ASSESSING THE IMPACT OF THE UNITED STATES–PEOPLE'S REPUBLIC OF CHINA TRADE DISPUTE USING A MULTIREGIONAL COMPUTABLE GENERAL EQUILIBRIUM MODEL

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ABSTRACT

Since the onset of the ongoing United States (US)–People's Republic of China (PRC) trade dispute in 2017, stakeholders and experts alike have expressed deep concerns that the tensions would come at a cost for the countries involved and the global economy. In this paper, we endeavor to quantify this cost by using a computable general equilibrium model based on the 2017 Asian Development Bank Multi-regional Input-Output Tables. We construct three scenarios: the baseline or business-as-usual (BAU) scenario; scenario 1, based on the bilateral measures implemented as of May 2019; and scenario 2, corresponding to a full-scale tariff war where both countries impose an additional 25% tariff on all bilateral imports. We find that scenario 1 is associated with a contraction of gross domestic product (GDP) with respect to the baseline by 0.17% in the US and 0.36% in the PRC. Employment contracts by 0.24% in the US and 0.55% in the PRC. Similarly, consumption, and investment decrease by 0.14% and 0.45%, respectively in the US, and by 0.20% and 0.64% in the PRC. Scenario 2 is associated with an even larger contraction in trade flows, which leads to larger decreases in GDP, employment, consumption, and investment in both economies. We observe trade diversion to other Asian economies, with Japan, Malaysia, the Republic of Korea, and Viet Nam benefiting the most, but sectoral analysis shows that export-competing sectors to the PRC in other Asian countries stand to benefit from the ongoing trade dispute, whereas sectors that supply to the PRC stand to suffer.

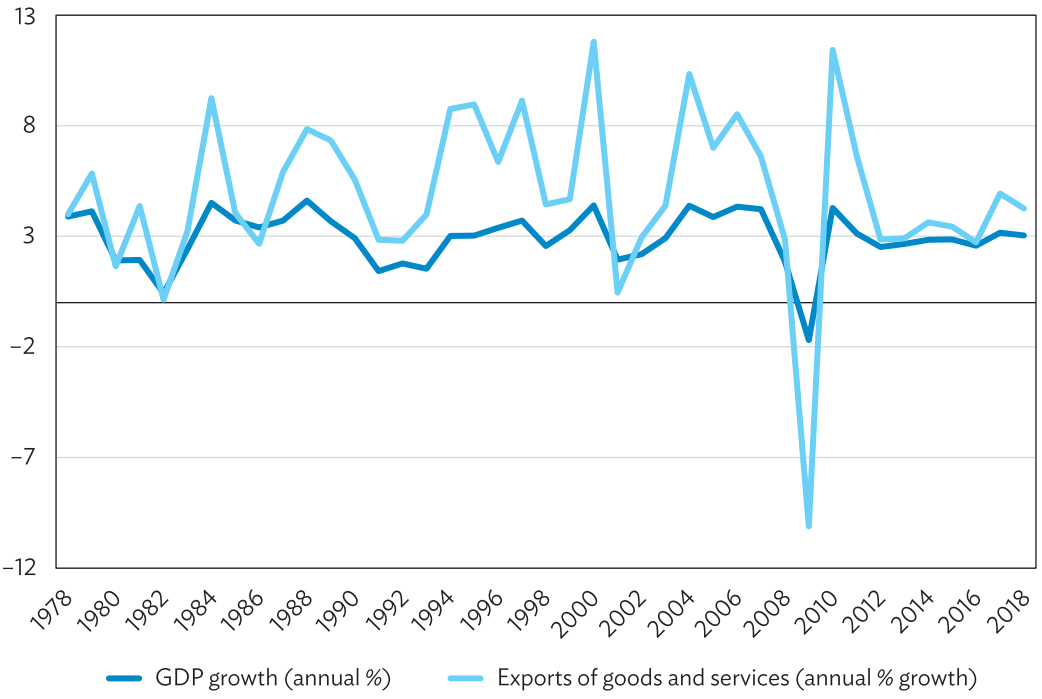
Keywords: computable general equilibrium (CGE) model, input output, Multi-regional Input-Output Tables (MRIOT)

JEL codes: D57, D58, F13, F17

I. INTRODUCTION

A captivating explanation of the trade dispute between the US and the PRC, which started in 2017 and is ongoing, would be to view it as the latest occurrence of Thucydides' trap: when a rising power challenges another's predominance, war is the inevitable outcome (Allison 2017).[1] In fact, this dispute is but one instance of a broader global unease that began in the aftermath of the global financial crisis. Figure 1 shows international trade faltering after the sharp collapse and rebound caused by the crisis. The average growth of exports of goods and services decreased from 5.4% in the 3 decades prior to the global financial crisis to 3.5% in the 2012–2018 period. Exports of goods and services were growing twice as fast as global gross domestic product (GDP) before the crisis, but now they are growing almost at the same rate as GDP.

