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Economic Impact of Tariff Hikes
-A CGE model analysis-

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Abstract

The US imposed US tariffs on steel and aluminum imports in March 2018. An estimate of the economic impact of tariff hikes made using a Computable General Equilibrium (CGE) model of global trade, incorporating a dynamic capital formation mechanism, indicates that US import tariffs could protect the relevant US sectors but would have a negative impact on the US economy at the macro level. This key policy finding could not be attributed to the conventional framework of fixed labor in a CGE model. Also, a sensitivity analysis using a CGE model indicates that international capital movements would differentiate the impact of tariff hikes among countries. Trade deficits themselves would not necessarily be of much concern given the somewhat compensatory benefits of international capital inflows. On the other hand, possible capital outflows could exaggerate the adverse effects of tariff hikes. It is estimated here that for an import tariff hike of one percentage point worldwide, global trade would decrease by around 1.7 per cent and global GDP would decrease by around 0.2 per cent. It is of concern that emergent protectionism would reduce the growth of both global trade and the global economy.

Key words: US, Tariff, Protectionism, CGE model
JEL classification: D58, F13, F14, F16, F17

[1] This paper is a substantially extended and updated version of Kawasaki (2018).

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I. Introduction

US President Trump issued a presidential proclamation on March 8, 2018 imposing a 25 per cent tariff on US steel imports and a 10 per cent tariff on aluminum imports. The White House Fact Sheets stated that "President Trump is taking action to protect America's critical steel and aluminum industries, which have been harmed by unfair trade practices and global excess capacity."[2] As of June 1, 2018, these tariffs apply to US steel imports from all countries except Argentina, Australia, Brazil and Korea and to US aluminum imports from all countries except Argentina and Australia.

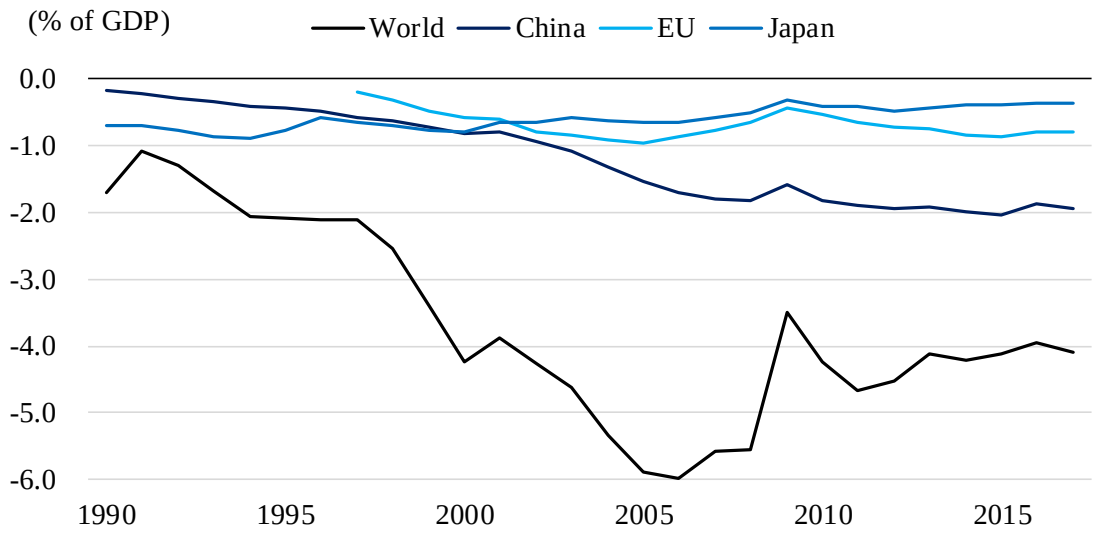
In the meantime, on April 2, 2018 China increased by 15-25 per cent its tariffs on 128 import products from the US, including fruit, wine, pork products and stainless steel. The US trade deficit with China constitutes nearly 50 per cent of the total US trade deficit. In that light, the focus here is on developments related to Chinese trade policy measures.

Emergent uncertainty caused by the UK's June 2016 decision to leave the EU and the US withdrawal from the Trans-Pacific Partnership (TPP) in January 2017 appears to have eased somewhat during 2017. This impression is supported by the agreement concluded by the eleven members (excluding the US) of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Japan-EU Economic Partnership Agreement (EPA). However, there is a need to monitor developments in global trade policy making, including protectionism movement on the one hand, and the progress of regional integration on the other.

In this paper, the economic impact of tariff hikes is evaluated by means of simulation analysis using a Computable General Equilibrium (CGE) model of global trade incorporating a dynamic capital formation mechanism. After a brief look at US trade developments in Chapter II and a description of the analytical data and model in Chapter III, the estimated impact of tariff hikes is discussed in Chapter IV. The sensitivity of the dynamic framework of CGE models is explored, along with the effects of endogenous

[2] https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-addressing-unfair-trade-practices-threaten-harm-national-security/

Chart 1 Trends in US trade deficits



Source: "Foreign Trade," The U.S. Census Bureau, The U.S. Department of Commerce
"World Economic Outlook Database (April 2018 edition)," IMF

labor supply, in Chapter V. Conclusions are drawn in Chapter VI.

