Impacts of Donald Trump's Tariff Increase against China on Global Economy: Global Trade Analysis Project (GTAP) Model

Alim Rosyadi, Saiful and Widodo, Tri

Economics Department, Fauclty of Economics and Business, Gadjah Mada University

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by:

Saiful Alim Rosyadi

Undergraduate Program, Economics Department, Faculty of Economics and Business, Gadjah Mada University, Indonesia

and

Tri Widodo*

Economics Department, Faculty of Economics and Business, Gadjah Mada University, Indonesia

* Current Mailing Address: Faculty of Economics and Business, Gadjah Mada University, Jl. Humaniora No. 1, Bulaksumur, Yogyakarta 55281, Indonesia. Phone: 62 (274) 548510; fax. 62 (274) 563 212. *E-mail address*: kociwid@yahoo.com.

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Abstract

This paper aims to analyze the possible impacts of the US import tariff against China on global economy. The GTAP model is implemented. The simulation scenarios depicted short-run effects of full-protection and manufacturing protection with appropriate retaliation response from China. On global level, the policy was projected to lead to decline in GDP, terms-of-trade, and welfare; and increase in trade balance for United States and China. Trade diversion phenomena would occur, predicting steep decline in bilateral trade between the two countries and increasing export towards their third trading partners.

Keywords: Donald Trump, Tariff Increase, GTAP Model
JEL: F13, F17

1. Introduction

The United States' presidential election on November 8, 2016 had elected Donald J. Trump as its 45th president. He was later sworn into the office on January 20, 2017. The world was taken by surprise considering that Trump's campaign included several controversial trade protectionism plans. These promises were pledged in conjunction with his campaign to reclaim the so-called "*American Economic Independence*". Below are some of his plans, as delivered in his speech on June 28, 2016 at Alumisource Factory, Monessen, Pennsylvania (Trump, 2016).

1. Withdrawal of United States from Trans-Pacific Partnership
2. Appointments of trade negotiators to fight for American workers
3. Direction of all appropriate agencies to end foreign trade abuses that harm United States' labor force.
4. Renegotiation of NAFTA terms of agreement to favor United States' labor force
5. Labeling China as currency manipulator
6. Bringing trade cases against China's unfair subsidy behavior to WTO.

7. Remediation of trade dispute with China, including possibility of tariff imposition against Chinese imports.

In the same speech, he further claimed that *"NAFTA was the worst trade deals in history, and China's entrance into World Trade Organization has enabled the greatest jobs theft in history.* [..] *Almost half of our entire manufacturing trade deficit in goods with the world is the result of trade with China*" (Trump, 2016). United States' various free-trade deals "*like the North American Free-Trade Agreement (NAFTA) and China's accession to the World Trade Organization (WTO)*" were claimed to "have *destroyed American jobs and created American losers*" (The Economist, 2016).

Regarding the last campaign promise outlined above, Donald Trump mentioned his planned rate of import tariff earlier on January 3, 2016 in a release by *The New York Times* which goes as follows.

> "In the editorial board meeting, which was held Tuesday, Mr. Trump said that the relationship with China needs to be restructured. "The only power that we have with China," Mr. Trump said, "is massive trade." "I would tax China on products coming in," Mr. Trump said. "I would do a tariff, yes – and they do it to us." (….) "I would do a tax. And the tax, let me tell you what the tax should be… the tax should be 45 percent," Mr. Trump said." (Haberman, 2016)

However, the amount of rate increase has not been finalized or drafted as a proper policy proposal. In a later occasion on April, 2016, he explained further that "*It doesn't have to be 45; it could be less. But it has to be something because our country and our trade and our deals and most importantly, our jobs are going to hell"* (Appelbaum, 2016). There were speculations whether the plan a was merely a bluff to leverage Donald Trump's bargaining position in trade negotiation with China (Jamrisko and Woods, 2016). However, considering that Donald Trump has

been putting the idea forward even before the election campaign period, global audience took the plan very seriously (Martin, 2017; Noland, *et al.*, 2016)

This policy, as predicted by several news pundits, will trigger trade war between two countries and make way for other countries to follow trade protectionism trend since United States is currently at the forefront of trade liberalization (Bryan, 2016). The effect can extend further to European countries and other Asian countries through various mechanism, most notably through international trade and investment (Elliott, 2016).

This paper aims to analyze the possible worldwide impacts of Donald Trump's tariff increase on United States' imports from China , as seen from GDP, terms-of-trade, equivalent variation, and trade balance of various countries. The rest of this paper is organized as follows. Part 2 describes the the US-China trade relations. Literature review is presented in Part 3. Methodology is in Part 4. Results and discussion are elaborated in Part 5. And finally, Part 6 draws concluding remarks.

2. The US-China Trade Relations

China rose rapidly to take largest share in United States total trade value. By 2015, the country's share in United States total trade value was 16.2 percent (see Figure 1), a rapid surge from merely 6.1 percent in 2000. Conversely, United States was also the country's top trading partner country in 2015 as the country made up 14.2 percent of China's total trade value in 2015 (see Figure 2).

Figure 1 about here.
Figure 2 about here.

The extent of which two country's import and export are compatible with each other can be measured using trade complementarity index by Michaely (1997). The index measures how much a country's export structure matches its partner's import structure. According to the index (see Figure 3), United States import structure have gotten more compatible with China's export structure, making the country pair a natural trading partner (WTO, 2012, 30-31). The compatibility was also in line with increasing share of China in United States' total trade volume. However, rising complementarity between two countries was only one-sided. According to the index, while China's export has gotten more compatible with United States' import structure, the opposite occurred for United States' export to China. This situation had contributed to deteriorating United States' trade balance deficit with China.

Figure 3 about here.

