimates to calculate the changes in real GDP.

40 Discounted to 2017 using a real interest in US of 2.5 percent, based on average of last 10 years (IMF, 2018a).

negative, due to the large adjustment costs incurred as workers and capital move between sectors as winners and losers emerge; and the overall negative impact suggests that, once the dust settles, there will be more losers than winners.

Figure 3-1: Impact of US trade actions and responses on real GDP of US over time (baseline vs. policy)



Source: Authors' calculations.

The impacts of the US Section 232 and 301 trade actions are separately identified from the partners' responses in Figure 1-1. The US Section 301 actions are the most detrimental of all the actions under consideration, accounting for 56.2 percent of the decline in long run 2030 real GDP. The impact of the partners' responses to the US trade action on automobiles are also detrimental, particularly in the short run, accounting for 58.5 percent of the decline in real GDP in 2019, but only 13.3 percent in 2030.

The contribution of China's Section 301 response is somewhat smaller than the US Section 301 action, accounting for only 12.6 percent of the US's loss in GDP in 2030, roughly the same as the US Section 232 action on automobiles (12.8 percent) and the long run impact trade partners' Section 232 responses on automobiles of 13.3 percent. US imports from China are several orders of magnitude larger than Chinese imports from the US (reflecting the US trade deficit with China), limiting the impact of China's response.[41] US actions on steel and aluminum and the partners' responses are also detrimental, although smaller when compared to the other actions.

Figure 1-1 also illustrates that the largest losses occur within the first two years of the actions and responses, after which the negative consequences dissipate as unemployed workers find

[41] This provides US policy makers a larger product and market space to carry out policy actions. US imports from China were valued at just over $500 billion while US exports to China were valued at between $130 - 150 billion (depending on weather US or Chinese data are used) in 2017.

new jobs and return to the workforce. The exception is the US Section 301 actions and China's response, which have a large and more persistent impact on investment, that lead to the continued decline of real GDP.

Impact on US trade partners

The impact of the US actions on the real GDP of US trade partners are provided in Table 10; the results for the US are also repeated for comparison. The results show that China will be the most negatively impacted by the US actions and partners' responses (column VII, Table 10), primarily because of the US 301 actions specifically targeted at China (column III).

Despite the considerable decline in growth in the US and China, the reduction in US and Chinese incomes does not lead to an overall decline in demand and growth in the rest of the world. Instead, the rest of the world gains as the US and China turn away from each other and towards alternative trading partners (column III and IV, Table 10). These gains from the Section 301 actions and responses (columns III and IV) also outweigh any negative consequences from the US Section 232 actions and responses on steel, aluminum, and automobiles targeted at the rest of the world (columns I, II, V and VI), leading to overall gains (column VII).

The impacts of US aluminum and steel actions on its trading partners (column I, Table 10) are mixed. While partners' exports of steel and aluminum to the US decline, their exports of products made from steel and aluminum, such as motor vehicles, increase, as the US becomes less competitive in global markets. For the EU, China, Japan and the rest of the world, these new growth opportunities outweigh the loss from reduced steel and aluminum exports to the US. Canada and Mexico, on the other hand, suffer alongside the US as they also become less competitive due to their interdependence with US supply chains as part of NAFTA. Finally, Korea and Argentina also lose (column I), as the quotas imposed on these economies become more restrictive as the US continues to grow.[42]

The impact of the partners' responses to the steel and aluminum tariffs are also mixed. All partners see negative impacts from their own responses, although in some cases the gains made from others' responses outweigh the loss from their own response. Canada and China lose (column II, Table 10) as their own responses outweigh any gains from the responses of others. On the other hand, Mexico, the EU, and Japan manage to gain slightly from their own and others' responses to the US actions (column II) as they export more, particularly to the EU.[43] Since Korea, Brazil, and Argentina do not respond to the US actions, they gain indirectly from

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42 As reviewed in sub-section 2.1.2, US quotas on these products were not provided annual growth rates, therefore, these quotas become increasingly restrictive as the US economy grows. Brazil, the other country restricted by US aluminum and steel quotas, is projected to have constant to declining growth in exports of these products in the baseline hence trade is not restricted further over time.

43 The EU has stated its intention to monitor aluminum and steel imports while maintaining its option to apply tariffs and or quotas on third party country imports into the EU to protect their domestic producers. Mexico has instituted tariffs against third party imports of steel, which are included in the estimates provided in Table 10.

the responses of the other partners (column II), who switch away from US goods towards their goods. For Russia, their own response is relatively restrained and the impacts negligible.

Table 10: Impact of US actions and partners' responses on US and partners' real GDP in 2030 (percentage differences from baseline and US$ billions where indicated)

Country	Aluminum and steel 232		China 301		Automobiles 232		Total	
	I US action	II Partners' response	III US action	IV China's response	V US action	VI Partners' response	VII Actions and response	VIII US$ billions
USA	-0.04	-0.03	-0.70	-0.16	-0.16	-0.17	-1.25	-331.8
Canada	-0.10	-0.07	0.60	0.20	0.60	0.15	1.39	29.9
Mexico	-0.01	0.01	3.67	0.23	1.57	0.09	5.64	93.2
EU	0.01	0.03	0.54	0.16	-0.01	0.02	0.76	173.5
China	0.05	-0.06	-2.25	-0.60	0.03	0.15	-2.68	-563.3
Japan	0.01	0.04	0.64	0.26	-0.08	-0.27	0.60	34.2
Korea	-0.04	0.05	0.97	0.38	-0.31	-0.60	0.44	9.5
Brazil	0.00	0.04	0.35	0.11	0.01	0.09	0.60	17.2
Russia	0.00	0.00	0.43	0.09	0.07	0.07	0.67	13.1
Argentina	-0.01	0.04	0.35	0.14	0.03	0.09	0.65	6.2
Rest of World	0.01	0.03	0.65	0.11	-0.02	0.10	0.93	281.2

Source: Authors' calculations.

Finally, the leading exporters of motor vehicles and parts (Japan, Korea, EU and India (included in the rest of world)) experience the largest declines in real GDP (column II, Table 10) as a result the automobile Section 232 actions. Japan and Korea also lose as a result of the partners' responses, although the EU and rest of world gain. As in the case of the partners' responses to Section 232 actions on steel and aluminum, each country loses from raising its tariffs, but gains from the responses of others; the final result depends on which of these effects is larger. Mexico and Canada, on the other hand, gain significantly, due to exemptions given under the proposed USMCA agreement.[44] China also gains slightly as Section 301 tariffs have already reduced trade between the US and China so significantly that further tariff increases have little negative impact on US-China trade and can easily be outweighed by increased demand by other countries. As mentioned above, the losses for Japan and Korea are outweighed by the gains from the US Section 301 actions, leading to an overall increase in real GDP (column VII).

[44] The US provided side agreement letters exempting Canada and Mexico from automobile Section 232 tariffs as part of the USMCA agreement.

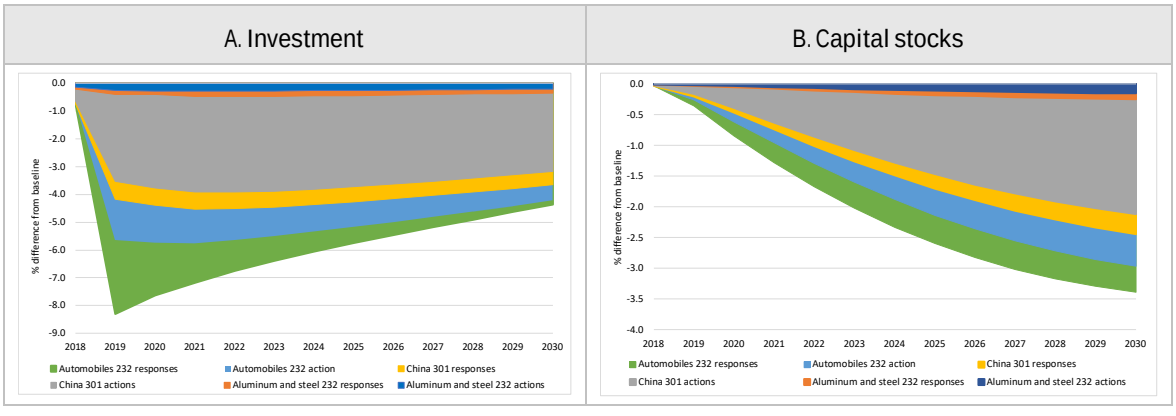
3.2.2 INVESTMENT AND TRADE

Investment in the US declines in 2019 because of US trade actions and partners' responses, with some gradual improvements occurring after 2020 (Figure 3-2 (panel A)). The reduction in investment is caused by a fall in the US rates of return to capital (goods), as tariffs are raised by both the US and its trading partners. The reduction in the rate of return is due to two, reinforcing, factors. First, increases in Section 232 and 301 tariffs increase the cost of investment type goods (cranes, steel, machinery etc.), raising the cost of newly installed domestic capital.[45] Second, lower overall output reduce returns (profits) to existing capital goods. So, capital goods are both more expensive and the return to those investments has declined. Combined, these effects result in a decline in investment.

Over time, depreciation and lower investment reduce the stock of capital (goods) (Figure 3-2, panel B). The smaller stock of capital causes returns to recover and investment returns, albeit, at a lower level then before the trade actions. This is illustrated in Figure 3-2 (panel A), where the total decline in US investment falls gradually after 2020. This reversal of investment is most evident in the partners' responses to automobile Section 232 actions, where the decline in investment has all but disappeared by 2030 (area under the curve associated with automobiles 232 responses (green) Figure 3-2 (panel A)). The decline in investment resulting from the US Section 301 actions, on the other hand, takes longer to reverse. The persistence of this part of the decline in investment is due to a decline in global savings of 0.55 percent. China is an important source of global savings, and Section 301 actions and responses cause Chinese income and hence savings to fall significantly; US savings also falls, while in other countries savings and income rise.

Lower investment and capital stocks causes production and GDP to decline further then the direct effects of the tariffs alone would have on final production prices for specific sectors.

Figure 3-2: Impact of US trade actions and partners' responses on US investment 2018-2030 (percentage differences from baseline)

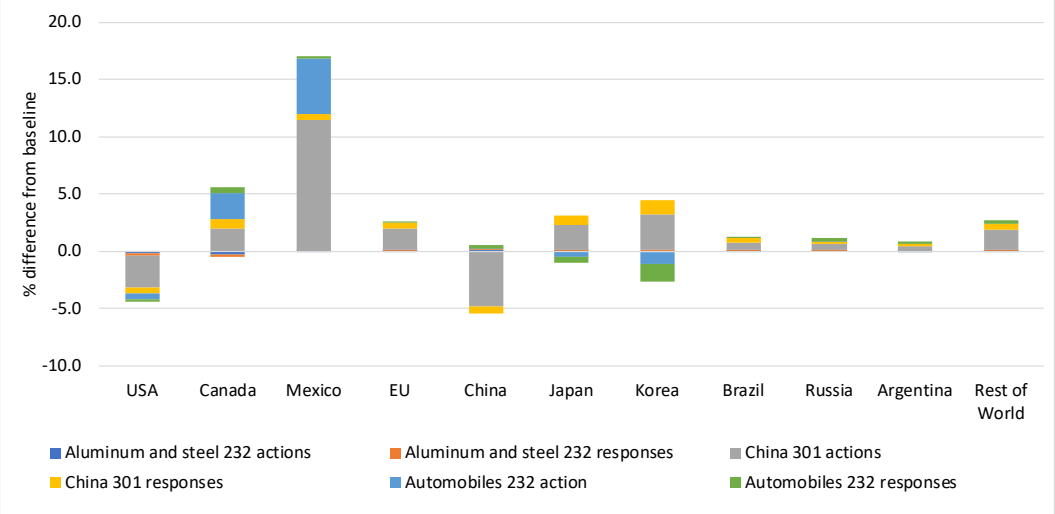


Source: Authors' calculations.

45 Note that no changes have been made to the perceived riskiness of investing in the US as a result of the US's trade actions, these changes are solely due to declining US rates of return.

As investment declines in the US and China, it rises in other countries, but most significantly in Mexico and Canada. (Figure 3-3). Most investment gains occur because of Section 301 actions (gray shading in Figure 3-3). As China and the US engage in a comprehensive tariff escalation, other countries seize export opportunities in both the US and China. The result is a rise in the relative returns to capital outside China and the US and the repositioning of investment to higher relative returns in other countries, most notably, Canada and Mexico. The automobile Section 232 actions cause investment in the two countries exempt from these action, Mexico and Canada, to rise further.[46]

Figure 3-3: Impact of US actions and partners' responses on global investment in 2030 (percentage differences from baseline)



Source: Authors' calculations.

US exports and imports also decline by 10.6 and 9.6 percent respectively (or $480.2 billion and $555.1 billion in 2017 dollars) (Table 11) as the US raises the cost of importing and exporting by raising tariffs. Trade falls globally by 0.93 percent due to the decline in real incomes of two of the largest global trading partners, the US and China. Most of the global decline in trade is in investment (-2.1 percent) goods; trade in intermediates and in final goods both fall by -0.8 percent. US trade in investment goods is particularly adversely impacted by US Section 301 actions, due to the prevalence of tariff increases on investment goods and the decline in investment in the US and globally. Exports of intermediates by US businesses also decline relatively more than exports of final goods, while the reverse is true of US imports. This suggests that a higher proportion of US production is being sold to final consumers in the US, although this is at the expense of lower total production and higher prices.

While both imports and exports fall, the dollar value of US imports falls by more than exports and the trade deficit falls (Table 11). This is linked to the decline in investment, particularly

46 The USMCA provides exemptions for Canada and Mexico from US Section 232 automobile tariffs, with some qualifications. Canada and Mexico were not provided relief from US Section 232 aluminum and steel actions under the proposed USMCA.

foreign investment; when foreign investment declines, the trade balance improves. The extent of the decline in the trade deficit is primarily determined by the US Section 301 actions (Table 11). Figure 3-4 shows that most of the US actions and partners responses have the effect of reducing investment in the US, and hence the trade deficit in the short run by $212 billion. However, by 2030 many of these impacts reverse with the return of foreign investment—leading to an improvement in the trade balance of only $40.3 billion in 2030 (Table 11).