II. The development of US trade

The US recorded a trade deficit amounting to 796 billion US dollars in 2017, eight times larger than that in 1990 (102 billion US dollars). That said, the expansion of

Table 1-A US trade by country (2017)

(Billion US dollars)

	Exports	Imports	Total trade	Balance
World	1,547	2,343	3,890	-796
China	130	506	636	-375
Japan	68	137	204	-69
Korea	48	71	119	-23
ASEAN	78	170	248	-92
India	26	49	74	-23
Australia	25	10	35	15
New Zealand	4	4	8	0
EU	284	435	718	-151
Russia	7	17	24	-10
Canada	282	300	582	-18
Mexico	243	314	557	-71
Argentina	10	5	14	5
Brazil	37	29	67	8

Source: "Foreign Trade," The U.S. Census Bureau, The U.S. Department of Commerce

Table 1-B US trade by commodity (2017)

(Billion US dollars)

	Exports	Imports	Balance
Total	1,547	2,343	-796
Food and Live Animals	99	106	-7
Beverages and Tobacco	6	25	-19
Animal and Vegetables Oils	3	7	-4
Crude Materials Except Fuels	77	34	43
Mineral Fuels and Lubricants	136	195	-59
Chemicals and Related Products	194	221	-27
Manufactured Goods by Material	106	256	-150
Iron and steel	15	37	-22
Nonferrous metals	14	42	-28
Manufactures of metals	25	53	-28
Machinery and Transport Equipment	502	1,015	-513
Telecommunications equipment	22	168	-146
Electrical machinery	78	176	-98
Road vehicles	117	286	-170
Miscellaneous Manufactured Articles	120	381	-262
Miscellaneous Commodities	65	103	-38
Re-Exports	239	0	239

Source: "U.S. International Trade in Goods and Services Report," The U.S. Census Bureau, The U.S. Department of Commerce

those trade deficits looks moderate in relative terms rather than as absolute values. The US trade deficit to GDP ratio has been around 4 per cent during the 2010s, which is more than twice that in the 1990s but less than its peak of 6.0 per cent in 2006, immediately before the global financial crisis (see Chart 1).

As for trade partner sources of the US trade deficit, Japan had the largest US trade deficit in the early 1990s, accounting for around 50 per cent of total US trade deficit. However, at present the largest share is held by China, with nearly 50 per cent of the total US trade deficit in 2017, as discussed above. Japan's share has been around 10 per cent throughout the 2010s. Meanwhile, the EU as a whole has seen its share rising to the current level of around 20 per cent.

The structure of US trade in 2017 is shown by country in Table 1-A, and by commodity in Table 1-B. The three largest destinations of US exports are the EU, Canada and Mexico, followed by China. On the other hand, the largest source of US imports is China, followed by the EU, then Canada and Mexico. What is striking is the fact that US imports from China are nearly four times larger than US exports to China. US imports from Asia, including Japan, the Association of Southeast Asian Nations (ASEAN) on

Table 2 Regional and commodity aggregations

Countries and Regions		Commodities	
JPN	Japan	AGR	Agriculture, forestry and fisheries
CHN	China	MNG	Minerals
KOR	Korea	PFD	Processed foods
ASA	ASEAN	TXL	Textiles and wearing apparel
IND	India	CHM	Chemical products
AUS	Australia	MTL	Metals
NZL	New Zealand	MVH	Motor vehicles and parts
OAO	Other Asia and Oceania	ELE	Electronic equipment
USA	US	OME	Other machinery and equipment
CAN	Canada	OMF	Other manufacturing
MEX	Mexico	CNS	Construction
ARG	Argentina	EGW	Electricity, gas and water
BRA	Brazil	T_T	Transportation
OAM	Other America	OSP	Other private services
EUM	EU	OSG	Public services
RUS	Russia		
ROW	Rest of the world		

Source: Author based on GTAP database version 10

average, and India are also about double US exports to those countries. The US trade deficit is for the most part accounted for by China (around 50 per cent), the EU (around 20 per cent) and Japan, ASEAN and Mexico (about 10 per cent each).

By commodity, the US trade deficit in metals (iron and steel, nonferrous metals and manufacture of metals) accounts for around 10 per cent of the US total trade deficit. Much larger trade deficits are recorded for machinery and transportation equipment including telecommunications equipment; electrical machinery; and road vehicles. Meanwhile, relatively large trade deficits are also indicated for mineral fuels and lubricants. On the other hand, exports and imports are almost balanced for agricultural commodities including food, unlike manufactured goods.

III. Analytical data and model

The economic impact of tariff hikes is estimated here using the Global Trade Analysis Project (GTAP) database[3] version 10 (beta version) and a static version of the GTAP model.

[3] An overview of the earlier GTAP database version 9 is available in Aguiar, A., B. Narayanan and R. McDougall (2016).