Judging from high intensity and complementarity between United States and China, it can be inferred *a priory* that any trade protectionism measures between two countries will lead to large trade pattern change in both countries. Due to rising domestic import price from China relative to other countries', United States could divert its trade away from China—its natural trading partner—towards other countries, *vice versa*. This phenomenon was coined as "trade deflection" by Bown and Crowley (2007). Mechanism for this effect can be modeled using Armington import substitution which was used in this research.

3. Literature Review

An import tariff puts a wedge between the world *c.i.f.* price and importing country's domestic consumer price. The policy is usually taken to protect domestic producer from cheaper foreign goods. Rigorous partial equilibrium analysis has been laid down by Krugman, *et al.* (2012: 192-202).

Assuming world price of a good (*c.i.f.* price, denoted as P_w) is lower than domestic price, the economy will import $D_1 - S_1$ in quantity if there is no tariff present (see Figure 4). An import tariff will raise the perceived consumer price to P_t, decreasing its import demand. If the country's import quantity is substantially large in the world market, the decline in import demand will reduce global demand of the good, thus, reducing the world price to P_t^*. Hence, the resulting tariff will be equivalent to $P_t - P_t^*$. This will lead to less import quantity of $D_2 - S_2$.

Figure 4 around here.

The area of a, b, c, d, and e represents welfare change from imposition of import tariff. Domestic consumer will suffer from decline of consumer surplus equivalent to area $a + b + c + d$. Domestic producers' surplus will increase by the area of a. A tariff is a tax on imported goods, hence, the government will collect tariff revenue equivalent to the size of tariff rate times import quantity represented by the area of $c + e$. Triangle b and d is welfare loss due to imposition of a tariff. Terms of trade will increase due to decline in country's import commodity price relative to export commodity price. Its gain is reflected under the area of e. Net welfare effect is, therefore, will be ambiguous as it depends whether terms-of-trade gain (area e) outweighs welfare loss (area $c+e$).

However, the above analysis rested on the assumption of perfectly competitive market. In the presence of a single domestic monopolist firm, tariff increase will have another distinctive aspect: it allows domestic monopolist to price above its marginal cost and domestic consumption to decline while the monopolist domestic marginal revenue increases. The monopolist will take advantage of the difference between marginal cost and domestic price by selling the gap between its production and domestic consumption to world market at world price, creating a dumping policy (Rieber, 1981). Armington (1969) proposed a concept of elasticity of substitution that will render similar goods coming from different sources as imperfect substitutes. This relationship can be represented using constant elasticity of substitution (CES) function.

The demand is determined by (1) total demand for good i (X_i), (2) ratio between price of the good from j source and its average price, (3) share of the good from source j (b_{ij}), and (4) elasticity of substitution in i-th market (σ_i). The larger the value of σ_i, the more quantity demanded of i-th good from source j will change when there is a change in relative price of the good from j-th source. "Source" can refer to either a country, country group, or domestic-foreign.

The CGE model used in this paper also incorporates Armington import substitution mechanism written in CES functional form. Both between-countries and between-foreign-and-domestic substitution nests are represented in this mechanism (Hertel eds. 1997, 39-41). If an import tariff is levied, it will alter domestic-foreign relative price and between-countries relative price. The change in

quantity demanded of a specific source will be governed by its relative price and its degree of substitute.

An import tariff has been proven empirically to lead to decline in import demand. USITC (2009) GTAP model simulation found that in the absence of tariff, India's trade with United States would have been around US$ 200-291 higher. Elsheikh *et al.* (2015) study found out that a decrease in Sudan's import tariff will increase the country's wheat imports. In multi-country setting, a trade restriction measure will introduce a phenomenon called "trade deflection"—a decline of export to tariff-enacting country accompanied by an increase of export to other third country (Bown and Crowley, 2007). The deflection phenomenon was also examined and confirmed by Dong and Whalley (2012) and Chandra (2017).

Aside from trade flow re-balancing, previous literature also examined adverse effect of import tariff increase on various macroeconomic variables. Chauvin and Ramos (2012) conducted a MIRAGE CGE model simulation of common increase in tariff among MERCOSUR countries. The simulation predicted mixed response in GDP and terms of trade. Mahadevan *et al*. (2017) dynamic CGE model simulation of Indonesia's rising mineral and general trade protectionism projected negative impact to GDP, household consumption, and employment.

Noland *et al.* (2016) conducted a Moody's DSGE model simulation of United States economy in the presence of Donald Trump's tariff increase policy on Chinese and Mexican imports. The study found out that under the full trade war scenario employment will fall more than 4 percent with largest job loss suffered by non-trade services sector. The rising unemployment will cause drop in domestic

consumption and investment. Scenarios of aborted trade war in which China and Mexico concede to United States demands shows softer repercussion to consumption, unemployment rate, and GDP growth. However, the research did not incorporate the policy in a multi-country setting, focusing only on domestic United States macro-economy.

Prolonged United States-China bilateral trade balance deficit was already predicted to spark tensions between both countries earlier in the study by Dong and Whalley (2012). Their simulation study of bilateral United States-China tariff war predicted shrinking world trade, welfare loss in both countries, and trade diversion. They suggested trade re-balancing to alleviate China's vulnerability from foreign trade shocks.

In the case of country-specific tariff, there is a possibility for the impacted country to "pass through" and re-brand its exports to another non-tariff impacted countries. Gardner and Kimbrough's model (Gardner and Kimbrough, 1990) stipulated that a country-specific tariff will not have an impact on welfare allocation but simply alters the world's pattern of trade. However, the effect will not occur if the tariff-imposing country adopts rules-of-origin to deter merchandise re-branding.

An import tariff is likely to be responded by retaliation from its partner country. Scitovszky (1942) argued that by retaliating, a country can reclaim its welfare loss generated by partner country's import tariff. However, as the country later recognizes that raising tariff will be responded by retaliation, both country will come into agreement of a common tariff.