Figure 1: World Exports of Goods and Services and Real Gross Domestic Product Growth, 1978–2018



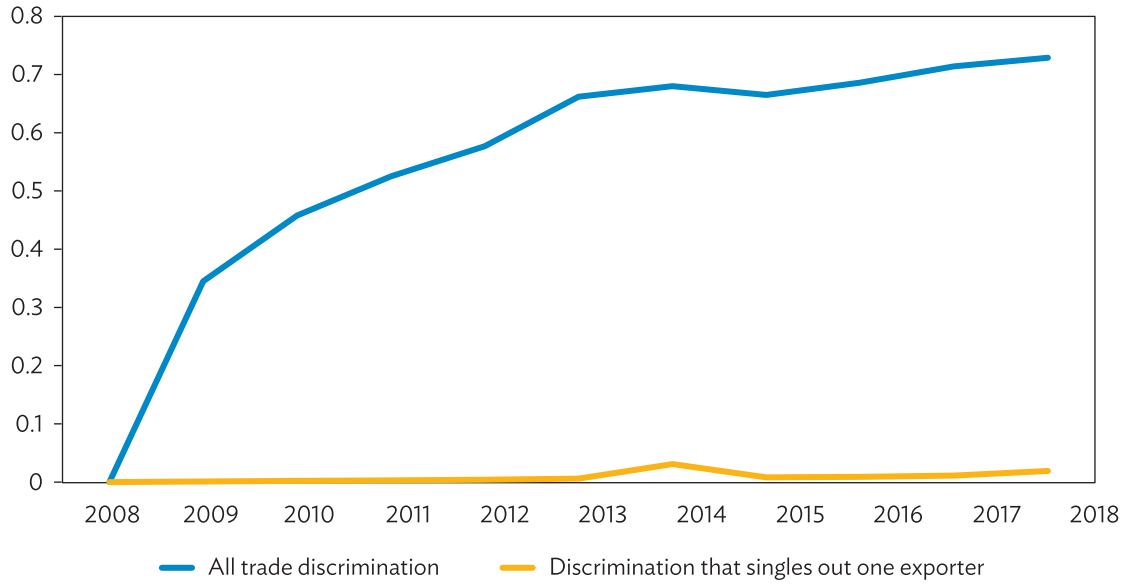
GDP = gross domestic product.

Source: Authors based on World Development Indicators. https://databank.worldbank.org/source/world-development-indicators (accessed July 18, 2019).

[1] Thucydides (460 BC–400 BC) is an influential Greek historian who detailed the fifth-century BC war between Sparta and Athens. In his History of the Peloponnesian War, he wrote that "it was the rise of Athens and the fear that this inspired in Sparta that made war inevitable" (Thucydides 1974).

While there is more than one reason for this "stalling of globalization" (James 2018), the most relevant to this study is the observed rise in protectionism since the onset of the financial crisis, with discriminatory measures implicating an increasing share of world trade (Figure 2).[2] This uptick in protectionism started years before the US–PRC trade dispute and it is a concerning trend, since trade has been a key driver of long-run productivity and income growth (see Frankel and Romer 1999, Alcalá and Ciccone 2004, Wacziarg and Welch 2008).

Figure 2: Share of World Trade Implicated in New Discriminatory Measures after 2008



Source: Evenett, Simon J., and Johannes Fritz. 2019. "Jaw Jaw Not War War: Prioritising WTO Reform Options." The 24th Global Trade Alert Report. London: CEPR Press.

In this paper, we use a static multiregional computable general equilibrium (CGE) model based on Koesler and Pothen (2013) to better understand the impact of the ongoing US–PRC trade dispute on output, employment, and other main macroeconomic indicators for the US, the PRC, and other Asian economies. We construct three scenarios: the baseline or BAU scenario aims to characterize the US–PRC trade relations in the absence of tariff escalation; scenario 1 represents tariff measures implemented as of May 2019 between the US and the PRC; and scenario 2 represents a full-scale tariff war in which the US and the PRC impose an additional 25% tariff on all goods imported from each other.