The trade and economic data of version 10 of the GTAP database are benchmarked to year 2014. In this paper, those data are used as is, without updating. Countries are aggregated to form 17 regions. The ASEAN countries[4] are aggregated into one region[5] as are the EU countries including the UK. On the other hand, certain countries were once exempted from the US metal tariff hikes; they are individually disaggregated (see Table 2). Commodities are aggregated to 15 major sectors, reflecting the structure of US trade. Agriculture, forestry and fisheries are aggregated into one sector. Ferrous metals, other metals and metal products are also aggregated into one sector. On the other hand, motor vehicles and parts, and electronic equipment are kept separate from other machinery and equipment.

> According to the GTAP website,
> "The standard GTAP Model is a multiregion, multisector, computable general equilibrium model, with perfect competition and constant returns to scale. Innovative aspects of this model include: … Bilateral trade is handled via the Armington assumption. … A global banking sector which intermediates between global savings and consumption."[6]

Several closure options are available in the GTAP model. In this paper, trade balance is not fixed. This means capital balance is also endogenous, which allows international capital movement, and the expected rates of return on capital are equalized across the regions. Moreover, capital stock is endogenous: this introduces dynamic capital accumulation effects into the standard static version of the model, which links changes in investment to capital stock. On the other hand, labor supply is still exogenous in the major model simulations in this paper. The sensitivity of endogenous labor supply is investigated separately.

IV. The impact of tariff hikes

1) The impact of US metal tariff hikes

Prior to the announcement by the US President that tariffs would be imposed on steel and aluminum imports, the US Department of Commerce (USDOC) investigated the

[4] This is composed of nine ASEAN member countries (not including Myanmar, whose data is not individually available in the current GTAP database).
[5] Two regions, each composed of more than one country, export to and import from their own regions.
[6] https://www.gtap.agecon.purdue.edu/models/current.asp

effect of US imports of steel and aluminum on US national security under section 232 of the Trade Expansion Act of 1962. USDOC (2018a), reporting an investigation of the effect of steel imports, stated that:

> "… the Secretary of Commerce concludes that the present quantities and circumstance of steel imports are "weakening our internal economy" and threaten to impair the national security as defined in Section 232." and,
>
> "… the Secretary recommends that the President take immediate action by adjusting the level of these imports through quotas or tariffs. The quotas or tariffs imposed should be sufficient, even after any exceptions (if granted), to enable U.S. steel producers to operate at an 80 percent or better average capacity utilization rate based on available capacity in 2017…." (p. 5-6).

USDOC (2018a) described alternative measures on all imported steel products, as below.

- 63 per cent quota on imports from all countries
- 24 per cent tariff on imports from all countries
- 53 per cent tariff on imports from "a subset of countries"[7]

It is estimated that "According to the Global Trade Analysis Project (GTAP) Model, produced by Purdue University, a 24 percent tariff on all steel imports would be expected to reduce imports by 37 percent…" (p. 8), and that other above measures would have equivalent impact on US steel imports.

Meanwhile, USDOC (2018b), investigating the effect of aluminum imports, described the following alternatives measures stating that:

> "… the quotas or tariffs would be designed, even after any exemptions (if granted), to enable U.S. aluminum production to utilize an average of 80 percent of production capacity" (p. 6).
>
> - 86.7 per cent quota on imports from all counties
> - 7.7 per cent tariff on imports from all countries
> - 23.6 per cent tariff on imports from "a subset of countries"[8]

In this paper, the impact of tariff hikes on US imports of all metal and metal products from all countries are estimated. This simulation somehow exaggerates the actual impact of US steel and aluminum tariff hikes. The simulation assumes that tariffs would be hiked by 25 per cent (higher than the 10 per cent tariff on aluminum) on all metal and metal products, rather than on steel and aluminum alone and from all countries,

[7] "Brazil, South Korea, Russia, Turkey, India, Vietnam, China, Thailand, South Africa, Egypt, Malaysia and Costa Rica" (USDOC 2018a p. 8).

[8] "China, Hong Kong, Russia, Venezuela, and Vietnam" (USDOC 2018b p. 8).

Table 3-A Impact of US metal tariff hikes: US sectors

(%, * Billion US dollars)

	Imports	Exports	Trade Balance*	Production
AGR	0.3	-0.6	-0.5	-0.4
MNG	-0.3	-1.7	1.7	-0.4
PFD	0.9	-1.8	-1.9	-0.3
TXL	0.7	-2.2	-1.4	-0.8
CHM	0.4	-1.3	-5.7	-0.5
MTL	-45.9	-14.2	59.4	9.0
MVH	1.1	-3.4	-6.6	-1.9
ELE	0.6	-5.1	-8.5	-3.0
OME	2.3	-5.8	-23.6	-2.2
OMF	1.5	-3.7	-5.2	-0.9
CNS	0.7	-2.4	-0.2	-0.4
EGW	1.9	-2.7	-0.2	0.1
T_T	0.4	-1.1	-1.2	-0.2
OSP	0.6	-1.4	-4.1	-0.2
OSG	0.1	-1.3	-0.8	0.0
Total	-2.0	-3.4	1.3	-0.2

Source: Author's simulations

not excluding the exempted countries[9] discussed above. The main purpose of this paper is to study the broad perspective of the economic impact of tariff hikes rather than focusing on the precise magnitude of US steel and aluminum tariff measures.