The extent to which foreign investment in the US, and hence the trade deficit, is expected to decline is subject to a degree of uncertainty. In the past, government policy has had little impact on foreigners' willingness to invest in the US, however, there is evidence to suggest that the US trade actions are already negatively impacting investment. Adam Posen of the Peterson Institute of International Economics (Posen, 2018)[47] reports a general decline in foreign direct investment due to the decline in attractiveness of the US as a destination.[48] In this report, we have assumed that foreigners will respond to lower rates of return and choose to invest elsewhere; we have not assumed any change, either positive or negative, in perceived riskiness of investment in the US due to the trade actions, although it could be argued that these trade actions increase uncertainty, raising the risk premium required by investors to invest in the US.[49] We also note that whether investors respond to the decline in US rates of return or not, the decline in Chinese savings is likely to reduce investment in the US and globally. The extent to which investment declines will determine the magnitude and longevity of the negative impact of the trade actions, since it is the impact of lower investment on capital stocks that will cement long-term reductions in US real GDP.

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[47] https://piie.com/blogs/trade-investment-policy-watch/cost-trumps-economic-nationalism-loss-foreign-investment-united.

[48] For other references see https://www.bloomberg.com/news/articles/2018-07-05/trump-s-trade-war-is-already-hurting-u-s-investment-fed-says and http://theconversation.com/trade-war-could-chill-chinas-growing-investment-in-us-economy-99906).[49] We have also assumed fixed savings rates; hence savings falls and incomes decline.

[49] We have also assumed fixed savings rates; hence savings falls and incomes decline.

Table 11: Impact of US actions and partners' responses on selected US macroeconomic variables in 2030 (percentage differences from baseline, unless otherwise stated)

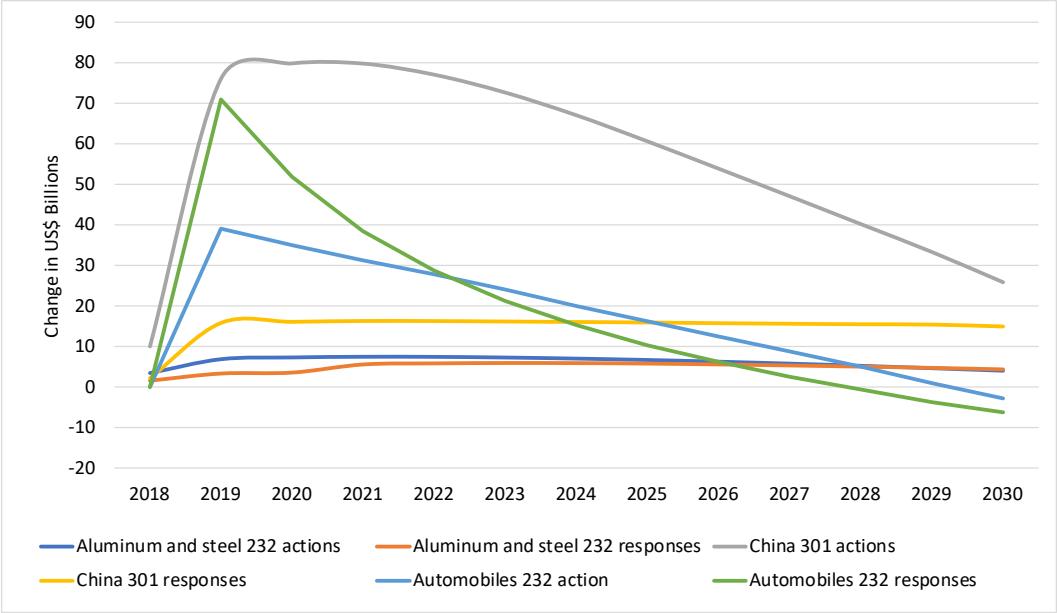
	Aluminum and steel 232		China 301		Automobiles 232		Total
	US action	Partners' responses	US action	Partners' response	US action	Partners' responses	Actions and responses
Real GDP	-0.04	-0.03	-0.70	-0.16	-0.16	-0.17	-1.25
Investment	-0.21	-0.14	-2.83	-0.48	-0.59	-0.17	-4.36
Exports	-0.50	-0.36	-5.37	-1.65	-1.64	-1.51	-10.61
Businesses (intermediates)	-0.51	-0.40	-5.16	-2.93	-1.39	-1.80	-11.67
Investment (goods)	-1.22	0.47	-10.73	-2.00	-3.39	-5.95	-21.11
Final consumers	-0.10	-0.62	-3.50	2.87	-1.88	0.61	-2.71
Imports	-0.38	-0.54	-4.73	-1.91	-0.92	-1.44	-9.58
Businesses (intermediates)	-0.72	-0.49	-2.83	-1.82	-0.70	-1.41	-7.74
Investment (goods)	0.15	-0.58	-9.35	-1.98	-1.65	-1.31	-14.14
Final consumers	0.02	-0.64	-5.42	-2.09	-0.89	-1.42	-10.08
Terms of trade	0.04	-0.32	0.39	-0.95	0.37	-0.54	-1.02
Change in trade balance relative to baseline (US$ millions)	4,005	4,444	25,754	15,005	-2,785	-6,152	40,270

Source: Authors' calculations.

The US terms of trade rise due to the US Sections 232 and 301 actions (columns I, III and V, Table 11), while they fall when its trading partners respond by raising their own tariffs on US goods (columns II, IV and VI).[50] The change in the terms of trade also reflects the extent to which import (c.i.f) prices fall due to the tariffs being borne by the foreign exporting firms; in addition to the fact that tariffs also raise the cost of producing (export) goods.

[50] The terms of trade are a trade weighted average of relative prices of imports to exports (c.i.f) prices before tariffs. A decline in import prices relative to export prices will raise the terms of trade.

Figure 3-4: Impact of US actions and partners' responses on the US trade balance in 2030 differences from baseline (US$ billions)



Source: Authors' calculations.

3.2.3 EMPLOYMENT

With real GDP declining by 1.78 percent in 2019, 2.75 million workers are projected to become unemployed as a result of all the US trade actions and partners' responses combined. The extent to which workers become unemployed depends critically on underlying wage growth in the economy. If wages are growing, government policies or shocks that cause reductions in production and employment in some industries may not result in increased unemployment, since workers can still find jobs at similar or better wages in other industries—we refer to this as displacement, since the unemployment caused by the movement of workers between industries tends to be temporary, provided the worker is willing to relocate. However, when wages are not growing, these displaced workers may experience longer periods of unemployment as they can no longer find jobs in other industries at the current wage.[51]

Over the last 20 years, real GDP growth in the US has averaged 2.0 percent per annum and, for most workers, wages have barely risen. In 2018, growth in US GDP was originally projected to be 2.9 percent, considerably higher than the average, with more recent projections suggesting it could go even higher.[52] With high growth and indications that the US is close to full employment, there is increasing pressure on wages to rise—nominal wages have been on the

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51 High baseline growth also provides firms with more opportunities to respond more cautiously to the trade actions and hence smooth out the decline in demand by accumulating inventories or gradually reducing their workforce, albeit at some cost to them. Our model assumes that firms respond immediately to any disruption—that is, they respond in 2019 when most of the trade actions and responses are implemented.

52 https://www.kiplinger.com/article/business/T019-C000-S010-gdp-growth-rate-and-forecast.html

rise since 2016, although evidence suggests that these increases have not kept up with inflation.[53] In the baseline considered here we project relatively strong economic growth in the US, particularly in 2018 and 2019, low population growth rates, and increased education of workers that leads to real wage rises of less than one percent per annum (Baseline, Figure 3-5).

When aluminum and steel Section 232 actions are introduced, wage growth declines relative to baseline (Policy: Baseline plus aluminum and steel 232 compared to Baseline, Figure 3-5) as employment in some sectors declines, however wage growth remains positive, workers move to new sectors, and unemployment does not increase. As more trade actions are implemented and partners' respond, the downward pressure on wages becomes critical. The addition, Section 301 actions puts pressure on wages to fall by more than one percent in 2019 (Policy: Baseline plus aluminum and steel 232 and China 301, Figure 3-5), resulting in a small amount of unemployment (less than 10,000 workers). When this is followed by automobile Section 232 actions (Policy: Baseline plus Aluminum and steel 232, China 301 and Automobiles 232, Figure 3-5), real wage growth is already zero and employment falls by 2.75 million workers in 2019 (Figure 3-6).

It is worth noting that taken individually, none of the actions or partners' responses (including automobile Section 232 actions) causes unemployment on its own, although wages decline, wage growth remains positive; however, when all three actions and responses are combined, wage growth is pushed to zero, generating unemployment. It is the cumulative effect of earlier policies causing real wages to fall that eventually results in the large increase in unemployment, which in turn causes real GDP to fall further in the short run with the introduction of automobile Section 232 actions and responses (Figure 1-1).[54] If the US can somehow continue strong wage growth with the trade actions in place, displaced workers could shift to new employment, lowering the costs of the trade actions and the reduction in real GDP. However, if real wages fall, displaced workers will likely become unemployed as they search for jobs with equal or higher wages until expectations readjust to the new lower wage rates or demand for labor increases again. The rise in tariffs in 2018 is relatively small compared to those implemented in 2019 and hence wages do not fall below the baseline growth and unemployment does not increase in 2018. The tariff increases imposed by the EU and Japan in 2021 are also insulated by rising wages caused by high baseline growth. Unemployment begins to recover slowly in 2020 (Figure 3-6) as wages rise again with baseline growth (Figure 3-5).[55]

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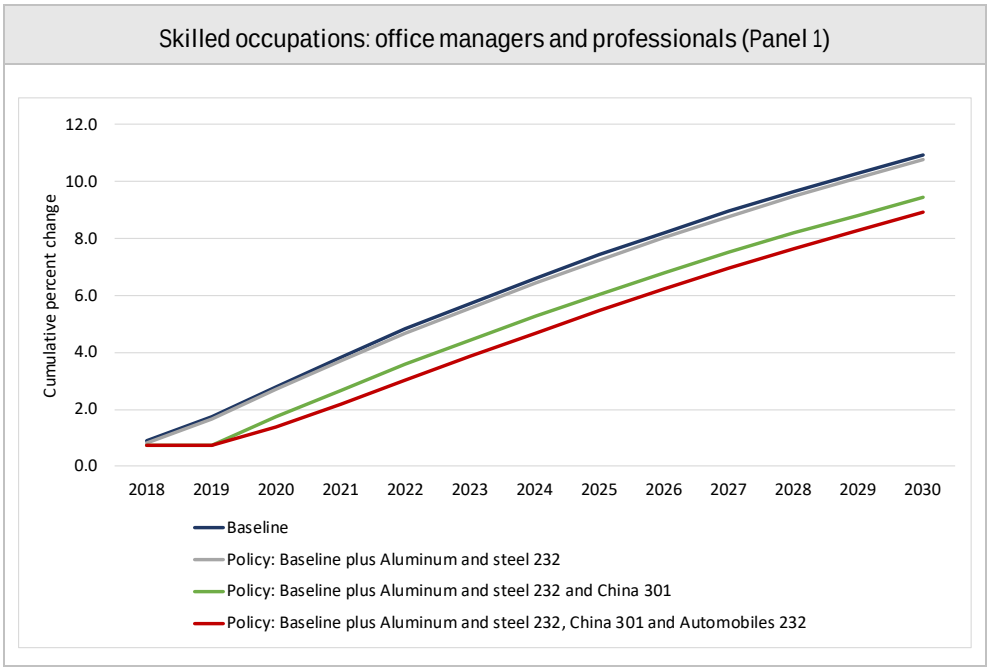
53 https://www.washingtonpost.com/business/2018/08/10/america-wage-growth-is-getting-wiped-out-entirely-by-inflation/?noredirect=on&utm_term=.b90999f6e604

54 It is worth noting that the importance of the US 232 actions on motor vehicles in explaining the detrimental impacts of all three trade actions together, partly reflects the decision to implement it last, once the wage cushion had diminished entirely. The order in which they are implemented and examined reflects the order in which they have been announced by the Administration.

55 Unemployment is assumed to gradually dissipate, even with high baseline growth in wages. This reflects the fact that once a worker becomes unemployed it is harder to re-enter the work force.

If underlying baseline growth is weak and wages are not rising, then the impact of these trade actions on US employment could be even more detrimental (see Appendix III). Further unemployment in the US could also have a detrimental impact on the world economy, as declining US demand and trade could completely offset the gains in competitiveness described above. A case in point is the Smoot-Hawley Tariff Act of 1930.[56] In that case, the US and indeed, the global economy, were already in serious peril, and it is generally agreed that the increase in US tariffs exacerbated the Great Depression (Whaples, 1995). While tariffs were much higher in the 1930s than they are today, the increases proposed under Sections 232 and 301, and the ensuing retaliation by the rest of the world, are similar to those implemented under the Smoot-Hawley Tariff Act. While similar losses in employment are not expected, the long run loss in US real GDP is considerable.