Post (1987) later extended analysis on country retaliation response by assuming perfect foresight—each country expects that its trading partner will always respond to changes in tariffs. The model developed various scenarios of response ranging from symmetric retaliation to opposite direction response and measured the welfare outcome from each option. Although a country could provide a respond based on its subjective beliefs on welfare effects, the optimal solution that provides highest welfare is by imposing similar tariff increase.

Does President Trump indeed have the authority to invoke the policy? Huffbauer (2016) analyzed its feasibility from legal and political standpoint and discovered that United States grants conditional authority to its president regarding tariff increase measures. The conditions vary from requiring prior investigation of industrial injury by US International Trade Commission, permission from Congress, justification of unfair trade, to requiring declaration of national economic emergency. Nevertheless, the policy is projected to face numerous objections both from Congress and multinational firms.

The adverse effect brought by tariff increase will cause Trump to "*face vigorous court challenges by adversely affected US firms and possibly some states, arguing that the president had exercised powers and invoked statutes in ways that the Constitution or Congress never intended*". The court procedure, however, "*would be difficult and would certainly take time. Thus, at least for a few years, a president Trump would have stronger legal hand and his actions would very likely survive challenge in the US courts and Congress*" (Huffbauer, 2016).

Based on the above literature, simulation scenarios in this research incorporated tariff retaliation by China due to it being the country's best response for the policy. Retaliation is introduced by simulating similar level of United States' tariff increase in China import tariff. Rule-of-origin is also assumed to be in place to simplify the analysis. The model was adjusted to depict short-run condition due to the possibility of court challenges faced by Donald Trump years after the policy was in effect.

4. Methodology

4.1. Data

This study utilized Global Trade Analysis Project (GTAP) Database version 9A from Center for Global Trade Analysis, Purdue University. The database covers 140 regional units and 57 sectors (Aguiar, *et al.* 2016) with reference year 2004, 2007, and 2011. The latest reference year was used in model calibration.

4.2. Aggregation

This research followed default GTAP database sector aggregation mapping with further dis-aggregation of "GrainCrops", "Extraction", and manufacturing sector to provide more detailed analysis (see Apendix for details). Countries were mapped into 1-to-1 mapping for each of United States' major trading partners making up 95 percent of its total trade volume in 2016. African countries were grouped into "Africa", 28 European Union countries were grouped as "EU-28", and both Australia and New Zealand were grouped as "Australia-Oceania". Other countries were mapped into "Rest-of-the-World" category (see see Apendix for details).

Factors of production were aggregated into “Land”, “Skilled Labor”, “Unskilled Labor”, “Capital”, and “Natural Resources” category (see Apendix for details). Land and natural resources were set to have limited mobility across sectors. To achieve short-run simulation result, capital goods were also assumed to have limited mobility (Burfisher, 2011, 137; Adams, 2005). The value of *ETRAE* for capital goods is assumed to be similar with those of land.

4.3. Simulation

This study employs tariff policy simulation using Global Trade Analysis Project (GTAP) CGE (Computable General Equilibrium) model (Hertel, eds. 1997). The model can calculate likely outcomes of the tariff policy *ex-ante* via mathematical simulation. Simulation study is suitable for this research as there are currently no *ex-post* data generated from the policy.

As both China and United States are large economies, their trade policy could send repercussions to other countries. A CGE model can capture these linkages through price mechanism (Hosoe, *et al.*, 2010, 2-3). The simulation is of general equilibrium in nature, meaning that it also captures both direct and indirect effect stemming from linkages across different countries and markets. Moreover, GTAP model was specifically chosen due to its extensive treatments of inter-regional trade which is deemed to be suitable for conducting global trade policy analysis.

4.4. The GTAP Model

GTAP model is a CGE model developed by Center for Global Trade Analysis, Purdue University. The full model was introduced in Hertel (ed., 1997). Aside from extensive modeling of inter-regional linkages—mainly via international trade—it

also models demand for domestic and foreign-produced goods, international transport cost, global investment allocation, regional household demand, and welfare decomposition (Hertel, 2013). The model uses GTAP database for calibration.

GTAP model followed MONASH-style approach in CGE modeling (Dixon and Jorgenson, 2013, 23). Most of its behavioral and identity equations were represented in percentage-change form rather than in level-form. The model will not solve for maximization or minimization problem as with several other CGE models, however, the problem was already implicitly specified within its equations. The model's mathematical functions were derived from constrained optimization problem.

In brief, the model has the following properties (Hertel, ed., 1997; *GTAP Version 6.2* TABLO Code, 2003).

1. It models the behavior of firms and three regional households (private household, government household, and savings expenditure) in each region r.
2. Firms minimize their cost of production subject to production technology represented in Constant Elasticity of Substitution (CES) functional form. Firms are assumed to be price takers.
3. Regional households maximize their utility subject to income from net payments of factor use (for private household) or revenue of government distortionary measures (for government household). Regional household utility is the sum of its three sub-components *per capita* under

the assumption of separate utility from consumption of public and private goods (Hertel, 2013, 827).

4. Private household expenditure are modeled using Constant Difference Elasticity functional form by Hanoch (1975) to account for its non-homothetic preferences.
5. "Margin commodity" is introduced as a proxy for transportation cost.
6. Savings from regional household are spent on global investment portfolio, with special treatment regarding lack of intertemporal closure in the model.
7. Imports are differentiated by source and governed by Armington import substitution elasticity parameter.

4.5. Computation

For computation, both GTAP database and GTAP model use GEMPACK (General Equilibrium Modeling Package) software (Harrison and Pearson, 1996) developed by Center of Policy Studies, Victoria University, Melbourne, Australia. In this research, runGTAP software—a GEMPACK interface for GTAP model simulation—was used to perform model simulations. This research employed standard version of GTAP Model version 6.2 (Global Trade Analysis Project, 2003), the latest version after several revisions regarding various modeling issues (Itakura and Hertel, 2001).