If the US were to impose an additional 25 per cent import tariff on all metal and metals products from all countries, it is estimated that US imports of metal and metal products would decrease by 45.9 per cent. The US metal trade balance would improve by 59.4 billion US dollars and US metal production would increase by 9.0 per cent (see Table 3-A).

That said, other sectors, in particular those that use metals as input materials, would likely lose international competitiveness due to rising production costs. US exports of autos, electronics, and other machinery are estimated to decrease by 3.4 per cent, 5.1 per cent, 5.8 per cent respectively. US imports of other sectors would also increase in general. The improvement of the US trade balance for all industries[10] is estimated to be

[9] The US and those countries have agreed to alternative measures. For example, the US and Korea have agreed to a steel quota amounting to 70 per cent of the average US steel imports from Korea during 2015-2017. This may have an impact equivalent to certain tariffs on US steel imports from Korea, even if Korea were exempted from the US steel tariff hikes.

[10] In this paper, the estimated impact on the trade balance for all industries includes the impact on both goods and services, which is a better indicator of external balance as a whole looking at national savings and investment balance.

Table 3-B Impact of US metal tariff hikes by country

(%, * Billion US dollars)

	Trade Balance*		Production	
	Metal	Total	Metal	Real GDP
JPN	-2.8	0.0	-0.8	0.0
CHN	-9.3	-1.0	-0.4	0.0
KOR	-2.8	0.0	-1.5	0.0
ASA	-1.2	-0.1	-0.7	0.0
IND	-0.9	0.0	-0.5	0.0
AUS	-0.3	0.0	-0.4	0.0
NZL	-0.1	0.0	-0.7	0.0
USA	59.4	1.3	9.0	-0.2
CAN	-10.4	1.0	-13.7	-0.3
MEX	-6.0	0.3	-11.2	-0.7
ARG	-0.2	0.0	-1.7	0.0
BRA	-2.0	0.1	-1.4	-0.1
EUM	-9.3	-0.1	-0.9	0.0
RUS	-1.8	-0.6	-1.3	-0.1

Source: Author's simulations

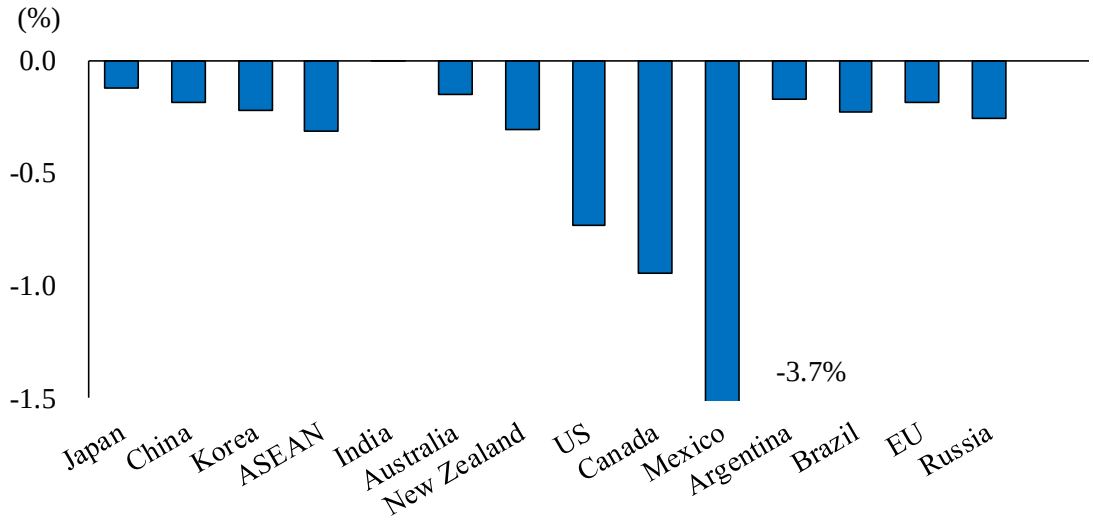
a relatively small 1.3 billion US dollars. Meanwhile, consumer real income and consumption would be adversely affected by those higher import costs. US total production is estimated to decrease by 0.2 per cent rather than increase. US real GDP is also estimated to decrease by 0.2 per cent. It is shown here that import tariffs could protect the relevant sectors but would have a negative impact on the economy at the macro level.

The impact of US metal tariff hikes on other economies at the macro level could be limited, as in the case of the US. It is estimated that China's metal trade balance would deteriorate by 9.3 billion US dollars, but that China's trade balance deterioration for all industries would be limited to 1.0 billion US dollars. EU's trade balance deterioration for all industries (0.1 billion US dollars) would also be minor compared with the deterioration of its metal trade balance (9.3 billion US dollars). Meanwhile, metal production in Canada and Mexico could decrease by more than 10 per cent but their real GDP would decrease by less than 1 per cent (see Table 3-B).