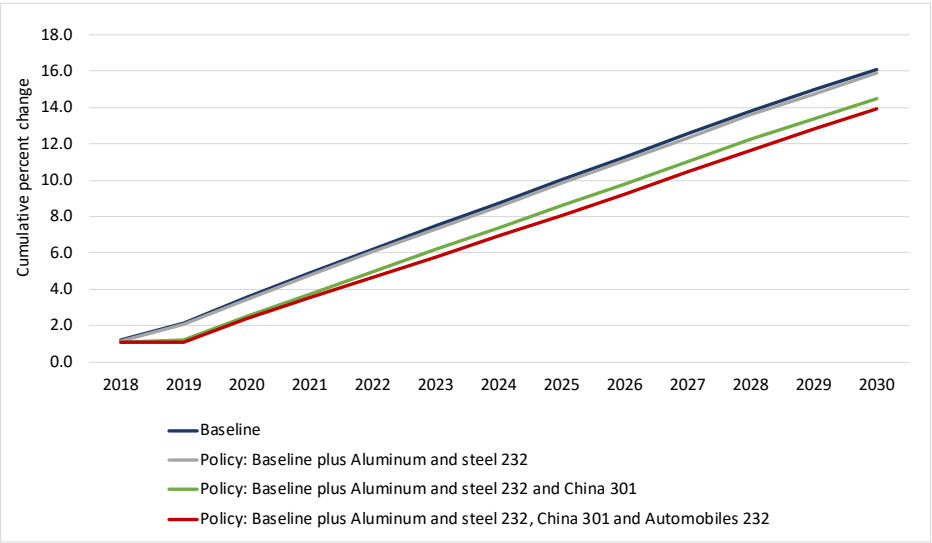
Figure 3-5: Impact of all US trade actions and partners' responses on wages by occupations in the US, over time (Baseline vs. total: 232 and 301 actions and responses)



56 Wikipedia (https://en.wikipedia.org/wiki/Smoot%E2%80%93Hawley_Tariff_Act).

Figure 3-5 (cont.)

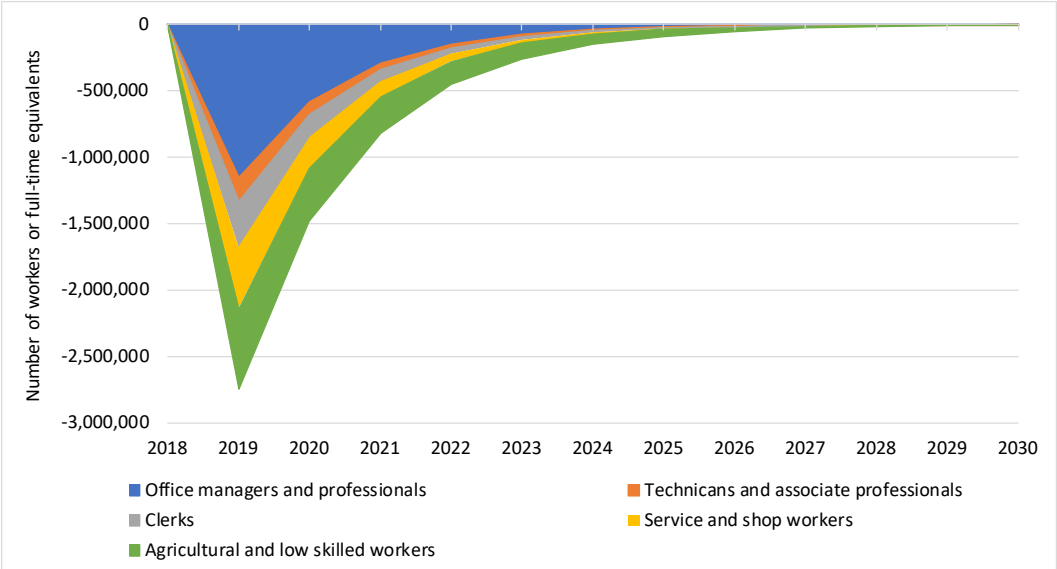
Low skilled occupations: agricultural and low skilled workers (Panel 2)



Source: Authors' calculations.

Figure 3-6 also decomposes the number of unemployed by occupation. Office managers and professionals is the largest labor category in the US, followed by agricultural and low skilled workers. Most of the unemployment is of office managers and professionals and agricultural and low skilled workers in line with labor force shares.

Figure 3-6: Impact of all US trade actions and partners' responses on employment in the US by occupation, over time (number of workers or full-time equivalents relative to baseline)



Source: Authors' calculations.

In addition to the unemployment of 2.75 million workers, the Section 232 and 301 actions also displace a large number of workers who will be required to move to different sectors or

occupations, particularly in the first few years following the imposition of tariffs. In 2019, 665,000 workers must leave their current sector of employment to find a position in another sector; [57] this number of displaced workers is in addition to the 2.75 million who are unable to find work in other sectors and will therefore become unemployed.

While a growing US economy eases this displacement, in the past, changes in tariffs have been implemented gradually to minimize the impact on displaced workers; for instance, TPP, which was projected to increase real GDP by 0.07 to 0.15 percent was planned to be implemented over 15 to 20 years. By 2030, 1.07 million workers are expected to be working in a sector different from the one they would have been working in if the trade actions had not taken place, with many of those displacements projected to occur in 2019.

Figure 3-7 illustrates which trade actions and partners' responses cause most of the displacement of workers in 2019 and 2030. While US Section 301 actions displace the most workers, the aluminum, steel, and automobile Section 232 actions also displace a large number of workers, particularly when compared to the relatively small impact these actions are expected to have on real GDP. In most cases, the level of displaced workers increases slightly over time as the trade actions alter the growth path of different sectors. The larger difference between the 2019 and 2030 displacement of workers due to partners' responses to automobile Section 232 action stems from the fact that this action causes workers not just to be displaced but also to become unemployed—lowering the number displaced in 2019 and raising it in 2030. By 2030 these workers have found new jobs and re-entered the workforce, although many are now employed in different sectors than they would have been, had the trade actions not taken place.

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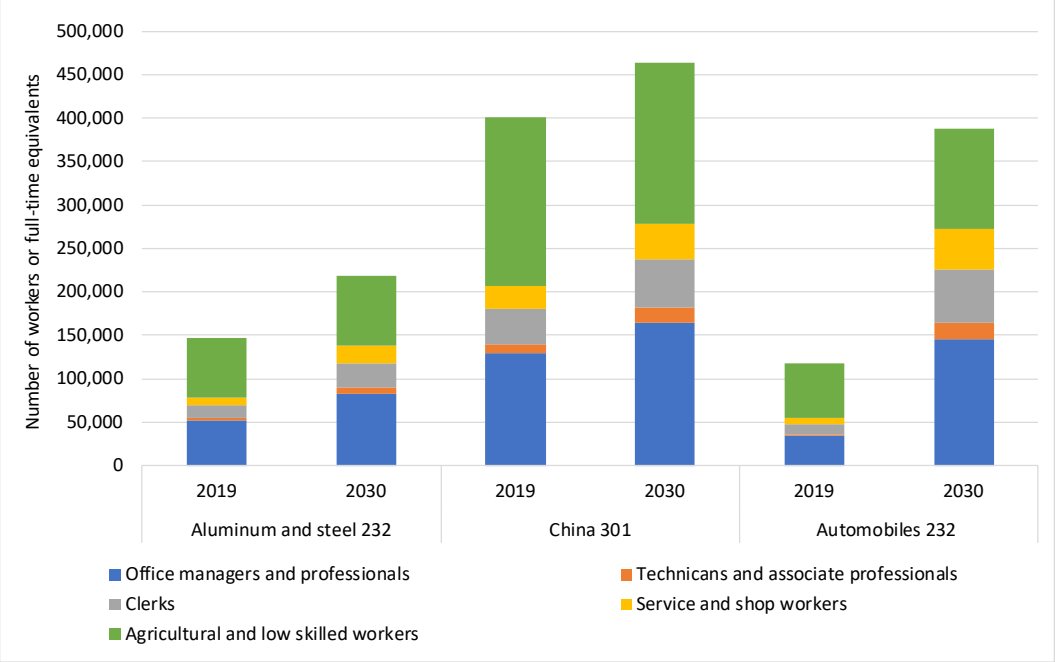
[57] This count depends on the sectoral definitions and does not include workers who may have lost and then found employment in the same sector, for instance workers who might have had to relocate within the services sector.

Figure 3-7: Impact of all US trade actions and partners' responses on the movement of workers in 2019 and 2030 (number of workers or full-time equivalents relative to baseline)



Source: Authors' calculations.

Note: The level of displacement is obtained by adding up the number of new jobs across all sectors (that is, the positive entries in Table 12).

Figure 3-7 also shows that most of the displacement is of agricultural and low skilled workers and office managers and professionals, reflecting the high share of these types of workers in the US labor force. When this share of workers in the labor force is taken into account it is clear that agricultural and low skilled workers are more adversely affected than the other occupations particularly in 2019, immediately following the trade actions. The greater displacement of lower skilled workers should not be surprising since the industries most affected by the trade actions—aluminum, steel, motor vehicles, and the other manufacturing (and to a lesser extent agricultural) – all employ a high proportion of low skilled workers.

Table 12 shows the increases or decreases in demand for workers by each sector in 2030 resulting from the US trade actions and partners' responses.[58] In general, these are related to the changes in production occurring in each of these sectors, although some sectors also take advantage of lower wages to demand more labor, particularly when the decline in production is small and the availability of capital is also declining. For example, the services sector increases its demand for labor, despite a slight decline in production caused by the US actions on aluminum and steel and the partners' responses. Beverages and tobacco also demand less labor, as production falls initially, only rising in the long run. The impacts on production are discussed further in sub-section 3.3.

[58] The difference between the number of workers demanded by each sector in the policy in 2030 and the number of workers demanded by each sector in the baseline in 2030.

Table 12: Impact of US actions and partners' responses on sectoral demand for labor in 2030 (change in number of workers or full-time equivalents)

Commodity	I Aluminum and steel 232	II China 301	III Automobiles 232	IV Total
Coarse grains (corn, sorghum, millet etc.)	-1,222	-15,133	-2,302	-18,657
Vegetables and fruit	-12,321	19,191	2,537	9,407
Oil seeds (Soybeans, sunflower, flax)	2,989	-15,297	1,812	-10,496
Sugar	135	359	167	661
Dairy products	990	-5,884	1,186	-3,708
Rice	-671	810	-391	-252
Cattle and sheep	-6,721	6,730	-2,960	-2,951
Cattle and sheep meat	-4,890	6,469	-2,022	-443
Meat nec (pork etc.)	-19,929	9,302	-5,226	-15,853
Vegetable oils	178	308	137	623
Agriculture nec (a)	-4,506	19,040	-7,386	7,148
Agriculture	-45,968	25,895	-14,448	-34,521
Processed food	293	-827	-3,066	-3,600
Beverages and tobacco products	-1,557	1,360	391	194
Textiles	7,002	-46,287	-4,606	-43,891
Wearing apparel and leather	1,060	19,148	2,120	22,328
Paper and paper products	596	-29,715	-807	-29,926
Chemicals, rubber and plastics (pharmaceuticals)	13,996	-97,896	-43,516	-127,416
Iron and steel	31,952	6,584	2,273	40,809
non-Ferrous metals (aluminum)	-16,515	-14,248	-2,679	-33,442
Fabricated metal products	-34,454	88,347	14,608	68,501
Motor vehicles and parts	-7,436	-42,344	76,540	26,760
Transport equipment nec	-9,426	-113,922	-180,513	-303,861
Electronic equipment	2,349	19,443	-12,389	9,403
Machinery and equipment nec	-31,066	46,857	-61,031	-45,240
Manufactures nec (b)	-9,829	23,678	-7,425	6,424
Manufactures	-53,035	-139,822	-220,100	-412,957
Coal, oil, gas and petroleum products	-10	-1,710	2,154	434
Lumber and forestry	-153	43,274	-153	42,968
Extractive	-163	41,564	2,001	43,402
Private and government services	99,983	73,069	226,425	399,477

Source: Authors' calculations.

(a) Includes hides and skins, forage (hay and clover), raw tobacco, wheat, muslin, animal guts and bladders, down, ginseng root, seeds, medicinal herbs, honey, live reptiles etc.

(b) Other minerals, non-metallic minerals and manufactures.

3.2.1 NATIONAL AND HOUSEHOLD INCOME

Table 13 examines the change in real income and the factors that contribute to this change. Real income is 0.76 percent lower (column VII) because of the trade actions and responses. This is primarily due to a decline in real household income of 1.8 percent. The difference in real income relative to real household income reflects the additional tariff revenues collected by the US government from foreign exporters. For US aluminum, steel, and automobiles Section 232 actions (columns I and V, Table 13), real income rises as the tariff revenues collected offset the loss in household income. This is not surprising given the size of the expected increases in tariff revenues outlined in Table 3, Table 5 and Table 7. The difference between the change in real income and real household income is less significant when partners respond, since increased tariffs in partner countries have only an indirect impact on US tariff revenues.

While the US government collects more income from its trade actions, real household income falls in response to all the US actions and partners' responses as real returns to labor, and the ownership of capital, land, and natural resources fall. This fall in real household income is equivalent to a loss of $1,646 per household (or $639 per person) in 2017 dollars, in 2030; in 2019, the loss in real household income per household is slightly higher at $2,357 (or $915 per person) in 2017 dollars, due to unemployment. When the losses are cumulated over the period 2018 to 2030 and discounted to 2017 dollars, each household will lose $17,276 in spending power over the period.[59]

The fall in returns to labor stem from the reduction in wages and, in the short run, the increase in unemployment. Returns to capital fall as rental returns to capital falls in the short run, and capital stocks fall in the long run. Returns to land and natural resources also tend to fall, except in a few limited cases where production of agriculture or production of extraction goods (oil, coal and gas and lumber and forestry) rise, respectively. Overall, the incomes of agricultural and low skilled workers and the owners of land decline the most, suggesting that the average loss in spending power for low income households and farmers is likely to be more than the averages provided above suggest.

Finally, prices tend to rise when the US imposes tariffs and fall slightly when partners respond, leading to an overall increase in consumer prices.[60] The rise in prices in the US contributes further to the decline in real income, particularly for those households that consume most of their income.

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59 Discounted to 2017 using a real interest in US of 2.5 percent, based on average of last 10 years (IMF, 2018a).