We find that scenario 1 is associated with a contraction of GDP with respect to the baseline by 0.17% in the US and 0.36% in the PRC. Employment contracts by 0.24% in the US and 0.55% in the PRC. Similarly, consumption and investment decrease by 0.14% and 0.45%, respectively in the US, and by 0.20% and 0.64% in the PRC. Scenario 2 is associated with an even larger contraction in trade flows, which leads to larger decreases in GDP, employment, consumption, and investment in both economies.

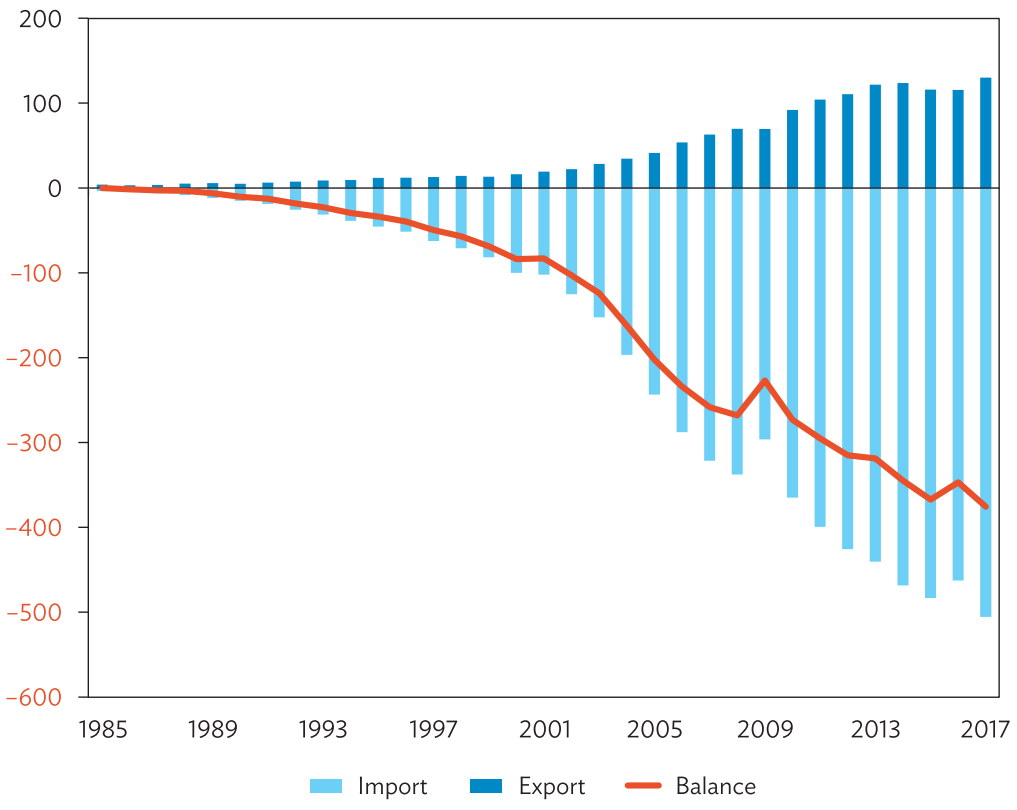
[2] See, for example, Hoekman 2015, IMF 2016, Haugh et al. 2016.

Both policy scenarios lead to trade diversion to other Asian economies, with Japan, Malaysia, the Republic of Korea, and Viet Nam benefiting the most. Expectedly, sectoral analysis shows that export-competing sectors to the PRC in other Asian countries stand to benefit from the ongoing trade dispute, whereas sectors that supply to the PRC stand to suffer.

Finally, we consider the possibility that a decrease in investor confidence could amplify the negative effects of the trade dispute. We simulate a scenario in which investment in the PRC further decreases by 1% in the full-scale tariff war scenario. We find that GDP would consequently contract by 1.1% in the PRC. For the other Asian economies that depend on exports to the PRC or investment from the PRC (e.g., Taipei,China), that would result in a substantial erosion of their potential gains from trade diversion.

It is helpful to discuss the origin of the trade dispute. US criticism points at unfair Chinese policies and practices as the reason for the soaring US trade deficit with the PRC. Such practices range from market access, currency manipulation, and forced technology transfers, to industrial policy, import duties, government subsidies, and alleged Chinese firms' violations of US sanctions on third countries. However, as Figure 3 shows, the PRC has maintained a large trade surplus with the US since the early 1990s, but it was really after the PRC joined the World Trade Organization in 2001 that it expanded rapidly.