2) The costs of protectionism

On May 23, 2018, on the instructions of US President Trump, USDOC initiated an investigation of US imports of automobiles under section 232 of the Trade Expansion Act of 1962. On the other hand, several countries have made notification to the World Trade Organization (WTO) concerning US steel and aluminum tariffs. Future

Chart 2 Impact of US tariff hikes



Source: Author's simulations

developments remain to be seen. In light of this situation, the potential impact of emergent protectionism is considered here.

Trade barriers including tariffs have fallen over time. According to World Bank's "World Development Indicators,"[11] the 2012 average weighted mean tariff for all products in the world was 2.9 per cent, ranging between 1.7 per cent on average for high income countries and 9.6 per cent on average for low income countries. In this paper, the magnitude of tariff hikes on all goods is mechanically assumed to be 10 per cent in the model simulations below, in light of the levels of remaining tariffs in global trade. As a matter of fact, 25 per cent US tariff hikes have not yet been applied to all products.

It is estimated that if the US were to add a 10 per cent tariff on US imports of all goods from all countries, the US trade balance would be least affected but US real GDP[12] would decrease by 0.7 per cent. Mexico and Canada would lose more than the US, 3.7 and 0.9 per cent respectively. On the other hand, Japan (0.1 per cent), China (0.2 per cent) and the EU (0.2 per cent) would lose less (see Chart 2).

In addition, a breakdown of the impact on US real GDP suggests that the impact of US tariffs on imports from China would be the largest (0.20 per cent), followed by that

[11] http://wdi.worldbank.org/table/6.6

[12] A conventional CGE model measurement of economic welfare is equivalent variation (EV). However, the impact on real GDP is discussed in this paper, which may be much more familiar to policy makers and others as a representative indicator of macroeconomic income and production.

Table 4 Comparison of impact of worldwide higher import prices

(%)

	Assumptions	Outcomes	
		Trade	Output
IMF	5 % tariff and 5 % non-tariff measures	-16 *	-2 *
PC	15 % tariff	-22 **	-3 **
Kawasaki	10% tariff	-17.1 **	-2.3 **

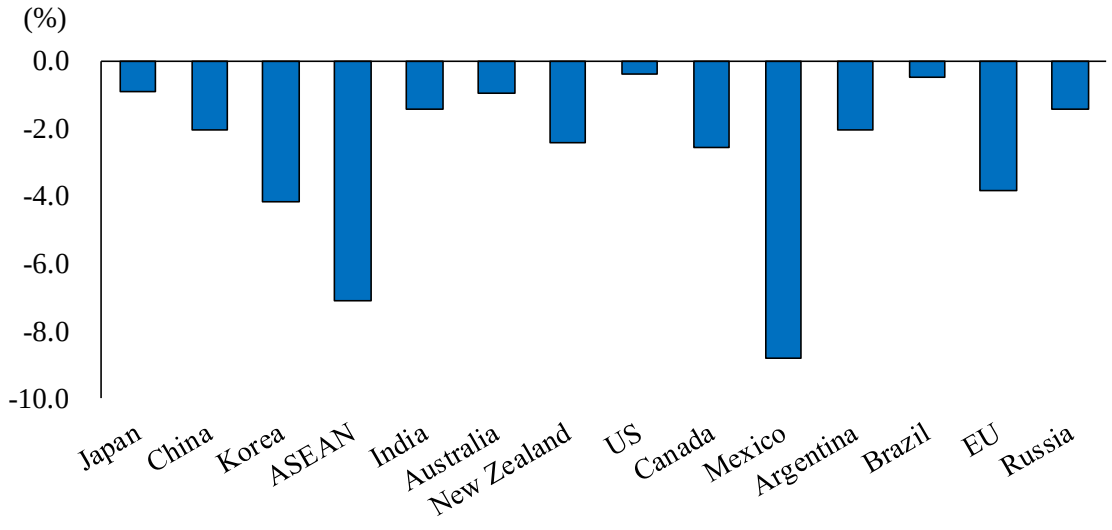
Note: * In the long run, ** estimates by a static model

Source: IMF (2016), PC (2017a) and author's simulations

on imports from the EU (0.14 per cent). By sector, the impact of US tariffs on the imports of minerals (0.17 per cent), electronic equipment (0.14 per cent), motor vehicles and parts (0.12 per cent) and other machinery and equipment (0.20 per cent) would be larger than that on metals (0.08 per cent) and other commodities. The impact of US tariffs on the import of metals, discussed in the previous section, would be around a tenth of that on imports of all goods.