60 The very small decline in consumer prices due to the US Section 232 actions on steel and aluminum is due to that fact most of the US consumers' budget is spent on services, which experienced a small decline in price due to falling wages. If services are excluded, consumer prices rise.

Table 13: Impact of US actions and partners' responses on US income and its components in 2030 (percentage differences from baseline, unless otherwise stated)

	Aluminum and steel 232		China 301		Automobiles 232		Total
	I US action	II Partners' responses	III US action	IV China's response	V US action	VI Partners' responses	VII Actions and responses
Real income	0.00	-0.09	-0.16	-0.35	0.07	-0.23	-0.76
Real households or factor income	-0.07	-0.10	-0.87	-0.36	-0.19	-0.22	-1.80
Real income from labor							
Office managers and professionals	-0.09	-0.07	-0.88	-0.30	-0.16	-0.28	-1.77
Technicians and associate professionals	-0.07	-0.06	-0.90	-0.24	-0.16	-0.21	-1.63
Clerks	-0.08	-0.06	-0.89	-0.26	-0.16	-0.23	-1.67
Service and shop workers	-0.08	-0.06	-0.89	-0.27	-0.16	-0.25	-1.71
Agricultural and low skilled workers	-0.16	-0.10	-0.80	-0.48	-0.15	-0.59	-2.27
Real income from:							
Land	0.14	-1.44	-2.49	-4.14	-1.12	-0.58	-9.31
Capital	-0.12	-0.09	-1.32	-0.41	-0.30	-0.38	-2.60
Natural resources	0.03	-0.23	-2.21	0.52	-0.91	1.16	-1.66
Consumer prices	-0.04	-0.23	1.39	-0.84	0.51	-0.57	0.21

Source: Authors' calculations.

3.3 US Sector and Industry Impacts

The following sections 3.3.1 and 3.3.2 review the estimated impacts of US Section 232 and 301 trade actions on broad sectors and selected industries[61]. Broadly, all the major sectors of the US economy, except extraction, experience short and long run declines in production because of the Section 232 and 301 actions. Initially, services decline the most in 2019, a reduction of 1.5 percent (Figure 1-2), followed by agriculture, and then manufactures (-0.3 percent). In the long term, as wages decline and unemployment is reduced, the services sector rebounds, since it is labor intensive. In contrast, manufactures, which is more capital intensive, continues to decline due to lower rates of return and declining investment in capital stocks.

Even though production declines in three of the four broad sectors, each of the two goods producing sectors, agriculture and manufactures, have sectors which expand because of the

[61] The model includes 28 detailed sectors which are aggregated to four broad sectors for analysis and summary purposes. See Appendix IV for a list of sectors and description of commodities included.

trade actions—creating winners and losers. The following two sections provide an overview of the individual actions and their impact, and analysis of selected sectors.

3.3.1 SECTOR IMPACTS BY TRADE ACTION

Table 14 provides the impact of the US trade actions and partners' responses on US production and prices by sector. Since changes in production are linked to trade, the impacts on US exports and imports are provided in Table 15. Finally, Table A 4 and Table A 5 in Appendix V separate the results further by US actions and partners' responses, which will be occasionally assist in interpreting results. This section summarizes the general impacts of each US trade action across all sectors concentrating on each of the actions in turn.

Aluminum and Steel Section 232 Actions and Responses

The implementation of higher tariffs on aluminum and steel as a result of the US Section 232 actions aimed at protecting these industries, raises the price of imported steel and aluminum, causing US consumers to substitute away from imported iron and steel and non-ferrous metals (aluminum) (column V, Table 15). Increased domestic sales cause production of iron and steel to expand; while production of non-ferrous metals (aluminum) declines (column I, Table 14) with a significant fall in exports (column I, Table 15). This is discussed further in the next section when we examine the impact of the trade actions on specific sectors.

Aluminum and steel are important intermediate inputs into manufactured goods. With the application of US tariffs on these goods, the production (and exports) of goods that depend on aluminum and steel, such as motor vehicle, transport equipment, and machinery and equipment, decline (column I, Table 14), as aluminum and steel prices rise (column V, Table 14).[62] Industries, such as agriculture, food processing, and wearing apparel, that do not rely as heavily on aluminum or steel, gain slightly due to the increased availability of labor at lower wages and, in some cases, a slight fall in their own prices. Increased access to lower wage labor comes from the decline in production of manufacturing sectors that depend on aluminum and steel, which shed more labor than the expanding iron and steel industry requires.

The US trading partners respond by raising tariffs on US goods and US exports decline further in those industries where tariffs were raised by the partner countries: vegetables and fruit, meat (beef, pork and others), beverages and tobacco, causing exports to decline, even with declining domestic prices of those goods (column I, Table 15). Some agricultural commodities and light manufactures (e.g., oil seeds and textiles) not targeted with retaliatory tariffs do experience gains in domestic and export sales.

Except for fabricated metal products, US imports decrease because of the aluminum and steel Section 232 action (column V, Table 15). The decline in imports is due, in part, to the Section

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[62] Results separated into US actions and partners' responses (illustrated into Appendix V).

232 tariffs themselves, but is more broadly a result of the decline in domestic prices relative to the price of imports, which follows from the small decline in wages and rental prices precipitated by lower production of manufactured goods (column V, Table 14). The broad-based decline in domestic wage costs and hence industry costs (despite rising iron, steel and aluminum costs), causes consumers to switch to domestically produced goods. However, this switching does not generally overcome any loss in export sales and hence production rises or falls with the change in exports. Imports of fabricated metal products, however, rise as domestic prices rise with the increase in US tariffs on intermediate aluminum and steel that raise their costs—declines in the cost of wages are not enough to outweigh the increased materials costs due to the Section 232 tariffs. The decline in exports and domestic sales therefore combine to cause production of fabricated metal products to decline further (column I, Table 14).

China Section 301 Actions and Responses

The current and proposed US China Section 301 actions (column II, Table 14) are the largest trade action the administration has undertaken with the potential to significantly impact broad segments of the US economy. While the US Section 301 actions were intended to address some of China's unfair acts related to technology transfer, intellectual property, and innovation, the impact of the US actions and China's responses are found to be detrimental to many sectors of the US economy, with most sectors experiencing a decline in production. As mentioned above, intermediate goods are a significant portion of US imports and raising tariffs on these intermediate goods raises the cost of production in the US (column VI, Table 14), particularly for manufactured goods that require more imported intermediate inputs. That said, in some industries (wearing apparel, fabricated metal products, electronics, and lumber and forestry) that compete directly with Chinese imports and where tariffs rise significantly, we do see a rise in production as US consumers switch from Chinese imports to domestically produced goods.

While China's response is less than the US Section 301 actions, specific sectors in the US which export a high portion of their production to China experience significant declines when China raises its tariffs. Those most impacted include oil seeds (soybeans); coarse grains (including corn); textiles; dairy products; and chemicals, rubber and plastics (pharmaceuticals).

The changes in trade with China are generally large, due to the magnitude of the US Section 301 tariffs and China's response, and hence drive most of the total changes in US exports and imports (columns II and VI, Table 15). There are a few notable exceptions, including vegetables and fruit and meat, where the decline in exports to China are outweighed by the increase in exports to the rest of the world to give an overall increase in US exports from the Section 301 actions (column II, Table 15).

Automobiles Section 232 Action and Response

Column III, Table 14 summarizes changes in US production, due to both the US automobile Section 232 actions and the partner responses combined. To understand the impacts of increasing tariffs on automobiles and parts, it is helpful to decompose the impacts due to the

US actions on autos and partners' responses. Appendix V Table A 5, provides this break down. With the exception of motor vehicles and fabricated metal products, US automobile Section 232 tariffs are detrimental for all sectors. Prices rise across all sectors (column V, Appendix V, Table A 5), particularly in manufacturing where more imported intermediates are used in production, but also more generally as wages become sticky, causing production costs and prices to remain high. As prices increase, demand (including for exports) and production of manufactures declines, except for motor vehicles and parts and fabricated metal products where consumers substitute away from more expensive imports (column VII, Table 14) towards domestically produced goods due to the higher US tariffs targeting these commodities under the automobile Section 232 action. The exclusion of Canada and Mexico from the automobile Section 232 action means that imports from Canada and Mexico increase by 30-35 percent,[63] while imports from Japan, Korea, EU, China, Brazil, Argentina and rest of world decline by 40 to 60 percent.

The partners' responses to US tariffs on automobiles and parts cause exports and production in some sectors to fall further: coarse grains (including corn), meat (beef, pork and others), chemicals, rubber and plastics (pharmaceuticals), transportation equipment, motor vehicles and parts, fabricated metal products, electronic equipment and other manufactures. The decline in these industries frees up resources (labor) to move to other sectors and puts further downward pressure on wages in the US causing unemployment to rise, as workers can no longer find employment at prior wage levels.

In summary, production declines across most sectors because of all US trade actions and partners' responses. Production does increase in a few selected industries, including vegetables and fruit, sugar, cattle and sheep, vegetables oils, agriculture nec, iron and steel, fabricated metal products, motor vehicles, electronic equipment, and forestry and lumber.

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63 The USMCA includes side letters exempting Canada and Mexico from automobile 232 actions. The increase in US imports projected here do not exceed side letter quotas. Pre- and post-simulation proportions of non-NAFTA content imported by Mexico and Canada remain relatively constant.

Table 14: Impact of US actions and partners' responses on production, by sector, 2030 (percent change from baseline)

Commodity	Production				Prices			
	I Alum. & steel 232	II China 301	III Auto 232	IV Total	V Alum. & steel 232	VI China 301	VII Auto 232	VIII Total
Coarse grains (corn, sorghum, millet etc.)	-0.12	-2.64	-0.39	-3.13	-0.94	-3.83	-0.98	-5.66
Vegetables and fruit	-0.55	1.75	0.27	1.46	-1.03	-1.62	-0.65	-3.26
Oil seeds (Soybeans, flax, etc.)	1.04	-3.92	0.70	-2.25	-0.39	-3.75	-0.44	-4.55
Sugar	0.30	0.84	0.28	1.43	-0.30	-0.02	-0.16	-0.47
Dairy products	0.16	-1.14	0.07	-0.92	-0.50	-1.13	-0.39	-2.00
Rice	-1.42	2.25	-0.85	-0.05	-0.54	-0.12	-0.27	-0.93
Cattle and sheep	-1.56	2.37	-0.63	0.14	-1.04	-2.27	-0.86	-4.13
Cattle and sheep meat	-1.72	1.84	-0.87	-0.78	-0.69	-1.20	-0.54	-2.42
Meat nec (pork etc.)	-5.02	2.14	-1.48	-4.43	-0.63	-0.93	-0.57	-2.12
Vegetable oils	1.11	1.33	0.56	3.02	-0.33	-1.76	-0.28	-2.35
Agriculture nec	-0.18	2.10	-0.39	1.51	-0.81	-1.46	-0.82	-3.07
Agriculture	-1.04	0.50	-0.39	-0.94	-0.73	-1.82	-0.64	-3.16
Processed food	-0.06	-0.67	-0.52	-1.25	-0.35	-0.27	-0.22	-0.83
Beverages and tobacco	-0.66	-0.61	-0.36	-1.62	-0.23	0.23	-0.12	-0.12
Textiles	0.84	-6.24	-0.82	-6.23	-0.27	0.34	-0.08	0.00
Wearing apparel and leather	0.31	6.06	0.50	6.91	-0.27	0.37	-0.16	-0.06
Paper and paper products	-0.06	-1.98	-0.33	-2.36	-0.29	0.28	-0.14	-0.15
Chem., rubber, and plastics	0.39	-4.33	-2.01	-5.89	-0.21	0.40	0.06	0.25
Iron and steel	5.84	0.68	0.17	6.74	0.80	0.55	-0.12	1.24
non-Ferrous metals (aluminum)	-6.20	-6.19	-1.39	-13.23	0.40	0.79	0.00	1.19
Fabricated metal products	-2.25	5.31	0.70	3.66	0.56	0.44	-0.16	0.85
Motor vehicles and parts	-0.53	-3.13	4.68	0.86	0.02	1.13	0.84	2.00
Transport equipment nec	-0.67	-7.81	-12.92	-20.25	-0.07	0.71	-0.03	0.61
Electronic equipment	0.48	4.01	-3.17	1.20	-0.08	2.65	-0.03	2.54
Machinery and equipment nec	-0.74	0.53	-1.54	-1.74	0.01	0.83	-0.07	0.76
Manufactures nec	-0.74	1.31	-0.68	-0.13	-0.17	0.40	-0.14	0.09
Manufactures	-0.23	-1.39	-1.02	-2.63	-0.05	0.69	0.02	0.66
Coal, oil, gas and pet. prod.	-0.01	-0.14	0.02	-0.13	-0.15	-0.06	0.12	-0.08
Lumber and forestry	-0.05	2.35	-0.16	2.13	-0.20	0.65	-0.09	0.35
Extractive	-0.02	0.37	-0.02	0.33	-0.15	0.04	0.09	-0.02
Services	-0.02	-0.61	-0.16	-0.79	-0.31	0.09	-0.20	-0.42

Source: Authors' calculations.