This research used *Gragg's* 4-6-8 steps solution method with "automatic accuracy" option enabled to provide maximum result accuracy (Horridge, 2001). The method divides the shock with interpolation into small increments and iterates

the calculation several times. The final and accurate solution are obtained from average value of each iteration's solutions.

4.6. Scenarios

Donald Trump's proposed tariff increased policy was simulated under the following scenarios.

1. Full trade protection scenario: United States imposes 45 percent import tariff on all commodities obtained from China. China retaliates by imposing similar percentage point of tariff increase.
2. Manufacturing trade protection scenario: United States imposes 45 percent import tariff only on manufacturing commodities ("ProcFood", "TextWapp","BasicInd", "MetalInd", and "HighInd"). China retaliates by imposing similar tariff rate increase on manufacturing import from United States.

GTAP model's "standard general equilibrium closure" was adopted for all simulations. Under this closure, price elasticity parameters can respond to shock from both supply and demand side (Hertel, ed, 1997, 158-159).

5. Results and Discussions

5.1. Impacts of Global Economy

GTAP Model predicted negative impact to China and United States' GDP (see Table 1). Although both scenarios simulated symmetric tariff increase in both United States and China, impact on China's GDP is larger than those of United States'. Manufacturing-only protection scenario generally predicted milder impact to GDP compared to full protection scenario. The impact on another countries' GDP

varies from strongly positive (for Vietnam, Mexico, and Canada) to slightly above zero. The projection of decline in both tariff imposing countries' GDP is in line with prior studies in the case of US (Noland, *et al.*, 2016) and Indonesia (Mahadevan, *et al.*, 2017) while contradicts Chauvin and Ramos (2012) study of MERCOSUR tariff escalation case.

Table 1 about here.

Disaggregating the percentage change according to its expenditure components gives a better picture of the change. In China, consumption, investment, and government expenditures were projected to decline sharply in both scenarios while net export experiences a rise. In the United States, net export was projected to decline with subdued decline in investment, consumption and government expenditure. (see Table 2). Indonesia was projected to experience mild increase in GDP around 0.91 percent to 1.11 percent under first and second scenario, respectively. The change is contributed by increase in investment and consumption expenditure component.

Table 2 about here.

Table 3 reports predicted change in trade balance (in million USD) due to the policy. United States trade balance will experience sharp positive change while China's change trade balance is comparable with those of other countries'. EU-28 countries, albeit reported to experience largest change, comprises of smaller changes within its country members comparable to those of other countries in the list. Japan and Brazil is the only country that will suffer from relatively large decline in trade balance compared to other countries.

Table 3 about here.

Equivalent variation is used by GTAP model as a measurement of a country's welfare gain or loss. Table 4 reports welfare gain or loss for each country. Only China and United States will suffer from welfare loss due to the tariff increase. This result contradicts simulation results by Dong and Whalley (2012) both in their Armington model and endogenous trade surplus model results.

Table 4 about here.

Predicted impact to change in terms-of-trade shows similar pattern to those of change in GDP (see table 5). Only China and United States will suffer from sharp worsening of terms of trade. China was predicted to experience the largest decline. Other countries will experience change in terms of trade around zero with Turkey being the only country to experience negative change. World price was not projected to change significantly, indicating that the tariff war will not yield significantly large world trade volume change.

The simulation result shows that the change in terms of trade is mainly contributed by change in export price. The phenomenon is more pronounced in China and United States where predicted negative change in both country's export price is very sharp. This is due to decline in both country's general decline in demand, bringing their *f.o.b.* export price lower.

There is also a possibility of deflection towards domestically produced goods as asserted by Burfisher (2011, 157). She argued that since imported goods will be more expensive under import tariff, both countries will shift their demand towards domestic goods, bringing down their export supply and increasing their

export price. However, the domestic diversion phenomenon is overshadowed by overall increase in both China's and United States' export towards each of their other trading partners.

Table 5 about here.

The export diversion effect towards other trading partner (Bown and Crowley, 2007; Chandra, 2017) is evident in both scenarios (see Table 6). As GTAP model only calculates price change and quantity change for region-specific trade, these percentage change in export value is obtained by using multiplication rule of price change and quantity change. Bilateral trade between China and United States is predicted to experience sharp decline, similar to US-China tariff war simulation by Dong and Whalley (2012) despite differences in the effect towards other trading partner countries. The diversion is larger in China than United States and in line with prediction of larger decline in China's export price.

Table 6 about here.

Literature of trade diversion only mentioned change in export pattern. However, looking at change in import pattern can show the impact on other countries' export towards China and United States. Table 7 presents change in import pattern. A riveting result is that, under manufacturing-only protection scenario, China import will diminish. This result is contrast with first scenario where import diversion was predicted by the model. Disaggregating the effect based on the commodity, simulation result shows that import diversion for primary commodities which were present under scenario 1 is absent in scenario 2. The policy under scenario 2 is levied on China's surplus commodities, therefore, China

will not substitute such commodities towards other trading partners. Instead of deflecting its import, general decline in import demand as result of general output contraction is more pronounced in the projection.

Table 7 about here.

6. Concluding Remarks

This research examined the possible impacts of Donald Trump's proposed import tariff increase towards Chinese imports on global economy using GTAP standard model. The simulation scenarios depicted short-run effects of full-protection and manufacturing protection with appropriate retaliation response from China. On global level, the policy was projected to lead to decline in GDP, terms-of-trade, and welfare; and increase in trade balance for United States and China. The results confirmed previous news pundits' predictions of declining GDP and negative welfare effect; and was mostly in line with previous trade simulation studies involving tariff increase policy. Other country will experience mixed impact on their macroeconomic variables.

Trade diversion phenomena was present in the simulation results, predicting steep decline in bilateral trade between the two countries and increasing export towards their third trading partners. Import pattern of both countries will also change as well, although under second scenario, China's import from all countries will generally decline. In general, second scenario simulation results show milder impact of the policy on all observed variables.