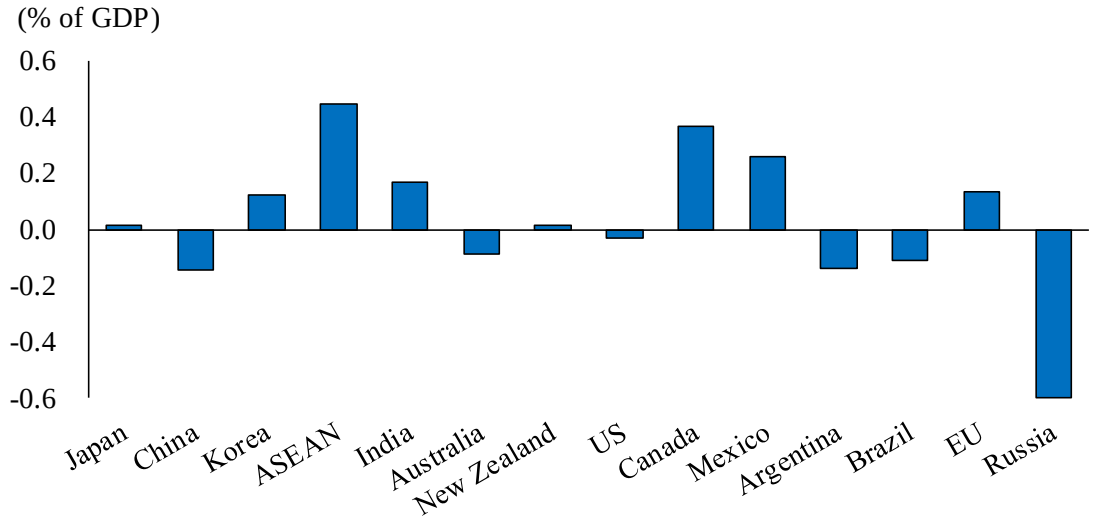
Moreover, it is estimated that if import tariffs were hiked by 10 per cent worldwide, global trade would decrease by 17.2 per cent and global real GDP would decrease by 2.3 per cent. The estimated magnitude of this impact is closer to those of earlier studies (IMF (2016); PC (2017a)). Three estimates, one reported here and two others, IMF (2016) and PC (2017a), coincidentally found a similar impact of one percentage point higher; worldwide import prices would lower global trade by 1.5 to 1.7 per cent and global output by 0.2 per cent (average figures, see Table 4). That said, the details of the methodology, including the structure of the model used, may vary among

Chart 3-A Impact of worldwide tariff hikes by country: Real GDP



Source: Author's simulations

Chart 3-B Impact of worldwide tariff hikes by country: Trade balance



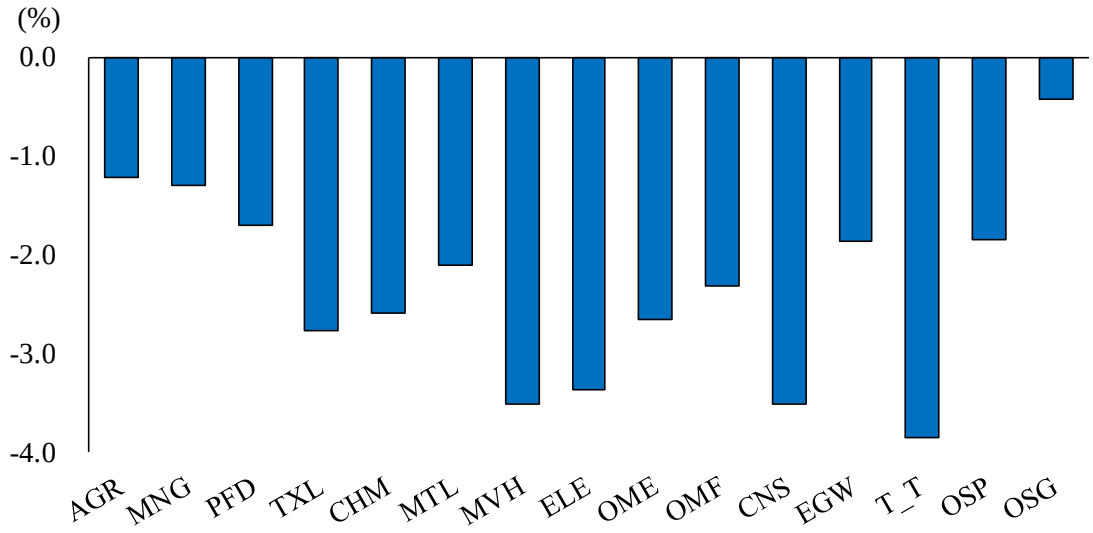
Source: Author's simulations

the three estimates. The likely magnitude of the impact would be interpreted as lying within a certain range, as discussed later.

The impact of worldwide tariff hikes would vary widely by country; it would be much more serious for Mexico (8.8 per cent) and ASEAN (7.1 per cent) than for the US (0.4 per cent), Japan (0.9 per cent) and China (2.0 per cent) (see Chart 3-A). US real GDP loss would be smaller relatively than other countries compared with the case of tariff hikes by the US only. One key reason for the variation in impact across countries would be the effect of international capital movement, discussed in detail below. As a matter of fact, the impact of worldwide tariff hikes on trade balance would also vary by region, not just in terms of magnitude but also direction. Trade balance for all industries is estimated to improve in ASEAN and Mexico but to deteriorate in China and the US (see Chart 3-B). This suggests that capital balance would deteriorate in ASEAN and Mexico but improve in China and the US.