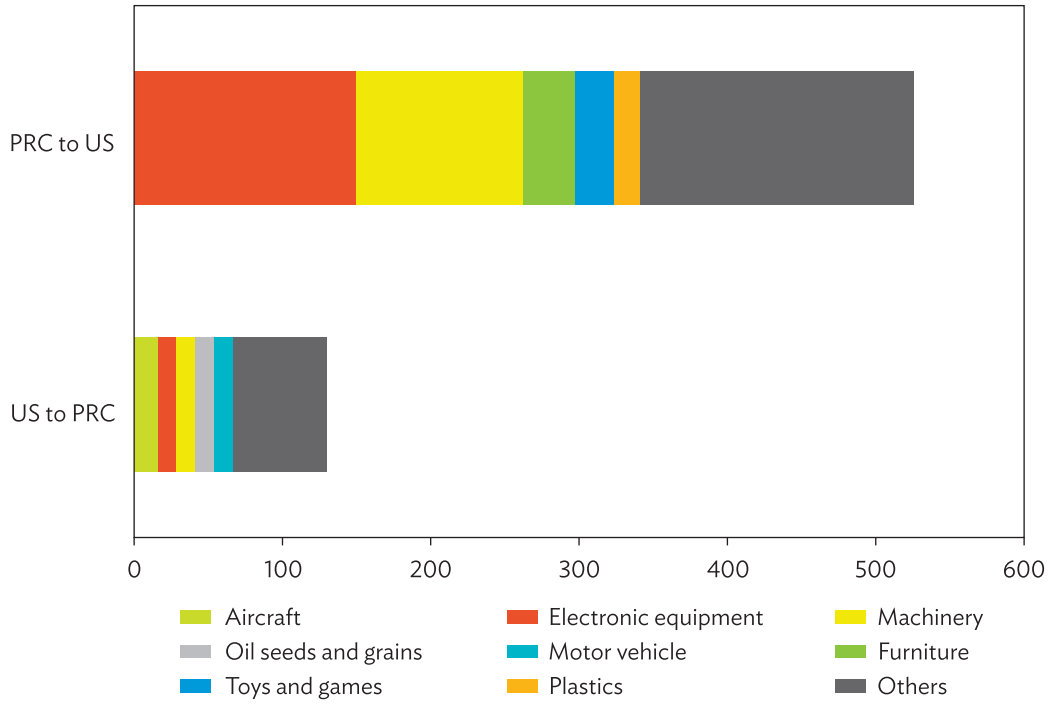
Figure 3: United States–People's Republic of China Trade in Goods



Source: Authors based on United States Census Bureau. https://www.census.gov/foreign-trade/balance/c5700.html (accessed July 18, 2019).

The trade imbalance between the US and the PRC has a long history that originates in the international trade division of labor. Briefly, the US is the world's largest consumer, and the PRC serves as the "world's factory." In the bilateral trade structure, the PRC mainly provides low-end products, assembling electronics, or basic living materials for the US, and the US mainly provides high-end technology products or service products to the PRC (Figure 4).

Figure 4: United States–People's Republic of China Trade Structure



PRC = People's Republic of China, US = United States.

Source: Authors based on UN Comtrade Database. https://comtrade.un.org/data/ (accessed July 18, 2019.)

It is also worth noting that the traditional way of calculating the trade deficit does not consider the fact that most profits are earned by US companies. Take, for example, the global value chain (GVC) of the iPhone. For an iPhone4, a trade imbalance of $169.41 is recorded in the PRC account toward the US, but the PRC only captures $6.54 of the assembling value (De Backer 2011). Furthermore, even the four Asian Tigers kept large trade surpluses with the US when they implemented their much-celebrated export-oriented strategy and served as the manufacturing center for developed economies.[3] Therefore, the PRC argues that the accusations from the US are not consistent with the facts of international trade.

[3] Hong Kong, China; the Republic of Korea; Singapore; and Taipei,China are known as the four 'Asian Tigers' because they underwent rapid industrialization and maintained exceptionally high growth rates (in excess of 7% a year) between the early 1960s (mid-1950s for Hong Kong, China) and 1990s. By the early 21st century, all four had developed into high-income economies (ADB 2020).

The rest of this paper is structured as follows. Section II provides a background for the ongoing US–PRC trade dispute, and section III contains the customary overview of the existing literature. Section IV presents the model, while section V discusses the data and calibration of the model. Section VI describes our simulation scenarios and related findings. Section VII provides a discussion of the implications of our results, and finally section VIII concludes with the limitations of our study, as well as potential avenues for future research.

II. CHRONOLOGY OF THE DISPUTE

Table A1 in the Appendix presents a detailed timeline of the US–PRC trade dispute, and Table A2 describes the rounds of trade negotiations between the two parties. In this section, we aim to provide a brief overview of the events that led to the escalation of the dispute.