Table 15: Impact of US actions and partners' responses on US exports and imports in 2030 (percent change relative to baseline)

Commodity	Exports				Imports			
	I Alum. & steel 232	II China 301	III Auto 232	IV Total	V Alum. & steel 232	VI China 301	VII Auto 232	VIII Total
Coarse grains (corn, sorghum, millet etc.)	0.52	-9.03	-0.54	-9.05	-1.34	-5.36	-1.79	-6.63
Vegetables and fruit	-3.36	3.12	0.13	-0.22	-1.39	-3.47	-1.37	-4.81
Oil seeds (Soybeans, flax, etc.)	1.10	-6.74	0.82	-4.94	-0.16	-10.19	-1.09	-10.34
Sugar	1.36	3.93	1.75	7.19	-0.50	-2.03	-0.96	-2.52
Dairy products	0.01	-11.23	-0.45	-11.62	-1.58	-6.03	-2.28	-7.51
Rice	-2.18	3.20	-1.20	-0.26	-1.73	-2.19	-1.17	-3.88
Cattle and sheep	3.85	8.47	2.73	15.72	-3.70	-3.31	-2.96	-6.89
Cattle and sheep meat	-11.36	4.39	-8.87	-15.68	-3.23	-5.33	-2.90	-8.39
Meat nec (pork etc.)	-12.25	4.00	-4.47	-12.82	-2.45	-4.94	-4.17	-7.27
Vegetable oils	1.63	0.40	0.75	2.80	-0.35	-3.72	-1.32	-4.06
Agriculture nec	4.26	2.26	-0.12	6.50	-1.31	-3.48	-1.78	-4.74
Agriculture	-2.32	-1.00	-0.78	-4.05	-1.50	-5.42	-4.64	-6.84
Processed food	-0.36	-5.25	-2.90	-8.32	-0.66	-2.08	-1.11	-2.72
Beverages and tobacco	-4.79	-2.91	-2.31	-9.70	-0.50	-0.93	-0.49	-1.43
Textiles	1.27	-17.31	-2.59	-18.43	-0.53	-2.95	-0.48	-3.47
Wearing apparel and leather	-1.29	-9.40	1.75	-9.00	-0.69	-4.90	-0.59	-5.55
Paper and paper products	-0.23	-12.50	-1.29	-13.82	-0.75	-8.96	-1.82	-9.64
Chem., rubber, and plastics	0.57	-9.81	-5.77	-14.53	-0.45	-3.67	-2.77	-4.11
Iron and steel	-19.81	-7.00	1.28	-24.47	-30.31	-3.92	-0.81	-33.04
non-Ferrous metals (aluminum)	-14.48	-13.41	-2.92	-28.11	-5.27	-1.51	-1.11	-6.70
Fabricated metal products	-8.89	-6.19	-0.86	-15.27	1.13	-19.94	-3.47	-19.03
Motor vehicles and parts	-0.92	-7.04	-4.37	-11.92	-0.38	-3.10	-8.50	-3.47
Transport equipment nec	-1.24	-15.92	-27.58	-39.87	-0.61	-6.56	-4.63	-7.13
Electronic equipment	0.94	-34.70	-11.58	-41.72	-0.35	-10.23	-1.46	-10.54
Machinery and equipment nec	-1.37	-16.37	-8.76	-24.74	-0.36	-11.27	-3.26	-11.59
Manufactures nec	-2.73	-6.02	-2.77	-11.11	-0.49	-10.86	-0.92	-11.30
Manufactures	-1.68	-12.97	-6.74	-20.20	-1.13	-7.34	-3.55	-8.39
Coal, oil, gas and petroleum products	-0.44	-0.35	0.41	-0.39	-0.30	-1.08	-0.19	-1.38
Lumber and forestry	-0.47	-19.96	-4.28	-23.74	-0.70	-16.15	-2.19	-16.73
Extractive	-0.44	-1.48	-0.97	-2.87	-0.34	-2.46	-0.97	-2.79
Private and government services	1.13	1.24	0.76	3.16	-0.67	-1.01	-0.62	-1.68

Source: Authors' calculations.
Note: See Appendix V, Table A 6 and Table A 7 for a more detailed breakdown of the impacts on trade with China and with the rest of the world.

3.3.2 IMPACT OF TRADE ACTIONS ON SELECTED SECTORS

Iron and Steel and non-Ferrous Metals (aluminum)

Aluminum and steel Section 232 actions are intended to raise domestic production of these products (steel—listed as iron and steel in the tables; and aluminum—listed as non-ferrous metals). For iron and steel, the aluminum and steel Section 232 actions has resulted in higher production, however for non-ferrous metals (aluminum) the Section 232 action lowers production.

In the case of iron and steel, the increase in domestic sales outweighs the considerable decline in exports (column IV, Table 15) resulting in a large overall increase in production of 6.74 percent (column IV, Table 14). While the initial rise in production of iron and steel from the US Section 232 action is partially reversed by the responses of the US major trading partners to that action (Appendix V, Table A 4), the other actions and partners' responses do not reduce the growth in production significantly—in most cases production of iron and steel rose further (columns II and III, Table 14).

The production of non-ferrous metals (aluminum), on the other hand, has been limited by the Sections 232 and 301 actions and the partners' responses, with a significant decline in production of 13.23 percent (column IV, Table 14). This decrease in non-ferrous metals (aluminum) production occurs for two reasons: first, a relatively large share of US produced non-ferrous metals (aluminum) are exported; and second, imported intermediate non-ferrous metals (aluminum) are important inputs into the production of US non-ferrous metals (aluminum). Hence the rise in the price of these imported inputs, due to increased tariffs on imported non-ferrous metals (aluminum), raises the price of US non-ferrous metals (aluminum) (column V and VI).[64] As a result, the increase in domestic sales fails to offset the decline in exports (columns I, II, and III, Table 15). This decline in production is magnified as the partners' respond by raising their tariffs on non-ferrous metals (aluminum). Although baseline growth in this sector is positive, it is small; hence the decline in production resulting from the trade actions and partners' responses causes growth of the industry to decline slightly over time.

Motor Vehicles

Like aluminum, steel and motor vehicles are also subject to a proposed automobile Section 232 action, however, for motor vehicles, production increases by less than one percent (0.86, column IV, Table 14). The automobile Section 232 action reverses the negative effects of rising input costs from US trade actions on aluminum, steel, and Section 301 actions.

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[64] https://www.reuters.com/article/us-usa-trade-alcoa/alcoa-asks-for-tariff-exemption-on-imports-of-canadian-aluminum-idUSKBN1KR277.

Iron and steel and non-ferrous metals (aluminum) are important inputs into the production of motor vehicles, higher tariffs on these products due to Section 232 actions, raise the cost of producing motor vehicles (column V), reducing US exports and production (column I, Table 15 and Table 14, respectively). The results are similar when the US raises tariffs on motor vehicle parts from China under the Section 301. US imports of Chinese motor vehicles and parts consist primarily of intermediate parts purchased to produce US motor vehicles (see Table 5). Raising tariffs on these intermediate inputs again raises the cost of producing motor vehicles in the US (column VI, Table 14), reducing exports and production (column II, Table 15 and Table 14, respectively).

When automobile Section 232 action raises tariffs on motor vehicles and parts from all countries, except Canada and Mexico, and partners respond, this further raises the costs of producing motor vehicles leading to a decline in imports from and exports to these countries. Since Canada and Mexico are exempt, the US imports more motor vehicles and parts from Canada and Mexico, although total imports still decline (column VII, Table 15). The US exports more to businesses (intermediates) and investment (goods) in Canada and Mexico, although again total exports still decline due to the fall in exports to other countries (column III). Final consumers in Canada and Mexico decrease their demand for US motor vehicles due to the higher price of US products. Regardless, the production of motor vehicles and parts rises due to the increase in domestic sales, caused by substitution away from imports.

Cattle and Sheep Meat and Meat nec (pork etc.)

In general, agricultural commodities are not impacted significantly by the US actions themselves; however, they are frequently targeted by US trade partners in their response to those actions. In both the responses to Section 232 actions on aluminum and steel and automobiles, and in China's response to US actions under Section 301, partner countries have raised tariffs on meat products.

Despite partners raising tariffs on meat in response to all three actions, the impact on US production differs between the three actions (Table 14). In the case of the partners' responses to the US actions under Section 232, the rise in tariffs reduces their imports from the US (i.e., US exports, columns I and III, Table 15) causing US production to fall (columns I and III, Table 14). China's Section 301 responses also reduce China's imports from the US, although in that case, US exports and production still rises due to increased domestic sales and exports to other countries. The reason for this is that China is just one of several important importers (Canada, Mexico, Japan, Korea and rest of world) of US meat, and hence the rise in imports of those other important importers outweighs the fall in China's imports (column II, Table 14).

The overall production of meat still falls, as the responses to US actions under Section 232 outweighs the response of China to US actions under Section 301 (column IV, Table 14).

Oil Seeds (soybeans)

As in the case of meat products, oil seeds (soybeans) are not directly impacted by the US actions, but by the partners' responses to those actions. China, a major consumer of soybeans, increases tariffs on its imports from the US, in responses to US actions under Section 301. Tariffs are also projected to increase in Japan and Korea, in response to US actions under Section 232 on automobiles. Tariffs on oil seeds are not increased by partner countries in response to US Section 232 actions on steel and aluminum.

Since tariffs on oil seeds are not raised by any of the trading partners in response to US actions under Section 232 on steel and aluminum, the general decline in wages and hence costs of producing oil seeds cause demand and hence production of oil seeds to rise slightly (column I, Table 14). When tariffs on oil seeds are raised by China—the largest importer of US oil seeds – in response to Section 301 actions, US exports and, in turn, production fall (column II, Table 15 and Table 14, respectively). On the other hand, when tariffs on oil seeds are raised by Japan and Korea in response to US automobile Section 232 action, US exports to Japan and Korea fall, although oil seed production does not (column III, Table 14). This is because Japan and Korea are not large importers of US oil seeds. Hence the fall in exports to Japan and Korea are easily offset by increased domestic sales and production rises.

The situation mirrors that found in meat production, since in that case it was the other trading partners that dominated, while in oil seeds, China is the most important trading partner. Regardless, production declines in both cases as important importers raise their tariffs in response to US actions brought against them, causing US exports and production to fall.

Lumber and Forestry

Unlike meat and oil seeds, for which the US is a net exporter, the US imports more lumber and forestry products than it exports. As a result, lumber and forestry production is not significantly impacted by the US trading partners' reciprocal tariffs. Instead, Section 301 tariffs placed on US imports from China, a major source of lumber and engineered wood products, reduces imports significantly (column II, Table 14). As tariffs are raised on imports from China, the largest foreign supplier of lumber and forestry products in the US, the US switches away from Chinese imports (column VI, Table 15) towards domestically produced goods, raising US production of lumber and forestry products.

Chemicals, Rubber, and Plastics (pharmaceuticals)

Chemicals, rubber, and plastics is another industry impacted by the US actions and partners' responses. The US raises tariffs on chemicals, rubber, and plastics from China as part of its actions under Section 301 and in response, China reciprocates, raising tariffs on its imports of

chemicals, rubber and plastics from the US. Japan is also projected to target US chemicals, rubber and plastics when responding to US actions under Section 232 on automobiles.[65]

Since the production of chemicals, rubber and plastics requires imported intermediate inputs of chemicals, rubber and plastics and other commodities, raising tariffs on imported intermediates from China, raises the cost of production in the US. This causes domestic sales and exports (columns II and III, Table 15) to decline, leading to the decline in US production (columns II and III, Table 14). When partners respond to US actions under Sections 232 on automobiles and Section 301 by raising their tariffs on chemicals, rubber and plastics, this further reduces US exports and production. The overall impact is a decline of 5.89 percent in US production (Column VI).

Transport Equipment

The transport equipment sector experiences the largest decline in percentage terms, just over a 20 percent (Column, IV, Table 14). As in the case of motor vehicles the production of transport equipment in the US relies heavily on imported intermediates, including non-ferrous metals (aluminum), as well as other machinery and equipment, transport equipment, and electronics from China. US Section 232 actions on steel and aluminum and Section 301 on China raise tariffs, causing the cost of producing transport equipment in the US to rise (Appendix V, Table A 5); exports and production fall (Columns I and II, Table 15 and Table 14 respectively). Raising tariffs on motor vehicle parts under the Section 232 action on automobiles also raises the price of these inputs (Appendix V, Table A 5), as both use similar intermediate inputs, causing the price of transport equipment to rise further, leading to an even greater decline in production (column III, Table 14).

China and the US trade partners respond to US actions by raising tariffs on transport equipment from the US, exports of transport equipment decline further. This is particularly true in the case of the partners' responses to Section 232 on automobiles, where transport equipment appears at the top of the list of reciprocal tariffs levied (Appendix I, Table A 2) and production decreases by a further 10.59 percent. Overall, prices rise and production falls (columns IV and VIII, Table 14).

3.4 Bilateral Trade

Table 16 allows us to examine the impact of the US trade actions and partners' responses on bilateral trade. As mentioned previously, trade falls globally by 0.93 percent due to the tariffs and resulting declines in real incomes of two of the largest trading partners, the USA and China.

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[65] US trading partners also increases in tariffs on chemicals, rubber and plastics in response to US actions under Section 232 on steel and aluminum, however the changes in tariffs are relatively small.

As expected, there is a very large decline in trade between the US and China (Table 16). This is primarily caused by US actions under Section 301 on China's trade practices, which cause trade to fall across almost every commodity as the US and China raise tariffs on a wide range of commodities (Appendix V, Table A 6). While the US decreases its imports from China, the rest of the world buys more Chinese goods – offsetting some of the decline in Chinese exports to the US. Chinese imports from most countries decline, however, as Chinese incomes and hence demand for goods from all countries falls. The exceptions to this are Argentina and Brazil, which export more oil seeds (soybeans) and meat to China because of China raising tariffs on US oil seeds (soybeans) and meat.

Except for Mexican exports to Canada, trade between the NAFTA countries rises, particularly in response to US actions under Section 301 and Section 232 on automobiles, to which Canada and Mexico were exempt. NAFTA countries exports to countries outside of NAFTA tend to fall as US goods (particularly manufactures), and Canadian and Mexican goods, become more expensive. The rise in the price of Canadian and Mexican goods is the result of NAFTA, which has caused increased trade in intermediates and the integration of US, Canadian, and Mexican supply chains. Canada and Mexico import more from outside of the NAFTA block as businesses search for cheaper intermediate inputs and investment goods; US firms also do this, but there are less opportunities to do this with higher US tariffs in place.