This would have key policy implications. Trade deficits themselves would not necessarily be of much concern given the somewhat compensatory benefits of international capital inflows. US sector by sector trade deficits have been associated with larger inflows of foreign direct investment, which have created more jobs in the US domestic market. On the other hand, possible capital outflows would exaggerate the adverse effects of tariff hikes. Those impacts would be watched carefully for ASEAN, Mexico and others, i.e. for those who have been hit by serious financial crises in the past due to capital flight.

Chart 4 Impact of worldwide tariff hikes by sector



Source: Author's simulations

The impact of worldwide tariff hikes would also vary by sector. The impact would be larger for machinery and equipment including motor vehicles and parts (3.5 per cent) and electronic equipment (3.4 per cent) than for agriculture, forestry and fisheries (1.2 per cent) and processed foods (1.7 per cent) (see Chart 4). The impact would be larger in the sector in which substitution elasticity among regions and income elasticity of domestic expenditure are higher.

V. Sensitivity of endogenous labor and capital

It may be important here to consider again the question as to whether or not protectionism could save jobs. Many conventional CGE model simulations have assumed that labor could move among the sectors within the regions, but the total employment of an individual region would remain unchanged. Therefore, there is no estimate here of the impact of changes in employment and labor at the macro level. In this chapter, the sensitivity of endogenous labor supply is investigated relative to endogenous capital effects.

The GTAP model has two major production endowments,[13] capital and labor. Endogenous capital accumulation effects have been incorporated in numerous studies following the methodology in Francois et al. (1996), which "explores trade policy and

[13] Other production endowments are land for agriculture sectors and national resources for forestry, fisheries and mining sectors.

Table 5-A Sensitivity of tariff hikes: Real GDP

(%)

	STD	ML1	ML2	MC1	MC2	MLC
JPN	-0.3	-0.6	-0.8	-0.9	-1.7	-2.8
CHN	-0.9	-1.2	-1.4	-2.0	-2.4	-3.7
KOR	-0.8	-1.4	-1.9	-4.1	-2.3	-8.0
ASA	-0.8	-1.5	-2.0	-7.1	-2.4	-11.8
IND	-0.4	-0.6	-0.7	-1.4	-1.8	-2.5
AUS	-0.2	-0.3	-0.5	-0.9	-1.6	-2.9
NZL	-0.2	-0.6	-0.9	-2.4	-1.8	-5.9
USA	-0.1	-0.3	-0.4	-0.4	-1.1	-1.4
CAN	-0.6	-1.7	-2.7	-2.5	-1.6	-6.2
MEX	-0.5	-1.0	-1.3	-8.8	-2.6	-14.2
EUM	-0.6	-1.3	-1.9	-3.8	-2.1	-8.9
RUS	-0.8	-0.9	-0.9	-1.4	-2.5	-3.3
World	-0.5	-0.9	-1.2	-2.3	-1.9	-5.1

Source: Author's simulations

investment linkages in the GTAP Model." That exploration is carried out "under alternative steady-state closure rules linking trade to consumption, production, and investment, and emphasizing the general equilibrium nature of capital accumulation mechanisms." (Abstract). In this paper, these capital accumulation effects are incorporated in the major simulations, as discussed above.

On the other hand, the impact of trade policy on distribution has also been a matter of concern. There have been several cases of development of endogenizing labor and employment, e.g., Japan's Cabinet Secretariat (2015) and the US International Trade Commission (ITC 2016) incorporated endogenous labor supply in response to changes in the real wage rate in their analyses of the impact of TPP Agreement. Cabinet Secretariat (2015) set elasticity at 0.8 based on literature surveys and provided a sensitivity analysis for the case of elasticity set at 0.4. USITC (2016) also reviewed the literature and used 0.4[14] as the elasticity for all developed countries and 0.44 for all developing countries.

In this paper, the sensitivity of endogenous labor and capital are investigated for the case of a 10 per cent worldwide tariff hike, examining the following six versions of the model, employing the methodology discussed above. The property of international capital movement is also considered via the model MC2 without assuming that the expected rates of return on capital are not equalized but rather that rates of change in capital stock are common across the regions.

[14] According to USITC (2016), "This is the same labor supply elasticity as the one calculated by the Congressional Budget Office for the United States" (p. 89).

STD: Fixed labor and capital
ML1: Endogenous labor with elasticity 0.4 and fixed capital
ML2: Endogenous labor with elasticity 0.8 and fixed capital.
MC1: Fixed labor and capital accumulation
MC2: Fixed labor and capital accumulation under alternative assumption
MLC: Endogenous labor with elasticity 0.8 and capital accumulation
The MC1 model corresponds to that employed in the previous chapter.