In April 2017, President Trump issued a Presidential Memorandum on Steel Imports and Threats to National Security and started a Section 232 investigation. In August 2017, President Trump further ordered the Office of the United States Trade Representative (USTR) to initiate a Section 301 investigation of the PRC's acts, policies, and practices related to technology transfer, intellectual property, and innovation. The investigations were considered the preludes to a trade war, and the PRC pointed at them as a symbol of US trade protectionism. As shown in Table 1, from 1988 to 2018, there were only 11 cases of Section 232 investigations, with the last of such investigations taking place in 2001. Similarly, there were five Section 301 investigations concerning the PRC since 1991, which all ended in a compromise with the PRC, as summarized in Table 2.

Table 1: Historical Section 232 Investigations

Time	Completed Reports
Apr 2019	The Effect of Imports of Uranium on the National Security (ongoing)
Jan 2018	The Effect of Imports of Steel on the National Security
Jan 2018	The Effect of Imports of Aluminum on the National Security
2001	Iron Ore and Semi-Finished Steel
1999	The Effect of Imports of Crude Oil on National Security
1994	Crude Oil and Petroleum Products
1993	Ceramic Semiconductor Packaging
1992	Gears and Gearing Products
1989	Crude Oil and Petroleum Products
1989	Plastic Injection Molding
1989	Uranium
1988	Antifriction Bearings

Source: U.S. Department of Commerce. 2019. Section 232 Investigations: The Effect of Imports on the National Security. Report. U.S. Department of Commerce Bureau of Industry and Security. https://www.bis.doc.gov/index.php/other-areas/office-of-technology-evaluation-ote/section-232-investigations.

Table 2: Section 301 Investigations between the United States and the People's Republic of China

Date	Area	Appeal	Solution
Apr 1991–Jan 1992	Intellectual property	Patent protection for pharmaceuticals and other chemicals; copyright protection for US works; trademarks granted to the first registrant in the PRC, regardless of the original owner; trade secrets protection	The PRC passed a copyright law with protection effective in June 1991.
Oct 1991–Oct 1992	Market barriers	Failure to publish trade-related laws, regulations, judicial decisions, and administrative rulings; nontariff barriers such as import licensing requirements and quantitative restrictions; and restrictive product standards, testing, and certification requirements	Signed a bilateral MOU that commits the PRC to eliminate certain market access barriers progressively over 5 years.
Jun 1994–Feb 1995	Intellectual property	Copyright piracy is particularly acute, and trademark infringement is also common. Denies fair and equitable market access to US persons that rely on intellectual property protection	Intellectual property enforcement agreement in 1995
Apr 1996–Jun 1996	Intellectual property	The PRC is not satisfactorily implementing the 1995 agreement and designated the PRC a "priority foreign country" under the US trade law, failed to stop illegal CD, video and CD-ROM production, to prevent the export of infringing goods, grant market access for legitimate audiovisual products	Secure, effective compliance with that agreement
Oct 2010–Dec 2010	Green technologies	The PRC is affecting trade and investment in green technologies. The US alleges PRC policies that protect and unfairly support its domestic producers of wind and solar energy products, advanced batteries and energy-efficient vehicles, among other products	Modify the content of the prohibited subsidy measures
Aug 2017–Mar 2018	Technology transfer, intellectual property, and innovation, etc.	The PRC fundamentally has not altered its acts, policies, and practices related to technology transfer, intellectual property, and innovation, and indeed appears to have taken further unreasonable actions in recent months	A range of tools may be appropriate to address these serious matters, including more intensive bilateral engagement, WTO dispute settlement, and additional Section 301 investigations.

CD = compact disk, CD-ROM = compact disc read-only memory, MOU = memorandum of understanding, PRC = People's Republic of China, US = United States, WTO = World Trade Organization.
Source: Authors based on Morrison, Wayne M. 2018. "Enforcing U.S. Trade Laws: Section 301 and China." *In Focus*. Congressional Research Service, July 23.

The first phase of the dispute started on March 22, 2018, when President Trump issued a presidential memorandum and instructed USTR to consider additional tariffs on Chinese goods, causing the PRC to impose 15% or 25% additional tariffs on 128 US products worth $3 billion, including fruits, nuts, wine, pork, steel pipes, and so on. The PRC retaliated on March 23, and imposed 15% additional tariffs on 120 kinds of US products worth $1 billion, including fruits, nuts, wine, and steel pipes; and a 25% tax on $2 billion worth of products, including pork.