Simulation results shows that the goal of "Reclaiming American Economic Independence" will not be attained by imposing strict import tariff. Instead of

enhancing United States economic condition, this research shows that it will lead to negative effect towards United States' economy. As the simulation also predicted largest negative effect towards China's macroeconomic condition, it might be beneficial for China to reduce its growth dependence on export (Dong and Whalley, 2012). Therefore, should any trade dispute arise pertaining China's dominance over world trade such as the case examined in this research, the economy would be more resilient.

Should the policy indeed take place, Indonesia can take advantage by engaging in stronger trade ties with United States and China, considering that the country will receive tailwind from trade diversion phenomena from the two countries. Textile and apparel industries can also take advantage by streamlining its production process as it is the only sector that will benefit from the policy.

However, this research has numerous drawbacks. Most of it is due to the limitations of GTAP model—and CGE model in general. The model adopted oversimplified treatments of firm production for short run condition such as perfectly competitive market and uniform production function across sectors and regions. Financial market and other monetary components of the economy was not included. Further, the simulation should have had included presence of factor unemployment, however, as data pertaining factor utilization mostly unavailable on global basis, it is impossible to include this aspect into analysis. Adoption of single-country model might be able to solve this issue with the cost of the simulation cannot be done in multiregional setting. Nevertheless, to the best of the author's knowledge, this research has been the best possible way to examine the issue as

there are almost no other multiregional trade models available to serve for the analysis.

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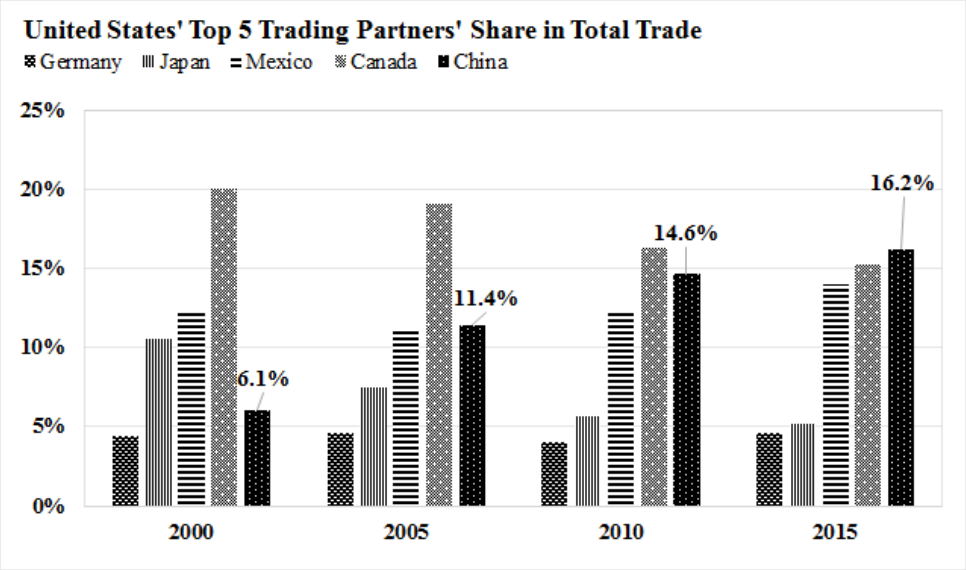
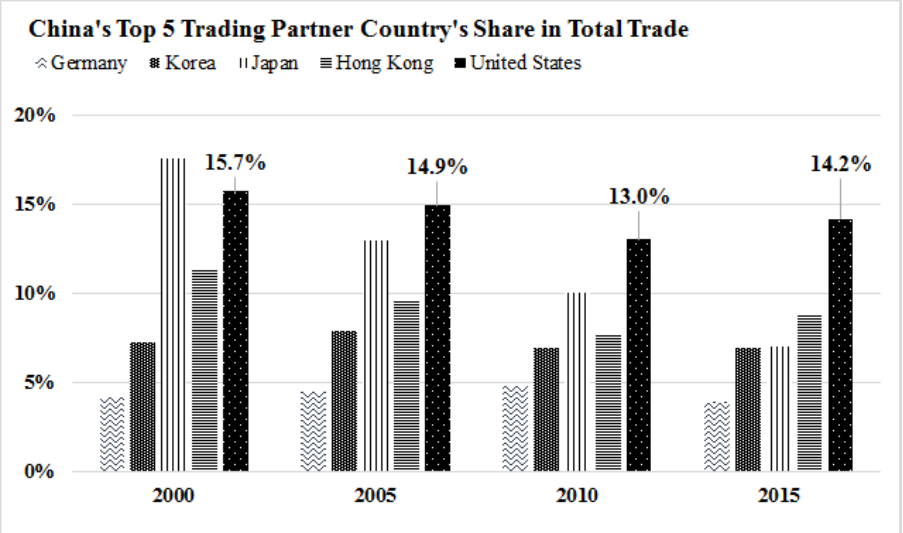


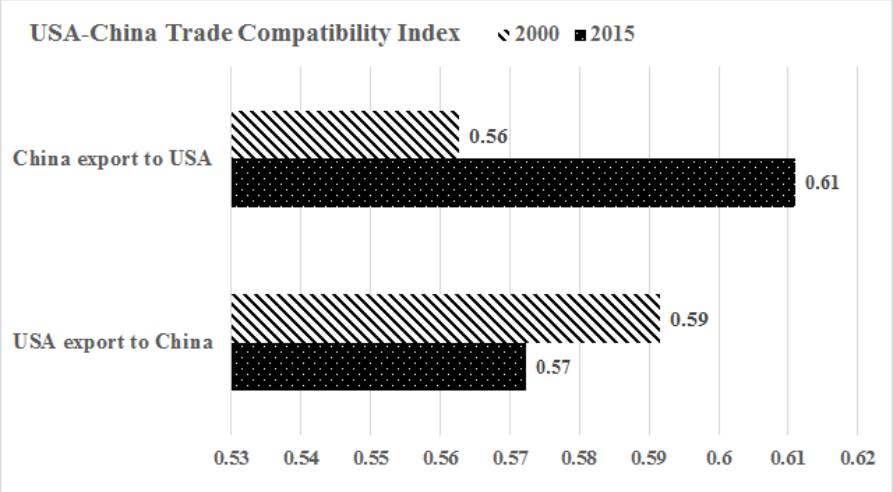
Source: World Bank WITS Database (2017), *processed*