The impact of the action on trade amongst the rest of the world is mixed. The EU, Japan, and Korea all increase their imports from non-NAFTA countries, while also increasing exports amongst themselves. Trade between Argentina and Brazil also rises, and their exports to most countries increase, including, as mentioned previously, China. Russia also increases its exports to most countries, including China.

Table 16: Impact of all US actions and partners' responses on global bilateral trade in 2030 (percent change relative to baseline)

Exporting country	Importing country											
	USA	Canada	Mexico	EU	China	Japan	Korea	Brazil	Russia	Argentina	Rest of World	Total exports
US	-	2.8	6.6	-6.7	-64.7	-41.2	-25.3	-0.1	-1.0	0.4	0.3	-10.6
Canada	8.5	-	4.2	-6.9	-4.5	8.8	0.6	-7.6	-10.9	-7.4	-6.6	3.8
Mexico	15.3	-8.5	-	-16.8	-18.7	-16.0	-16.7	-18.6	-16.7	-18.7	-17.5	6.6
EU	5.1	6.1	12.5	0.7	-1.7	5.0	2.6	-1.2	-1.3	-1.4	-0.3	0.8
China	-65.8	21.6	27.6	12.1	-	13.1	12.7	8.5	8.7	8.2	10.7	-5.7
Japan	-2.6	14.5	18.8	1.8	-2.0	-	2.1	-0.5	0.5	-0.3	0.9	0.1
Korea	7.9	13.9	7.6	2.8	-2.5	1.6	-	-1.9	-0.8	-1.8	0.3	0.4
Brazil	1.2	3.1	13.8	1.1	3.7	8.6	3.4	-	-1.7	1.3	0.0	1.6
Russia	-0.5	3.8	12.4	0.5	0.5	1.2	0.3	0.5	-	-0.1	1.0	0.6
Argentina	-3.8	12.2	14.5	2.0	9.9	10.7	1.1	1.8	0.2	-	-0.7	1.5
Rest of World	15.5	4.5	11.2	0.4	-2.8	1.7	0.7	-1.2	-1.2	-1.5	0.2	1.6
Total Imports	-9.2	5.4	11.5	1.1	-8.0	0.7	0.8	0.8	0.7	0.5	1.9	-0.9

Source: Authors' calculations.

4 Conclusion

This report applies a global CGE model of production and trade to estimate the impacts of recent and proposed US Section 232 and 301 trade actions. The CGE model employed includes data on US and global supply chains. A supply chain approach is essential to illuminate the impacts of US tariffs and quotas, since many goods targeted for US action include business intermediates and capital goods—tariffs and quotas targeted to help one sector, such as steel, can have wide ranging impacts on US supply chains and downstream using industries such as automobiles, machinery, and transportation equipment. US trade actions have been accompanied by trade partner responses, which raise tariffs on US exports, necessitating a global approach to modeling, in contrast to selected sector or industry observation—a narrow focus on one industry or a single country is unlikely to provide useful information on national impacts.

Our model and analysis conclude that, when combined, current and proposed Section 232 and 301 trade actions will result in substantial costs to the US economy in terms of lost real GDP (-1.78 percent or $365.1 billion dollars in 2019), unemployment (2.75 million workers in 2019), and lower household income ($2,357 per household or $915 per person; long run cumulative losses of $17,276 per household), while government revenues from tariffs increase. Investment also declines as returns to capital fall, and lower Chinese incomes cause a decline in global savings. Our estimates of the impacts of US trade actions include historically high US baseline GDP growth, particularly in 2018 and 2019. The high rate of baseline growth in the US economy reduces many of the negative impacts of US trade actions. However, when all the trade actions are considered together, even the high rate of growth in the US economy is unable to prevent the negative impacts of current and proposed US trade actions on employment. Furthermore, we find that a 0.5 percent reduction in real GDP projections causes the negative impacts of US trade actions on employment to increase. In addition to the substantial losses in these major national welfare indicators, we find the transition costs—the costs of workers moving to new sectors of employment (665,000 in 2019)—to be substantial as some sectors expand, while others contract. US producers are forced to withdraw from global markets as the increased cost of intermediate goods rises and their products become less competitive.

Section 301 actions and China's responses are estimated to have the greatest negative impacts on US production and trade, followed by potential Section 232 tariffs on automobiles and parts

(even when recognizing NAFTA members will likely be exempt). Section 232 actions on aluminum are found to cause a contraction in that industry, since the US imports a substantial amount of aluminum as an intermediate input into the aluminum process and US exports of aluminum fall, as trade partners respond and the costs of US aluminum rise. US actions on steel and proposed US actions on China and automobiles have substantial negative impacts on US supply chains and downstream, intermediate using, industries. The negative downstream effect on prices of US produced goods reduces demand in both domestic and foreign markets and hence production. These declines in production of downstream industries outweigh the positive growth in other sectors, caused by domestic consumers switching from imported to domestic goods due to the rise in tariffs. When trading partners' respond to the US actions by raising tariffs on US goods, US exports and production decline further, particularly in key commodities such as oil seeds (soybeans), meats (pork and beef), and coarse grains (corn, oats, sorghum).

A stated goal of the US administration's trade policy is to strengthen the US economy. The findings in this report indicate that the administration's trade actions could be potentially costly and reduce economic growth. These actions can be even more costly if the US economy slows from its current, historically high, growth. While it is beyond the scope of this paper to estimate the benefits of US trade actions in terms of national security, investment in automotive research, or defending US trade laws and international trade practices, it highlights the costs and risks associated with employing, in rapid succession, tariffs and quotas without considering the broader economy in the context of integrated and global production and supply chains.

Appendix I Tariff Reciprocation

Table A 1: Trade partners' reciprocal tariffs US 232 aluminum and steel actions (2017 imports US$ million and percent)

Commodity	Canada		EU(a)		Mexico		China		Russia		Japan (a)		India	
	Value	Tariff	Value	Tariff	Value	Tariff	Value	Tariff	Value	Tariff	Value	Tariff	Value	Tariff
Iron and steel	4,690.5	25%	491.3	25%	752.8	25%	115.2	15%	0.0	0%	28.2	25%	104.1	15%
Machinery and equip. nec	1,499.4	10%	792.8	26%	164.0	11%	0.0	0%	324.1	26%	782.5	17%	0.0	0%
Manufacturing nec	75.9	10%	1,329.6	23%	0.0	0%	0.0	0%	0.0	0%	578.7	25%	0.0	0%
non-Ferrous metals (aluminum)	1,613.1	10%	195.2	25%	0.0	0%	832.3	25%	0.0	0%	195.5	13%	0.0	0%
Beverages and tobacco products	44.5	10%	1,289.6	25%	10.7	25%	81.9	15%	0.0	0%	111.8	25%	0.0	0%
Meat nec (pork etc.)	204.8	10%	0.0	0%	1,257.3	20%	285.6	25%	0.0	0%	2.3	20%	0.0	0%
Chemicals, rubber and plastics	660.6	10%	773.0	20%	0.0	0%	0.0	0%	0.0	0%	9.1	20%	301.7	12%
Transport equipment nec	137.4	10%	871.0	25%	10.3	15%	0.0	0%	0.0	0%	177.2	23%	10.6	50%
Fabricated metal products	709.4	10%	888.8	17%	19.4	15%	0.0	0%	16.4	26%	109.1	13%	130.5	15%
Processed food nec	614.4	10%	144.5	25%	599.8	16%	5.5	15%	0.0	0%	227.5	15%	0.0	0%
Cattle and sheep meat	0.0	0%	0.0	0%	0.0	0%	873.8	25%	0.0	0%	0.0	0%	0.0	0%
Vegetables and fruit	0.0	0%	0.0	0%	276.5	20%	760.6	15%	0.0	0%	0.0	0%	823.7	20%
Dairy products	0.2	10%	0.0	0%	383.2	22%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Paper and paper products	604.4	10%	29.7	30%	0.0	0%	0.0	0%	0.0	0%	39.5	10%	0.0	0%
Lumber and forestry	182.9	10%	51.4	50%	74.7	7%	0.0	0%	0.0	0%	3.1	15%	0.0	0%
Coarse grains (corn, sorghum, millet etc.)	0.0	0%	142.2	25%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Wearing apparel	0.0	0%	63.8	33%	0.0	0%	0.0	0%	0.0	0%	16.6	33%	0.0	0%
Textiles	8.8	10%	114.4	19%	0.0	0%	0.0	0%	0.0	0%	3.9	20%	0.0	0%
Motor vehicles and parts	0.0	0%	166.9	10%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Processed rice	0.0	0%	39.6	25%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Agriculture nec	0.0	0%	0.0	0%	0.0	0%	13.7	15%	0.0	0%	0.0	0%	25.1	10%
Sugar	0.5	10%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Total	11,046.8	16%	7,383.7	23%	3,548.8	20%	2,968.8	22%	340.5	26%	2,285.0	19%	1,395.7	17%

Source: Authors' calculations. Trade data: Statistics Canada; Euro Stat; Ministry of Finance Japan. All other data from official sources as reported by Trade Data Monitor (TDM). Trade values and revenues may differ somewhat from official summaries due to import classification, exemptions, and exchange rate fluctuations applied when converting from national currency to US dollars.

(a) The EU and Japan has delayed the implementation of selected reciprocal tariffs until 2021 or when the WTO rules on the safeguard issue, whichever comes first. Retaliatory tariffs for Japan have been estimated based on lists and tariffs provided by other countries and the prioritization of imports from the US based on import value. The EU provided a list of products scheduled for tariffs in 2021.

Table A 2: Trade partners' reciprocal tariffs attributed to estimated automobile 232 action (2017 imports US$ million 2017 and percent)

Commodity	EU		Japan		Korea		China		India		Total value	Total revenue
	Imports	Tariff	Imports	Tariffs	Imports	Tariffs	Imports	Tariffs	Imports	Tariffs		
Transport equipment nec	36,649.1	25%	7,493.0	25%	2,137.8	25%	--	--	--	--	46,279.9	11,570.0
Motor vehicles and parts	12,466.4	25%	1,771.9	25%	2,160.0	25%	15,560.9	25%	420.9	25%	32,380.2	8,095.0
Machinery and equipment nec	4,882.5	25%	14,321.5	25%	8,136.0	25%	1,930.3	25%	290.2	25%	29,560.5	7,390.1
Chemicals, rubber, and plastics (pharmaceuticals)	757.6	25%	10,330.6	25%	2,147.3	25%	385.1	25%	95.5	25%	13,716.1	3,429.0
Electronic equipment	482.1	25%	3,883.3	25%	3,945.0	25%	8.7	25%	14.0	25%	8,333.1	2,083.3
Manufacturing nec	778.6	25%	2,235.1	25%	284.1	25%	161.7	25%	15.6	25%	3,475.2	868.8
Coarse grains (corn, sorghum, millet etc.)	--	--	2,482.6	25%	848.5	25%	--	--	--	--	3,331.1	832.8
Processed food nec	--	--	2,492.5	25%	685.2	25%	--	--	--	--	3,177.7	794.4
Cattle and sheep meat	--	--	1,869.2	25%	1,133.6	25%	--	--	--	--	3,002.8	750.7
Agriculture nec	--	--	1,414.8	25%	909.2	25%	--	--	--	--	2,324.0	581.0
Meat nec (pork etc.)	--	--	1,706.2	25%	386.7	25%	--	--	--	--	2,092.8	523.2
Oil seeds (soybeans, sunflower, flax)	--	--	1,107.6	25%	279.1	25%	--	--	--	--	1,386.8	346.7
Fabricated metal products	301.0	25%	772.2	25%	44.0	25%	173.0	25%	14.6	25%	1,304.6	326.2
Lumber and forestry	318.3	25%	726.5	25%	16.1	25%	77.0	25%	21.0	25%	1,158.7	289.7
Vegetable and fruit	--	--	785.9	25%	209.1	25%	--	--	--	--	995.0	248.8
Paper and paper products	--	--	956.1	25%	--	--	--	--	--	--	956.1	239.0
non-Ferrous metals (aluminum)	--	--	640.0	25%	264.7	25%	--	--	--	--	904.7	226.2
Beverages and tobacco products	--	--	548.2	25%	--	--	--	--	--	--	548.2	137.1
Textiles	--	--	83.3	25%	273.9	25%	--	--	--	--	357.2	89.3
Processed rice	--	--	197.8	25%	--	--	--	--	--	--	197.8	49.5
Dairy products	--	--	166.1	25%	--	--	--	--	--	--	166.1	41.5
Vegetable oils	--	--	114.2	25%	--	--	--	--	--	--	114.2	28.5
Iron and steel	--	--	31.7	25%	--	--	--	--	--	--	31.7	7.9
Cattle and sheep	--	--	28.4	25%	--	--	--	--	--	--	28.4	7.1
Total	56,635.5	25%	56,158.6	25%	23,860.3	25%	18,296.7	25%	871.8	25%	155,823.0	38,955.7

Source: Authors' calculations. Trade data: Statistics Canada; Euro Stat; Ministry of Finance Japan. All other data from official sources as reported by Trade Data Monitor (TDM). Trade values and revenues may differ somewhat from official summaries due to import classification, exemptions, and exchange rate fluctuations applied when converting from national currency to US dollars.

Appendix II Model and Databases

The IESC-Dyn model combines the features of a number of models, including the widely used Global Trade Analysis Project (GTAP) model (Hertel and Tsigas, 1997), the ImpactECON supply chain model (Walmsley and Minor (2016b) and the Dynamic GTAP model (Ianchovichina and McDougall, 2012).[66] Further modifications are made to incorporate labor supply by education and unemployment.