On April 3, 2018, USTR announced a proposed list of approximately 1,300 tariff lines valued at an estimated $50 billion, followed by the US proposing additional tariffs on Chinese products worth $100 billion. On April 4, the PRC retaliated by proposing 25% additional tariffs on a list of 106 US products worth $50 billion.

The second stage of trade tensions, starting from late April to December 2018, was characterized by escalations and short-term negotiations without significant outcomes. During this stage, the US and the PRC announced several rounds of tariff lists targeting mostly high-tech sectors and some agricultural products. Surprisingly, on December 1, 2018, after the G20 Conference, the US and the PRC agreed to begin negotiations on structural changes concerning forced technology transfer, intellectual property protection, non-tariff barriers (NTBs), cyber intrusions, and cyber theft; thus, tariffs were delayed again. Specifically, at the end of 2018, the PRC suspended tariffs on cars and parts originating in the US for 3 months, involving 211 tax items.

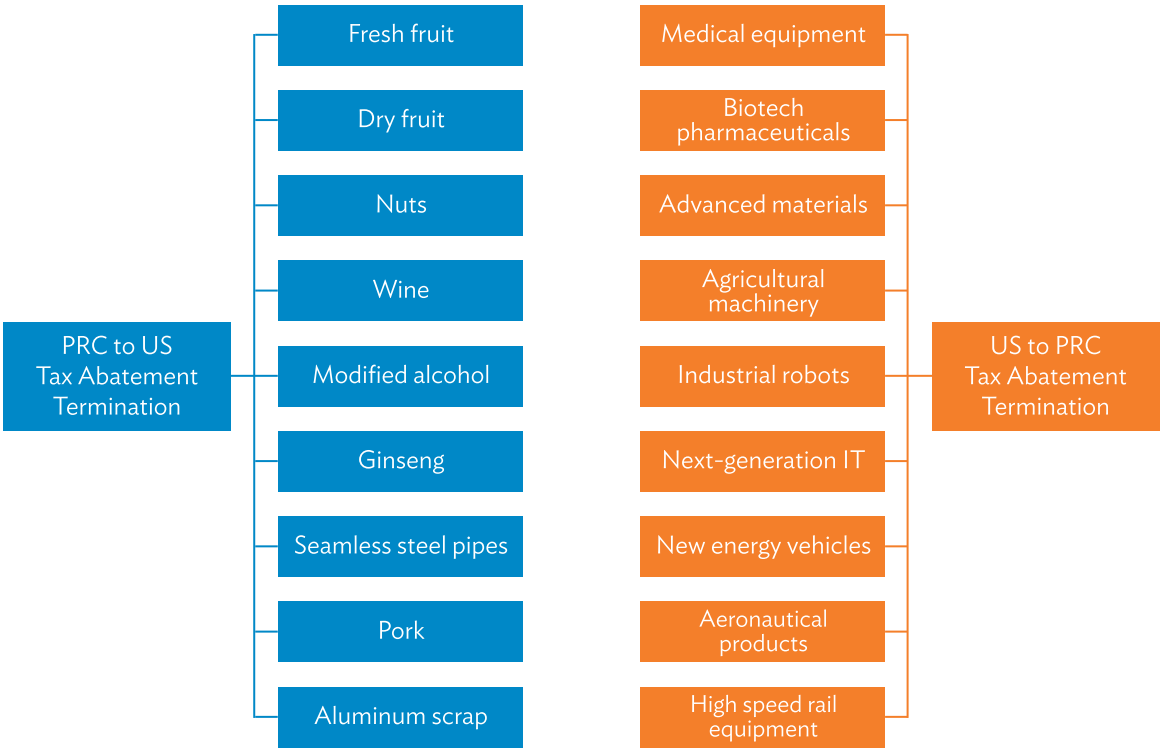
Tensions ratcheted up again in early May 2019, with USTR instructing US Customs and Border Protection to collect 25% duties on $200 billion worth of imports from the PRC. All importers subjected to Section 301 tariffs must pay the increased duty amount of 25% instead of 10%. By May 10, USTR was ordered to get ready to raise tariffs on essentially all remaining imports from the PRC, which were valued at approximately $300 billion. In response, the PRC imposed 25%, 10%, and 5% tariffs, respectively on 2,493 categories of US products worth $60 billion.

In sum, as of May 31, 2019, the US has already levied tariffs on $250 billion worth of Chinese products and has threatened tariffs on more than $300 billion. The PRC retaliated by imposing tariffs on $110 billion worth of US goods, and is considering additional "necessary countermeasures," (The Straits Times 2019) including cutting exports of rare-earth minerals to the US.[4] Figure 5 shows all import categories in which the US and the PRC threw tariffs at each other.