Figure 1. United States Top 5 Trading Partner Countries' Share in Total Trade



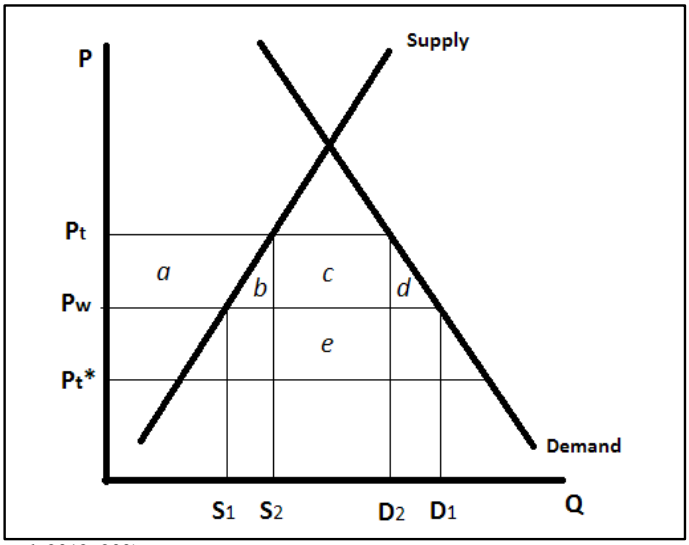
Source: World Bank WITS Database, (2017), *processed*

Figure 2. China's Top 5 Trading Partner Country's Share in Total Trade



(Source: UN-COMTRADE Database (2017), *processed*

Figure 3. USA-China Trade Compatibility Index



Source: Krugman et al. 2012: 200)

Figure 4. Graphical Representation of Market Condition under Import Tariff

Table 1. Impact on GDP

Region	Change in GDP (%)	
	Scenario 1	Scenario 2
Australia-Oceania	0.89	0.52
EU-28	0.7	0.63
Africa	0.87	0.73
Rest-of-the-World	1	0.86
China	-4.1	-3.93
Canada	2.43	2.29
Mexico	3.24	3.19
Japan	1	0.97
Korea	0.9	0.87
India	0.87	0.67
Taiwan	0.81	0.79
Switzerland	0.71	0.63
Brazil	1.57	0.98
Vietnam	3.66	3.42
Malaysia	1.17	1.1
Singapore	0.62	0.54
Hong Kong	0.58	0.33
Thailand	1.04	0.89
Israel	2	1.93
Saudi Arabia	0.87	0.79
Colombia	1.55	1.42
UEA	0.77	0.67
Indonesia	1.01	0.87
Chile	0.74	0.61
Russia	1	0.9
Philippines	1.42	1.29
Turkey	0.44	0.32
Venezuela	1.42	1.32
USA	-0.92	-0.66

Source: GTAP model simulation result (2017), *processed*.

Table 2. Disaggregation of Change based on Expenditure Components

Region	Weighted Change in GDP expenditure (%)				
	C	**I**	**G**	**NX**	**GDP**
Scenario 1					
China	-1.48	-1.89	-0.61	-0.08	-4.07
USA	-0.84	-0.70	-0.20	0.70	-1.05
Indonesia	0.64	0.56	0.11	-0.21	1.11
Scenario 2					
China	-1.45	-1.77	-0.58	-0.11	-3.91
USA	-0.62	-0.57	-0.15	0.60	-0.74
Indonesia	0.52	0.46	0.09	-0.17	0.91

Source: GTAP model simulation result (2017), *processed*

Table 3. Change in Trade Balance

	Change in Trade Balance	
Region	Scenario 1	Scenario 2
Australia-Oceania	-3656.16	-2141.6
EU-28	-33671.11	-27954.12
Africa	-2230.44	-1934.7
Rest-of-the-World	-8477.04	-7482.46
China	-6129.2	-8382.2
Canada	-5390.34	-4709.72
Mexico	-2907.57	-2645.16
Japan	-15385.15	-14024.9
Korea	-3026.27	-2745.15
India	-3477.06	-2741.36
Taiwan	-347.49	-291.45
Switzerland	-824.81	-664.99
Brazil	-7696.42	-4017.27
Vietnam	-2788.98	-2614.29
Malaysia	-1294.45	-1200.49
Singapore	149.55	104.71
Hong Kong	-461.01	-349.5
Thailand	-1197.26	-1109.45
Israel	-1178.93	-1059.72
Saudi Arabia	997.96	1008.25
Colombia	-800.42	-717.34
UEA	-804.95	-717.21
Indonesia	-1743.13	-1407.05
Chile	-300.24	-220.83
Russia	-3172.77	-2744.74
Philippines	-1036.56	-913.78
Turkey	-1051.08	-805.22
Venezuela	-302.91	-261.02
USA	108203.75	92742.91

Source: GTAP model simulation result (2017), *processed.*

Table 4. Equivalent Variation

Region	Scenario 1	Scenario 2
Australia-Oceania	2078.51	476.1
EU-28	14419.18	13130.71
Africa	4665.28	4320.04
Rest-of-the-World	15232.55	14119.64
China	-100994.8	-94061.28
Canada	8739.55	7709.65
Mexico	7887.86	7626.97
Japan	7038.48	7015.53
Korea	2591.64	2521.56
India	2108.03	1454.4
Taiwan	964.4	913.82
Switzerland	428.18	367.49
Brazil	4288.02	1962.76
Vietnam	2584.54	2452.52
Malaysia	1543.79	1487.98
Singapore	340.4	256.75
Hong Kong	786.1	493.54
Thailand	1028.02	856.2
Israel	1321.64	1279.76
Saudi Arabia	2426.23	2444.18
Colombia	604.85	572.67
UEA	1724.22	1673.53
Indonesia	1370.57	983.21
Chile	254.97	116.61
Russia	5370.94	5292.72
Philippines	668.61	612.38
Turkey	31.51	-214.57
Venezuela	879.08	857.59
USA	-90881.03	-79528.23

Source: GTAP model simulation result (2017), *processed*.