First of all, it must be noted that the impact of tariff hikes on macro economy as measured in terms of changes in real GDP is estimated to be negative for endogenous labor supply models as well as for fixed labor supply models (see Table 5-A). The earlier key finding, that protectionism would be harmful to the economy at the macro level, is confirmed regardless of exogenous or endogenous labor supply in the framework of CGE model simulations.[15]

Second, the dynamic effects of trade policy through endogenous labor and capital are shown to be significant. The static version of the CGE model has often been criticized for underestimating the impact of trade policy, focusing on the impact of resource reallocation and the terms of trade effects but not giving consideration to the dynamic impact of economic growth effects. Moreover, the spillover effects of both endogenous labor and capital are shown to be much larger than the combined effect of endogenous labor and capital individually. Global real GDP is estimated (via the MLC model) to decrease by 5.1 per cent, which is much larger than the simple sum of the estimated impacts under the ML2 model (1.2 per cent) and the MC1 model (2.3 per cent).[16]

Third, such dynamic effects appear to vary widely among countries in the case of endogenous capital but not so widely in the case of endogenous labor, according to the results of current versions of model simulations used in this paper. The differences in impact on real GDP are estimated to be almost proportional to the size of the labor supply elasticity of real wage and those variations among countries are shown to be limited. On the other hand, those variations among countries are indicated to be larger with endogenous capital. The MC1 model estimate of impact on global real GDP (2.3 per cent) is five times larger than the STD model impact (0.5 per cent). This ratio is shown to be

[15] Francois, J., L. M. Baughman and D. Anthony (2018), for example, estimate that US steel and aluminum tariffs would increase employment in those industries but would decrease employment in other industries, resulting in a job loss at the total industries level.
[16] The estimates of the impact of lowering global trade vary relatively little among the six versions of the model (14.5 to 20.2 per cent).

Table 5-B Sensitivity of tariff hikes: Labor and capital

(%)

	Labor			Capital		
	ML1	ML2	MLC	MC1	MC2	MLC
JPN	-0.6	-1.0	-1.8	-1.5	-3.3	-3.6
CHN	-0.7	-1.1	-1.8	-2.6	-3.3	-4.2
KOR	-1.4	-2.3	-4.3	-7.0	-3.3	-10.7
ASA	-1.8	-3.0	-6.1	-11.9	-3.3	-16.2
IND	-0.5	-0.8	-1.2	-2.5	-3.3	-3.6
AUS	-0.3	-0.5	-1.7	-1.8	-3.3	-4.3
NZL	-0.7	-1.3	-3.3	-4.5	-3.3	-8.4
USA	-0.2	-0.4	-0.9	-0.9	-3.3	-2.3
CAN	-1.8	-3.3	-3.9	-5.7	-3.3	-9.1
MEX	-1.3	-2.2	-7.1	-13.3	-3.3	-18.2
EUM	-1.4	-2.5	-5.1	-6.8	-3.3	-12.0
RUS	-0.2	-0.3	-1.3	-1.0	-3.3	-3.4

Source: Author's simulations

smaller in Japan (3 times), China (2 times) and the US (3 times) but larger in ASEAN (9 times), and particularly large in Mexico (17 times).

The above difference between the endogenous labor and endogenous capital models is explained by the different behaviors of labor and capital. As mentioned above, the relative changes in labor among countries are shown to be limited, but those in capital are much larger under the MC1 model (see Table 5-B). As discussed above, this would largely be due to the general equilibrium mechanism of international capital movements. The differences in estimated impact among the countries are suggested to be less significant for the MC2 model, in which such international capital movements are limited. International capital movements would be driven by differences in induced changes in the expected rate of return on capital, which in turn depend on capital income ratios among countries.[17]

In other words, if international movement of labor and equalization of changes in real wage among the regions are introduced into the model, the behavior of the endogenous labor model would be substantially different from that of the current versions of model simulations used here. International adjustment of labor market would take a much longer time than that of capital market; this is a future issue for the development of the CGE model.

[17] PC (2017b) also discusses the effects of alternative capital closures on the CGE modeling of trade policies with a PC Global model.

All in all, the CGE model sensitivity analysis suggests a wider range of estimated impacts of tariff hikes and trade policy. It would be useful to compare the impacts of various policy scenarios using the same version of the model rather than focusing on the absolute magnitude of the likely impact of a specific policy scenario.

VI. Concluding remarks

US import tariffs could protect the relevant US sectors but would have a negative impact on the economy at the macro level. This is confirmed by this paper's sensitivity analysis of a CGE model with both endogenous and exogenous labor supply. This key policy finding could not be attributed to the conventional framework of fixed labor in a CGE model.

The CGE model sensitivity analysis also suggests that international capital movements would differentiate the impact of tariff hikes among countries. Trade deficits themselves would not necessarily be of much concern given the somewhat compensatory benefits of international capital inflows. On the other hand, possible capital outflows could exaggerate the adverse effects of tariff hikes.

It is estimated that for an import tariff hike of one percentage point worldwide, global trade would decrease by around 1.7 per cent and global GDP would decrease by around 0.2 per cent. It is of concern that emergent protectionism would reduce the growth of both global trade and the global economy.

The above CGE model estimates are applied to an analysis of the general equilibrium mechanism of supply and demand in goods markets. It must be noted that in the short term, the impact could be much larger than indicated here, depending on the response in markets including the financial, foreign exchange and commodity markets.

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