The subsequent months have been characterized by high levels of uncertainty, with cycles of trade talks, followed by tariff exemptions, and then back to further escalations. At the time of writing, President Trump announced that negotiators from the US and the PRC had reached a "Phase 1" agreement following a 2-day meeting on October 10–11. Under the agreement, the PRC will reportedly purchase $40–$50 billion in US agricultural products annually, strengthen intellectual property provisions, and issue new guidelines on how it manages its currency. The US will delay a tariff increase scheduled to go into effect on October 15. The delay will apply to tariffs that were scheduled to increase to 30% on $250 billion of Chinese goods. It is still uncertain whether this will result in a final agreement.

[4] Rare-earth minerals "are used in a wide range of consumer products, from iPhones to electric car motors, as well as military jet engines, satellites and lasers" (Webb, Shumaker, and Oatis 2019). The PRC supplied 80% of the rare earths imported by the US from 2014 to 2017.

Figure 5: Import Categories Affected by Tariffs of the United States and the People's Republic of China



IT = information technology, PRC = People's Republic of China, US = United States.

Source: Authors.

Many international organizations have revised the GDP forecast downward due to the US–PRC trade dispute. The World Trade Organization forecasted that global trade growth will slow to 3.7% and could be even lower if trade tensions deteriorate (WT0 2019). The World Bank and the International Monetary Fund expressed concerns that an increase in trade tensions would come at a cost for the countries involved and the global economy (IMF 2019, World Bank 2019). Trade tensions between the US and the PRC dominated the 2018 APEC Summit (The Straits Times 2018), and they were on the agenda of the 2019 Association of Southeast Asian Nations leaders' summit, among fears of fallout on developing Asia (The Bangkok Post 2019). The Asian Development Bank (ADB) trimmed the estimated 2019 growth rate of developing Asian GDP to 5.4% from the original 5.7% (ADB 2019).

Given the global importance of this dispute, we use a CGE model, which is a common tool for international trade analysis, to assess its impact not only on the two protagonists, but also on developing Asia and the rest of the world.

III. LITERATURE REVIEW

Since Norwegian economist Leif Johansen developed the first CGE model in 1960 (Førsund, Hoel, and Longva 1985), they have been widely used in international trade analysis. As a large-scale economic computing model for policy analysis, CGE research is distinguished based on the model structure, the comprehensiveness of the data, and the target policy.

The basic CGE model is static, that is, it compares the difference between two or more alternative scenarios—with and without the policy shocks—while the other settings remain constant. However, there are also dynamic models that expand the simulation period across multiple years by assuming future economic pathways, like the Shared Socioeconomic Pathways project (O'Neill et al. 2014).

There are several ways to add layers of sophistication to a CGE model. First, imperfect competition can be introduced in the underlying market structures (Roson 2006). Foreign direct investment (FDI) can be incorporated, for example, by modeling affiliates of multinational enterprises alongside local firms, as in Latorre and Hosoe (2016).

Following the theoretical and empirical revolution in international trade analysis (Melitz 2003), heterogenous firm characteristics were introduced into standard CGE frameworks (see, for example, Caliendo et al. 2015). Additional features relate to production functions (Leontief, or constant or increasing returns to scale with constant elasticity of substitution [CES]), consumer behavioral change (e.g., preference for 'green' products), imperfect substitutability of goods (the so-called Armington assumption), and trade costs.

CGE models require large amounts of data, which include base year data like input–output (IO) tables, social accounting matrices (SAM), tariff data, satellite accounts, and economic pathway data (specific for dynamic models). The quality of the base year data is almost decisive in the reliability of the CGE analysis. Currently, the largest global CGE trade project is the well-known Global Trade Analysis Project (GTAP) model (Hertel and Tsigas 1997), whose latest database GTAP 10 was released in July 2019. The latest reference year of GTAP 10 is 2014, which means that counterfactual policy simulation after 2014 relies on assumptions on the growth rate of key indicators like GDP, the labor force, investments, etc. between 2014 and the target year to produce the base year data for the target year. Other influential global CGE datasets include the World Input-Output Database (WIOD), with latest year 2014, the ADB Multi-regional Input-Output Tables (MRIOT), with latest year 2017, and the Eora MRIO (Lenzen et al. 2013), with latest year 2015. It is worth noting that while the WIOD and ADB MRIOT databases are derived from each country's supply and use tables—and therefore its national accounts—the Eora MRIO is constructed by estimating missing data and then using an optimization algorithm to make sure that all elements conform as much as possible with the information contained in the raw data items.