The supply chain database documented in Walmsley and Minor (2016a) is based on version 9 of the GTAP Database (Narayanan et al, 2015). The 57 sectors/commodities and 141 countries/regions in the database are aggregated to 28 sectors and 11 countries/regions. Of the 28 sectors there are 27 goods and one services sector; a list of these commodities is provided in Appendix VI. The choice of sectors reflects the commodities subjected to the change in tariffs by the US and its partners. The 11 countries include: the US, Canada, Mexico, China, EU, Japan, Korea, Brazil, Argentina, Russia, and the rest of world. Partner countries were selected based on the value of their trade with the US and their stated intention to reciprocate. Korea, Brazil and Argentina were identified separately to represent the impact of quotas on steel and aluminum agreed to by the US on these countries.

This baseline scenario uses historical data[67] from the International Monetary Fund's (IMF, 2018b) World Economic Outlook for real gross domestic product (GDP), investment, employment, government spending, savings, and global trade; United Nations (UN, 2017) data on population growth, International Institute for Applied Systems Analysis (IIASA) (Goujon, Samir, Lutz and Sanderson, 2013) data on labor force growth by education level, and Organization for Economic Cooperation and Development (OECD, 2014) data on the production and consumption of selected agricultural and processed food commodities (OECD, 2017) to first, update the 2011 GTAP data to the beginning of 2018. Data on tariffs in 2011 and 2017 are also collected from UN International Trade Centre (ITC) and the country specific sources outlined above to incorporate changes in tariffs over this historical period. Information from the historical simulation is then combined with forecasts, including GDP from the OECD,[68] to create a baseline from 2018 to 2030. The baseline scenario assumes strong US

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

67 Historical data are available to 2016 in some cases; where historical data are unavailable forecasts from the same sources are used.

68 GDP forecasts are based on OECD forecasts, since the IMF forecasts were developed more recently and are believed to include a decline in real GDP, most likely due to US trade policy actions. The OECD forecast were developed before these trade actions were announced and hence are believed to more accurately reflect what the world economy would look like without the US trade actions and partners' responses. Since

growth and continued global growth of production, trade and investment over the period, combined with stagnant or declining populations and increasing education rates in many of the countries considered in this report. The US trade actions and partners' responses are then imposed on this baseline scenario and their impacts examined over the period 2018 to 2030. The results provided in this report show how different the economy would be, relative to the baseline, as a result of the US trade actions and the partners' responses over time or in a given year, 2030.

IMF forecasts of investment and trade have also been updated, the historical data are predominantly used as a guide to create the baseline scenario. Population and labor forecasts from the UN and IIASA are unaffected by this issue.

Appendix III Impact of Alternative Baseline Growth on Employment

In Section 3.2.3, the unemployment impacts of the US trade actions and partners' responses were examined. In that section, we highlighted the importance of the baseline in determining to what extent the US trade actions could lead to unemployment. With increased government spending and reduced corporate taxation rates, demand for labor is high and wages are expected to increase. In this appendix, we examine what would happen if growth in the US was less robust in 2019 onwards than expected. We do this by considering a decline in forecast real GDP, without the trade actions, of 0.5 percentage points. Hence in our original baseline, average growth in the baseline was reported to be 2.46 percent per annum and in this alternative, lower growth baseline, average growth is expected to be 2.01 percent.[69]

The impact of this alternative baseline on the results of the US trade actions is twofold. First, the decline in real GDP experienced in 2019 as a result of the trade actions is greater when the lower growth baseline is used, -2.04 percent (Figure A 1 compared to Figure 1-1), than when the original baseline is used, -1.78 percent. This larger decline in real GDP from the US trade actions stems from lower wage growth in the baseline, that leads to more unemployment; 3.34 million as opposed to 2.75 million (Figure A 2 compared to Figure 3-6). This emphasizes the importance of wage growth in the baseline. In the alternative low growth baseline, wages are still growing, but at half the rate of the original baseline, thereby providing less protection to workers against possible unemployment caused by an adverse shock, such as the US trade actions.[70]

The second difference, is a slightly smaller decline in long run 2030 real GDP of 1.18 percent, as opposed to 1.25 percent in the original baseline. This is due to the decline in investment recovering more quickly in the lower baseline growth scenario, because investment growth is lower in the lower growth baseline. US actions under Section 301 and China's responses continue to explain the largest proportion of the losses in real GDP, in the long run.

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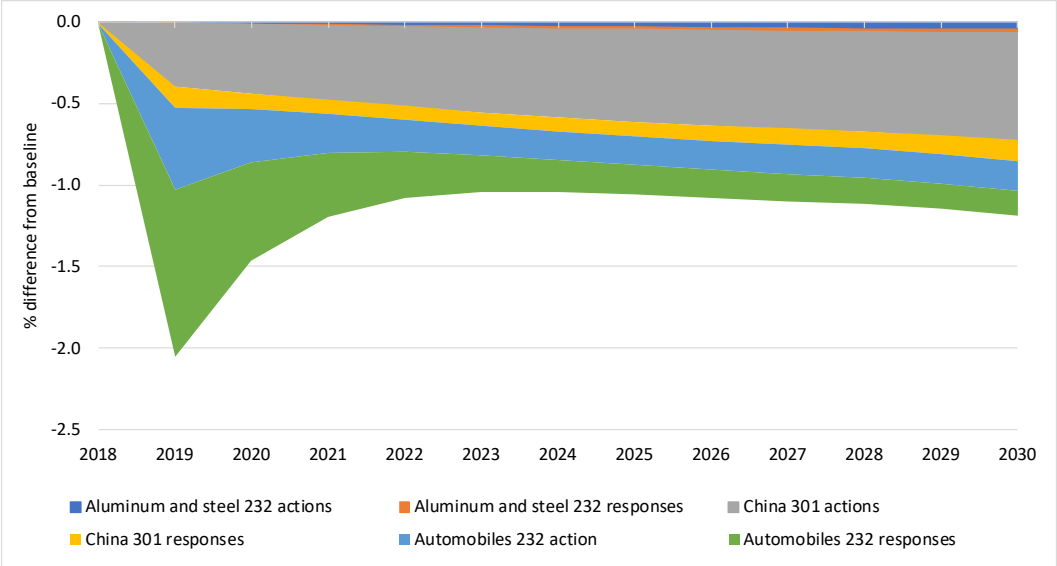
69 The average is based on growth between 2018 to 2030. Since growth is reduced by 0.5 percent from 2019 onwards, the average growth rate does not fall by the full 0.5 percentage points.

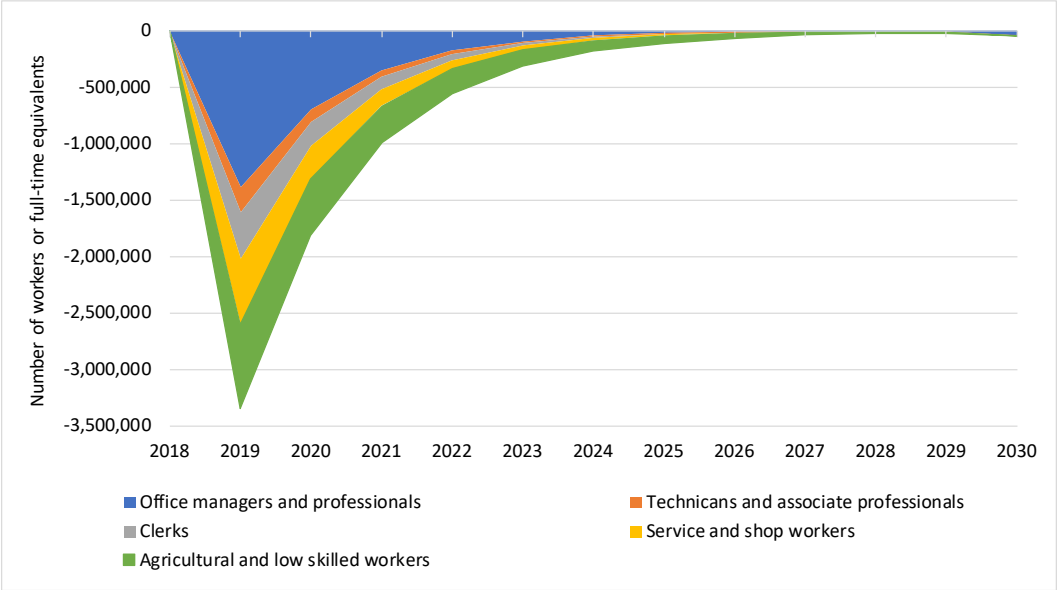
70 Note that the opposite is also true, if underlying baseline growth is higher than expected there will be less unemployment.

Figure A 1: Impact of US trade actions and responses on US real GDP 2018-2030, alternative baseline (percentage differences from baseline)



Source: Authors' calculations.

Figure A 2: Impact of all US trade actions and responses on employment in the US by occupation, over time, alternative baseline (number of workers or full-time equivalents relative to baseline)



Source: Authors' calculations.

Appendix IV Aggregation

Table A 3: Commodities

Label	Description
Coarse grains (corn, sorghum, millet etc.)	Other grains: maize (corn), barley, rye, oats, other cereal grains
Vegetables and fruit	Vegetables and fruit
Oil seeds (Soybeans, sunflower, flax)	Oil seeds: oil seeds and oleaginous fruit; soybeans, copra
Sugar	Sugar: sugar cane and processed sugar
Dairy products	Dairy products: milk, cheese and other dairy
Rice	Rice: paddy and processed rice
Cattle and sheep	Cattle: cattle, sheep, goats, horses, asses, mules, and hinnies
Cattle and sheep meat	Cattle meat: fresh or chilled meat and edible offal of cattle, sheep, goats, horses, asses, mules, and hinnies
Meat nec (pork etc.)	Other meat: pig meat and offal. preserves and preparations of meat, meat offal, flours, meals
Vegetable oils	Vegetable oils: crude and refined oils of soya bean, maize (corn), olive, sesame, ground-nut, olive, sunflower-seed, safflower, cotton-seed, rape, colza and canola
Agriculture nec (a)	Agricultural products: wheat, other crops and other animal products
Processed food	Other food and fisheries
Beverages and tobacco products	Beverages and tobacco products
Textiles	Textiles: textiles and man-made fibers
Wearing apparel and leather	Wearing apparel and leather: clothing, dressing and dyeing of fur, leather and footwear
Paper and paper products	Paper and paper products: including publishing, printing and reproduction of recorded media
Chemicals, rubber and plastics (pharmaceuticals)	Chemical, rubber and pharmaceuticals: basic chemicals, other chemical products, rubber, plastics products and pharmaceuticals
Iron and steel	Iron and steel: basic production and casting
non-Ferrous metals (aluminum)	non-Ferrous metals: production and casting of copper, aluminum, zinc, lead, gold, and silver
Fabricated metal products	Fabricated metal products: sheet metal products, but not machinery and equipment
Motor vehicles and parts	Motor vehicles and parts: cars, lorries, trailers and semi-trailers and parts
Transport equipment nec	Other transport equipment: manufacture of other transport equipment
Electronic equipment	Electronic equipment: office, accounting and computing machinery, radio, television and communication equipment and apparatus
Machinery and equipment nec	Other machinery and equipment: electrical machinery and apparatus n.e.c., medical, precision and optical instruments, watches and clocks
Manufactures nec (b)	Other minerals, non-metallic minerals and other manufactures
Coal, oil, gas and petroleum products	Coal, oil, gas and petroleum and coke products
Lumber and forestry	Lumber: wood and products of wood and cork, except furniture; articles of straw and plaiting materials
Private and government services	Private and government services

Source: Authors' compilations and GTAP Data Base.

Appendix V Sectoral Results

Table A 4: Impact of US actions and responses on production in selected US sectors in 2030 (percent change from baseline)

Commodities	Aluminum and steel 232		China 301		Automobiles 232		Total: Actions and responses
	US Action	Partners' Responses	US Action	China's Response	US Action	Partners' Response	
Coarse grains (corn, sorghum, millet etc.)	0.01	-0.13	-0.41	-2.24	-0.07	-0.32	-3.13
Vegetables and fruit	0.00	-0.56	0.21	1.54	0.01	0.26	1.46
Oil seeds (Soybeans, sunflower, flax)	0.02	1.02	-0.33	-3.61	-0.20	0.90	-2.25
Sugar	0.05	0.25	0.00	0.85	-0.13	0.41	1.43
Dairy products	0.02	0.14	-0.44	-0.70	-0.21	0.28	-0.92
Rice	0.12	-1.54	-0.96	3.25	-1.16	0.32	-0.05
Cattle and sheep	0.02	-1.59	0.21	2.16	-0.06	-0.57	0.14
Cattle and sheep meat	0.02	-1.74	0.12	1.73	-0.06	-0.81	-0.78
Meat nec (pork etc.)	0.06	-5.07	-0.11	2.25	-0.12	-1.36	-4.43
Vegetable oils	0.08	1.03	-1.50	2.87	-0.73	1.30	3.02
Agriculture nec (a)	0.03	-0.21	-0.13	2.24	-0.16	-0.23	1.51
Agriculture	0.03	-1.07	-0.21	0.70	-0.16	-0.23	-0.94
Processed food	0.01	-0.07	-0.38	-0.29	-0.15	-0.38	-1.25
Beverages and tobacco products	-0.05	-0.61	-0.31	-0.30	-0.06	-0.30	-1.62
Textiles	0.20	0.64	-2.54	-3.80	-1.58	0.77	-6.23

Commodities	Aluminum and steel 232		China 301		Automobiles 232		Total: Actions and responses
	US Action	Partners' Responses	US Action	China's Response	US Action	Partners' Response	
Wearing apparel and leather	0.21	0.09	4.63	1.36	-1.03	1.54	6.91
Paper and paper products	0.00	-0.06	-0.54	-1.45	-0.39	0.06	-2.36
Chemicals, rubber and plastics (pharmaceuticals)	0.02	0.36	-2.21	-2.17	-0.68	-1.33	-5.89
Iron and steel	9.53	-3.38	0.49	0.19	-0.04	0.22	6.74
non-Ferrous metals (aluminum)	-1.06	-5.20	-5.22	-1.02	-1.96	0.58	-13.23
Fabricated metal products	-1.98	-0.27	4.60	0.69	0.93	-0.22	3.66
Motor vehicles and parts	-0.64	0.11	-2.84	-0.29	6.57	-1.78	0.86
Transport equipment nec	-0.71	0.05	-6.13	-1.79	-2.60	-10.59	-20.25
Electronic equipment	-0.53	1.01	5.95	-1.84	-2.04	-1.16	1.20
Machinery and equipment nec	-1.26	0.53	0.65	-0.12	-0.59	-0.95	-1.74
Manufactures nec (b)	-0.16	-0.58	1.29	0.02	-0.61	-0.08	-0.13
Manufactures	-0.18	-0.05	-0.47	-0.92	0.12	-1.14	-2.63
Coal, oil, gas and petroleum products	0.00	-0.02	-0.20	0.06	-0.09	0.11	-0.13
Lumber and forestry	-0.15	0.10	3.17	-0.80	-0.24	0.08	2.13
Extractive	-0.03	0.01	0.49	-0.12	-0.12	0.10	0.33
Private and government services	-0.02	0.00	-0.60	-0.01	-0.16	0.00	-0.79

Source: Authors' calculations.