Table 5. Terms of Trade Change

Region	Scenario 1				Scenario 2			
	World Price Contrib.	Export price contrib.	Import price contrib	Terms-of-trade	World Price Contrib.	Export price contrib.	Import price contrib	Terms-of-trade
Australia-Oceania	0.05	0.25	-0.22	0.52	-0.06	-0.02	-0.22	0.13
EU-28	-0.06	0.28	0.05	0.16	-0.06	0.25	0.05	0.14
Africa	0.43	0.22	-0.16	0.81	0.42	0.16	-0.17	0.75
Rest-of-the-World	0.34	0.33	-0.07	0.74	0.33	0.28	-0.08	0.69
China	-0.23	-2.55	0.26	-3.03	-0.22	-2.51	0.22	-2.94
Canada	0.13	1.16	-0.26	1.56	0.13	1.14	-0.11	1.39
Mexico	0.02	1.8	-0.33	2.16	0.03	1.87	-0.17	2.08
Japan	-0.25	0.51	-0.42	0.69	-0.22	0.51	-0.4	0.69
Korea	-0.25	0.28	-0.3	0.33	-0.22	0.28	-0.28	0.34
India	-0.29	0.42	-0.19	0.32	-0.29	0.31	-0.18	0.21
Taiwan	-0.21	0.34	-0.17	0.3	-0.2	0.35	-0.13	0.29
Switzerland	0.01	0.31	0.18	0.14	0.01	0.28	0.16	0.13
Brazil	0.02	0.85	-0.15	1.02	-0.02	0.25	-0.13	0.36
Vietnam	0.02	1.14	-0.44	1.6	0.01	1.04	-0.44	1.49
Malaysia	0.07	0.38	-0.17	0.62	0.06	0.37	-0.18	0.61
Singapore	-0.13	0.15	-0.08	0.11	-0.13	0.13	-0.08	0.08
Hong Kong	0.05	0.08	-0.32	0.44	0.03	-0.05	-0.3	0.29
Thailand	-0.13	0.37	-0.13	0.37	-0.14	0.31	-0.13	0.3
Israel	-0.08	1.05	-0.05	1.02	-0.07	1.04	-0.02	0.99
Saudi Arabia	0.83	0.1	-0.09	1.01	0.84	0.09	-0.08	1.01
Colombia	0.39	0.39	-0.03	0.8	0.36	0.43	0.01	0.78
UEA	0.63	0.11	-0.14	0.88	0.63	0.09	-0.15	0.87
Indonesia	0.09	0.4	-0.2	0.68	0.01	0.32	-0.19	0.52
Chile	-0.04	0.13	-0.2	0.29	-0.09	0.06	-0.17	0.15
Russia	0.62	0.25	-0.11	0.98	0.61	0.24	-0.12	0.98
Philippines	-0.14	0.59	-0.23	0.67	-0.13	0.52	-0.23	0.62
Turkey	-0.19	0.2	0	0.02	-0.21	0.16	0.03	-0.07
Venezuela	0.74	0.36	-0.09	1.19	0.74	0.34	-0.09	1.17
USA	-0.09	-0.66	0.32	-1.06	-0.08	-0.31	0.29	-0.68

Source: GTAP model simulation output (2017), processed.

Table 6. Trade Diversion (Export)

Destination Region	Scenario 1		Scenario 2	
	China Export	US Export	China Export	US Export
Australia-Oceania	11.72	4.14	11.33	0.55
EU-28	12.52	5.37	12.86	2.03
Africa	12.33	4.85	12.55	1.59
Rest-of-the-World	12.59	5.10	12.87	2.02
China	15.55	-83.94	8.56	-35.66
Canada	12.15	4.04	13.83	2.83
Mexico	13.47	5.20	15.54	4.16
Japan	10.35	2.92	11.13	0.62
Korea	10.23	2.77	11.03	0.46
India	12.22	4.82	12.25	1.39
Taiwan	10.95	3.02	12.14	1.16
Switzerland	13.17	5.82	13.48	2.45
Brazil	13.36	5.91	12.81	1.94
Vietnam	13.39	5.84	13.52	2.65
Malaysia	11.76	4.27	11.81	1.17
Singapore	11.82	4.03	12.00	1.14
Hong Kong	10.58	2.88	11.13	0.28
Thailand	12.05	4.27	12.16	1.21
Israel	13.16	5.48	13.90	2.86
Saudi Arabia	12.87	5.22	13.14	2.18
Colombia	13.21	5.24	14.13	2.89
UEA	12.11	4.52	12.38	1.48
Indonesia	12.32	4.76	12.45	1.77
Chile	11.30	4.06	11.67	0.93
Russia	12.81	5.24	13.00	2.06
Philippines	12.49	4.97	12.53	1.76
Turkey	12.01	4.30	12.75	1.68
Venezuela	14.22	6.34	14.58	3.26
USA	-83.78	11.40	-26.49	8.22

Note: All values are expressed in all-commodity percentage change average of f.o.b. export value
Source: GTAP model simulation output (2017); *processed*

Table 7. Trade Diversion (Import)