Table A 5: Impact of US actions and responses on prices in selected US sectors in 2030 (percent change from baseline)

Commodities	Aluminum and steel 232		China 301		Automobiles 232		Total: Actions and responses
	US Action	Partners' Responses	US Action	China's Response	US Action	Partners' Response	
Coarse grains (corn, sorghum, millet etc.)	0.02	-0.96	-0.12	-3.72	-0.02	-0.96	-4.73
Vegetables and fruit	0.01	-1.03	0.28	-1.90	0.06	-0.70	-2.63
Oil seeds (Soybeans, sunflower, flax)	0.01	-0.40	0.11	-3.85	0.01	-0.45	-4.13
Sugar	-0.05	-0.25	0.89	-0.90	0.35	-0.51	-0.32
Dairy products	-0.03	-0.47	0.66	-1.78	0.31	-0.70	-1.61
Rice	-0.03	-0.51	0.77	-0.89	0.29	-0.55	-0.66
Cattle and sheep	0.01	-1.05	0.22	-2.49	0.07	-0.93	-3.29
Cattle and sheep meat	-0.03	-0.66	0.54	-1.73	0.23	-0.78	-1.89
Meat nec (pork etc.)	-0.03	-0.60	0.50	-1.42	0.20	-0.77	-1.56
Vegetable oils	-0.02	-0.31	0.57	-2.31	0.20	-0.48	-2.08
Agriculture nec (a)	0.01	-0.83	0.20	-1.66	0.02	-0.84	-2.27
Agriculture	-0.01	-0.72	0.34	-2.16	0.13	-0.77	-3.16
Processed food	-0.03	-0.32	0.90	-1.16	0.38	-0.59	-0.62
Beverages and tobacco products	0.02	-0.25	1.14	-0.90	0.45	-0.56	0.00
Textiles	-0.06	-0.21	1.14	-0.79	0.46	-0.53	0.08
Wearing apparel and leather	-0.06	-0.20	1.14	-0.77	0.39	-0.54	0.10
Paper and paper products	-0.06	-0.23	1.17	-0.88	0.49	-0.62	-0.01
Chemicals, rubber and plastics (pharmaceuticals)	-0.03	-0.18	1.08	-0.67	0.50	-0.44	0.19
Iron and steel	1.00	-0.20	1.34	-0.78	0.45	-0.56	1.35
non-Ferrous metals (aluminum)	0.55	-0.15	1.46	-0.65	0.48	-0.48	1.20

Commodities	Aluminum and steel 232		China 301		Automobiles 232		Total: Actions and responses
	US Action	Partners' Responses	US Action	China's Response	US Action	Partners' Response	
Fabricated metal products	0.77	-0.21	1.29	-0.84	0.46	-0.61	1.00
Motor vehicles and parts	0.19	-0.17	1.84	-0.70	1.36	-0.52	1.15
Transport equipment nec	0.12	-0.19	1.48	-0.76	0.50	-0.53	0.64
Electronic equipment	0.06	-0.15	3.24	-0.57	0.40	-0.43	2.57
Machinery and equipment nec	0.22	-0.21	1.66	-0.82	0.53	-0.60	0.83
Manufactures nec (b)	0.06	-0.22	1.23	-0.82	0.45	-0.59	0.23
Manufactures	0.15	-0.20	1.48	-0.78	0.56	-0.54	0.66
Coal, oil, gas and petroleum products	0.01	-0.15	0.17	-0.22	0.03	0.08	-0.20
Lumber and forestry	0.02	-0.22	1.50	-0.84	0.51	-0.60	0.45
Extractive	0.01	-0.16	0.36	-0.31	0.10	-0.01	-0.02
Private and government services	-0.06	-0.25	1.03	-0.93	0.46	-0.65	-0.22

Source: Authors' calculations.

Table A 6: Impact of US actions and responses on US trade with China in 2030 (percent change relative to baseline)

Commodity	Exports to China				Imports from China			
	I Aluminum and steel 232	II China 301	III Automobiles 232	IV Total	V Aluminum and steel 232	VI China 301	VII Automobiles 232	VIII Total
Coarse grains (corn, sorghum, millet etc.)	2.06	-34.87	2.91	-31.60	-1.71	-42.24	-2.77	-44.80
Vegetables and fruit	-32.95	-48.28	3.09	-64.25	-1.80	-50.52	-1.54	-52.16
Oil seeds (Soybeans, sunflower, flax)	0.90	-46.02	1.97	-44.46	-0.39	-66.89	-1.61	-67.56
Sugar	1.87	-62.41	1.15	-61.27	-0.96	-62.39	-0.07	-62.78
Dairy products	3.20	-71.37	3.53	-69.41	-2.75	-77.66	-2.70	-78.86
Rice	3.67	-74.82	2.39	-73.28	-2.16	-68.05	-1.84	-69.31
Cattle and sheep	5.87	-51.59	4.74	-46.32	-4.77	-41.46	-3.64	-46.28
Cattle and sheep meat	-69.32	-69.31	4.41	-90.17	-6.12	-78.09	-3.10	-80.07
Meat nec (pork etc.)	-75.84	-75.88	6.82	-93.77	-4.80	-82.37	-1.62	-83.49
Vegetable oils	1.89	-71.03	2.62	-69.71	-1.28	-77.20	-1.75	-77.88
Agriculture nec (a)	5.45	-42.66	6.20	-35.79	-3.27	-71.78	-2.59	-73.41
Agriculture	-15.30	-47.61	3.43	-54.11	-2.14	-62.10	-1.84	-63.59
Processed food	1.42	-47.18	1.52	-45.61	-1.29	-53.31	-0.54	-54.16
Beverages and tobacco products	-1.22	-38.08	0.61	-38.47	-0.77	-37.79	-0.40	-38.51
Textiles	1.79	-76.11	1.03	-75.43	-1.02	-74.32	-0.48	-74.70
Wearing apparel and leather	2.37	-58.05	1.40	-56.45	-1.33	-67.83	-0.76	-68.50
Paper and paper products	1.53	-55.48	1.39	-54.17	-1.40	-68.19	0.23	-68.57
Chemicals, rubber and plastics (pharmaceuticals)	1.41	-67.70	-1.88	-67.86	-0.86	-74.33	-1.39	-74.91
Iron and steel	-17.96	-62.68	0.71	-69.17	-4.41	-64.42	-0.10	-66.02
non-Ferrous metals (aluminum)	-41.87	-81.76	0.30	-89.37	-34.50	-80.46	1.26	-87.04

Commodity	Exports to China				Imports from China			
	I Aluminum and steel 232	II China 301	III Automobiles 232	IV Total	V Aluminum and steel 232	VI China 301	VII Automobiles 232	VIII Total
Fabricated metal products	-4.31	-66.20	-13.26	-71.94	2.27	-67.35	-1.35	-67.06
Motor vehicles and parts	0.12	-67.85	-60.99	-87.44	-0.34	-66.88	-40.61	-80.40
Transport equipment nec	0.86	-83.69	2.94	-83.07	-0.71	-79.79	-0.27	-79.99
Electronic equipment	0.79	-89.19	-0.02	-89.11	-0.48	-66.76	0.32	-66.82
Machinery and equipment nec	0.00	-72.78	-10.38	-75.60	-0.31	-72.95	0.20	-72.98
Manufactures nec (b)	0.81	-51.56	-2.60	-52.44	-0.58	-46.86	-0.90	-47.65
Manufactures	-1.47	-70.31	-6.10	-72.53	-0.64	-68.22	-1.04	-68.75
Coal, oil, gas and petroleum products	1.95	-91.07	0.48	-90.85	-0.67	-90.60	-0.91	-90.75
Lumber and forestry	1.19	-68.87	-1.93	-69.11	-1.00	-62.00	-0.48	-62.57
Extractive	1.69	-83.68	-1.05	-83.58	-0.98	-64.38	-0.49	-64.90
Private and government services	1.39	-6.38	0.86	-4.26	-0.93	9.58	-0.53	7.99

Source: Authors' calculations.

(a) Includes hides and skins, forage (hay and clover), raw tobacco, wheat, muslin, animal guts and bladders, down, ginseng root, seeds, medicinal herbs, honey, live reptiles etc.

(b) Other minerals, non-metallic minerals and manufactures.

Table A 7: Impact of US actions and responses on US trade with rest of world in 2030 (percent change relative to baseline)

Commodity	Exports to rest of world				Imports from rest of world			
	I Aluminum and 232	II China 301	III Automobiles 232	IV Total	V Aluminum and steel 232	VI China 301	VII Automobiles 232	VIII Total
Coarse grains (corn, sorghum, millet etc.)	-0.38	6.49	-1.81	4.18	-1.34	-5.46	-1.80	-8.42
Vegetables and fruit	-1.00	5.88	0.05	4.87	-1.38	-2.67	-1.31	-5.27
Oil seeds (Soybeans, sunflower, flax)	1.22	15.22	0.52	17.23	-0.14	-3.82	-1.07	-4.98
Sugar	1.36	4.34	1.75	7.62	-0.50	-1.79	-0.90	-3.16
Dairy products	-1.18	12.30	-0.85	10.03	-1.58	-6.02	-2.26	-9.59
Rice	-2.21	3.58	-1.20	0.07	-1.72	-2.14	-1.16	-4.94
Cattle and sheep	3.77	10.82	2.70	18.10	-3.71	-3.27	-2.93	-9.58
Cattle and sheep meat	3.74	10.07	-9.16	3.73	-3.24	-5.30	-2.87	-11.00
Meat nec (pork etc.)	0.69	7.90	-4.58	3.66	-2.44	-4.81	-4.15	-10.99
Vegetable oils	1.59	11.06	0.68	13.59	-0.37	-3.66	-1.28	-5.25
Agriculture nec (a)	4.04	10.73	-0.73	14.36	-1.27	-2.40	-1.77	-5.34
Agriculture	1.08	9.22	-1.74	8.47	-1.59	-3.52	-1.94	-6.89
Processed food	-0.70	2.80	-3.33	-1.32	-0.64	-0.57	-1.10	-2.29
Beverages and tobacco products	-5.20	1.27	-2.52	-6.41	-0.50	-0.76	-0.48	-1.73
Textiles	1.12	-0.57	-2.84	-2.31	-0.47	5.57	-0.42	4.63
Wearing apparel and leather	-1.77	-2.76	1.77	-2.79	-0.30	29.72	-0.51	28.66
Paper and paper products	-0.80	1.79	-1.67	-0.72	-0.59	7.15	-1.90	4.50
Chemicals, rubber and plastics (pharmaceuticals)	0.43	0.28	-5.99	-5.32	-0.41	5.11	-2.78	1.77
Iron and steel	-20.04	0.11	1.31	-18.91	-33.38	9.35	-0.81	-27.74
non-Ferrous metals (aluminum)	-8.05	-3.26	-3.01	-13.74	-2.40	3.63	-1.05	0.08

Commodity	Exports to rest of world				Imports from rest of world			
	I Aluminum and 232	II China 301	III Automobiles 232	IV Total	V Aluminum and steel 232	VI China 301	VII Automobiles 232	VIII Total
Fabricated metal products	-9.26	-1.02	-0.49	-10.63	-0.44	47.99	-4.08	41.32
Motor vehicles and parts	-1.01	-1.76	-2.76	-5.44	-0.39	0.93	-8.26	-7.76
Transport equipment nec	-1.60	-3.90	-28.50	-32.39	-0.60	5.52	-4.74	-0.08
Electronic equipment	0.98	-19.01	-12.03	-28.05	-0.05	116.16	-2.00	111.73
Machinery and equipment nec	-1.64	-5.28	-8.67	-14.91	-0.39	43.38	-3.82	37.36
Manufactures nec (b)	-3.18	0.00	-2.78	-5.87	23.80	-0.83	22.26	-3.18
Manufactures	-1.72	-2.62	-6.98	-10.98	24.23	-3.46	18.38	-1.72
Coal, oil, gas and petroleum products	-0.52	2.79	0.41	2.68	-0.53	-0.19	-1.01	-0.52
Lumber and forestry	-1.08	-1.36	-4.56	-6.88	34.92	-2.76	30.72	-1.08
Extractive	-0.55	2.61	0.20	2.26	1.49	-0.38	0.80	-0.55
Private and government services	1.22	1.82	0.82	3.90	-1.75	-0.61	-3.00	1.22

Source: Authors' calculations.

(a) Includes hides and skins, forage (hay and clover), raw tobacco, wheat, muslin, animal guts and bladders, down, ginseng root, seeds, medicinal herbs, honey, live reptiles etc.

(b) Other minerals, non-metallic minerals and manufactures.

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