Destination Region	Scenario 1		Scenario 2	
	China Import	US Import	China Import	US Import
Australia-Oceania	1.82	5.83	-3.46	7.29
EU-28	2.21	6.12	-4.34	6.27
Africa	1.45	5.34	-4.78	5.74
Rest-of-the-World	1.28	5.05	-5.01	5.39
China	15.55	-83.68	8.56	-26.37
Canada	-0.93	2.30	-7.47	2.44
Mexico	-2.27	0.44	-9.55	-0.03
Japan	2.22	6.00	-4.70	5.82
Korea	3.13	6.91	-3.94	6.70
India	1.64	5.50	-4.40	6.09
Taiwan	2.81	6.53	-4.35	6.19
Switzerland	2.06	5.89	-4.56	5.97
Brazil	-0.23	3.41	-4.97	5.45
Vietnam	-1.87	1.71	-7.78	2.26
Malaysia	1.80	5.65	-4.63	5.90
Singapore	3.05	6.83	-3.68	6.90
Hong Kong	3.13	6.91	-3.53	7.16
Thailand	1.62	5.52	-4.38	6.15
Israel	-0.27	3.31	-6.85	3.30
Saudi Arabia	1.63	5.57	-4.85	5.73
Colombia	0.19	3.76	-6.55	3.70
UEA	2.16	6.07	-4.36	6.25
Indonesia	1.28	4.95	-5.01	5.35
Chile	2.81	6.75	-3.81	6.97
Russia	1.16	4.97	-5.26	5.19
Philippines	0.53	4.19	-5.62	4.60
Turkey	2.84	6.75	-3.76	6.93
Venezuela	-0.75	2.94	-7.04	3.11
USA	-83.81	11.40	-35.63	8.22

Note: All values are expressed in all-commodity percentage change average of c.i.f. import value
Source: GTAP model simulation output (2017); *processed*

Appendix

Sector Aggregation Mapping

Aggregation Name	Group Description	GTAP Sector Code	Disaggregated Sectors
Grains	Basic primary grains crops	pdr	Paddy rice
		wht	Wheat
		gro	Cereal grains, not elsewhere classified (n.e.c)
Crops	Horticulture products, farm crops	v_f	Vegetables, fruit, nuts
		osd	Oil seeds
		c_b	Sugar cane, sugar beet
		pfb	Plant-based fibers
		ocr	Crops n.e.c
MeatLstk	Meat, animal products from farms	ctl	Cattle, sheep, goats, gorses
		oap	Animal products, n.e.c
		rmk	Raw milk
		wol	Wool, silk-worm cocoons
		cmt	Meat, cattle, sheep, goats, horse
		omt	Meat products, n.e.c.
Extraction	Extraction and mining products	frs	Forestry
		fsh	Fishing
		coa	Coal
		omn	Minerals, n.e.c
OilGas	Oil and gas	oil	Oil
		gas	Gas
ProcFood	Processed food products	vol	Vegetable oils and fats
		mil	Dairy products
		pcr	Processed rice
		sgr	Sugar
		ofd	Food products, n.e.c.
		b_t	Beverages and tobacco products
TextWapp	Textile and apparel products	tex	Textiles
		wap	Wearing apparel
BasicInd	Basic manufacturing producing raw or primary materials	lea	Leather products
		lum	Wood products
		ppp	Paper products, publishing
		p_c	Petroleum, coal products
		crp	Chemical, rubber, plastic products
		nmm	Mineral products n.e.c.
MetalInd	Metal manufacturing	i_s	Ferrous metals
		nfm	Metals n.e.c.
		fmp	Metal products
HighInd	High-tech manufacturing	mvh	Motor vehicles and parts
		otn	Transport equipment n.e.c.
		ele	Electronic equipment
		ome	Machinery and equipment n.e.c.
		omf	Manufactures n.e.c.
Util_Cons	Utility and construction sector	ely	Electricity
		gdt	Gas manufacture, distribution
		wtr	Water
		cns	Construction
TransComm	Transport and communication sector	trd	Trade
		otp	Transport n.e.c.
		wtp	Sea transport
		atp	Air transport
		cmn	Communication
OthServices	Other services sector	ofi	Financial services n.e.c.
		isr	Insurance
		obs	Business services n.e.c.
		ros	Recreation and other services
		osg	Public administration/defense/health/education
		dwe	Dwellings

Source: Author's specification from GTAP 9 Database; Aguiar, *et al.* (2016)

Regional Aggregation Mapping

Regions	Members
AusOce	Australia, New Zealand, Other Oceania
EU_28	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Bulgaria, Croatia, Romania
Africa	Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo, Rest-of-Western Africa, Central Africa, South Central Africa, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe, Rest of Eastern Africa, Botswana, Namibia, South Africa, Rest of South African Countries.
China	China
Canada	Canada
Mexico	Mexico
Japan	Japan
Korea	Korea
India	India
Taiwan	Taiwan
Switzerland	Switzerland
Brazil	Brazil
Vietnam	Vietnam
Malaysia	Malaysia
Singapore	Singapore
Hongkong	Hong Kong
Thailand	Thailand
Israel	Israel
SaudiArb	Saudi Arabia
Colombia	Colombia
UEA	UEA
Indonesia	Indonesia
Chile	Chile
Russia	Russia
Phlpns	Philippines
Turkey	Turkey
Venzuela	Venezuela
USA	USA
ROW	Other countries not specified above

Source: Author's specification from GTAP 9 Database

Factors of Production Aggregation Mapping

Factor of Production	Aggregation Group	Factor Mobility
Land	"Land"	Sluggish ($ETRAE = -1$)
Technicians, Associates, Professionals Officials and Managers,	Skilled Labor "SkLabor"	Mobile
Agricultural and Unskilled Clerks Service / Shop workers	Unskilled Labor "UnSkLabor"	Mobile
Capital	"Capital"	Sluggish ($ETRAE = -1$)
Natural Resources	Natural Resources "NatRes"	Sluggish ($ETRAE = -0.001$)

Source: Author's specification from GTAP 9 Database