Generally, the higher the country and sector resolution, the better CGE models can depict policy impacts on more specific areas. The GTAP 10 database includes 65 sectors and 121 regions; the 2014 WIOD dataset includes 56 sectors and 43 regions; the Eora dataset includes 120 sectors and 190 regions; and the 2017 ADB MRIOT consists of 35 sectors and 63 regions. However, detailed disaggregation would also increase the computing complexity of the model, and a lot of research would aggregate the dataset as needed.

Traditionally, CGE models use two-dimensional IO tables of each region (i.e., product *A* to sector *B* or to export) and then combine all the tables with additional international trade data. However, capturing the value chain effects requires more detailed four-dimensional data (i.e., product A from region *X* to sector *B* in region *Y*). MRIO projects like the WIOD, ADB MRIOT, and the Eora MRIO provide the data at the GVC level.

In the case of the ongoing US–PRC trade dispute, because the situation is extremely fluid, it is important to distinguish the various policy scenarios when comparing the related studies. Table 3 compares recent CGE studies on the US–PRC trade dispute.

Table 3: Recent General Equilibrium/Computable General Equilibrium Studies on Increased Protectionism and the United States–People's Republic of China Trade Dispute

	Model	Base Year	Regions	Sectors	Policy Scenario	Main Conclusions
Bollen and Rojas-Romagosa (2018)	WorldScan (GTAP-9 based + monopolistic competition setting, endogenous labor supply)	2011	30	29	Tariff action by July 2018	1.2% GDP loss for the PRC and 0.3% GDP loss for the US; other economies like the EU will benefit
Caceres, Cerdeiro, and Mano (2019)	CFRT (Eora based + heterogenous firms + GVC + imperfect competition)	2015	165	17	25% tariff increase between the US and the PRC	US GDP –0.2%~0.3%; PRC GDP –0.6%; positive for other main trading partners
Kawasaki (2018)	GTAP-10	2014	17	15	An import tariff hike of 1% worldwide	Global trade would decrease by 1.7% and global GDP would decrease by 0.2%
Li, He, and Lin (2018)	Global general equilibrium framework	2013	29	2	Tariffs between the US and the PRC are increased by 15%	0.01% GDP loss for the PRC, and 0.67% GDP loss for the US
Tsutsumi (2018)	GTAP-6	2011	16	12	Tariff action by September 2018	0.2% GDP loss for the PRC and 0.1% GDP loss for the US
Yane and Nishioka (2019)	GTAP-9	2011	13	18	25% tariff increase between the US and the PRC + US motor tariffs	0.7% GDP loss for the PRC, and 0.8% GDP loss for the US; global GDP shrinks by 0.2%

CFRT = Caliendo, Feenstra, Romalis, and Taylor; CGE = computable general equilibrium; EU = European Union; GDP = gross domestic product; GE = general equilibrium; GTAP = Global Trade Analysis Project; GVC = global value chain; PRC = People's Republic of China; US = United States.

Source: Authors.

The studies in Table 3 either construct their own simplified general equilibrium framework or apply the GTAP model. As mentioned above, the latest year for GTAP 10 is 2014, and therefore the impact of policy changes happening in 2019 relies on assumptions on the growth rate of key model indicators to produce base year data for 2019. Moreover, the GTAP database is country by country and does not include the GVC information as in the WIOD and ADB MRIOT databases.

Perhaps the most sophisticated CGE model on the US–PRC trade dispute is the one in Caceres, Cerdeiro, and Mano (2019). It includes heterogenous firms and trade in intermediate inputs (i.e., GVCs). However, it relies on the Eora MRIO database, which is not necessarily linked to each country's supply and use tables.

Abiad et al. (2018) used the ADB MRIOT to uncover partial equilibrium effects of the US–PRC trade dispute on employment, GDP, and output of economy-sectors worldwide. The analysis quantified impacts working via three trade-related channels, namely: (i) direct effects, which are felt only by tariff-affected economy-sectors; (ii) indirect effects, which occur via local and international supply chain linkages; and (iii) potential trade redirection effects. They found that measures implemented until May 2019 have a small negative impact on both the PRC and the US, reducing their GDP by 0.5% and 0.1%, respectively over 2–3 years. However, a full escalation of tensions—that is, the US and the PRC apply 25% tariffs on all bilateral trade flows—would shave 1% off PRC GDP and 0.2% off US GDP. Trade redirection effects could potentially benefit the rest of developing Asia, but the extent of the impact would depend on countries' capacity to fill in the slack in global demand brought about by the trade conflict.

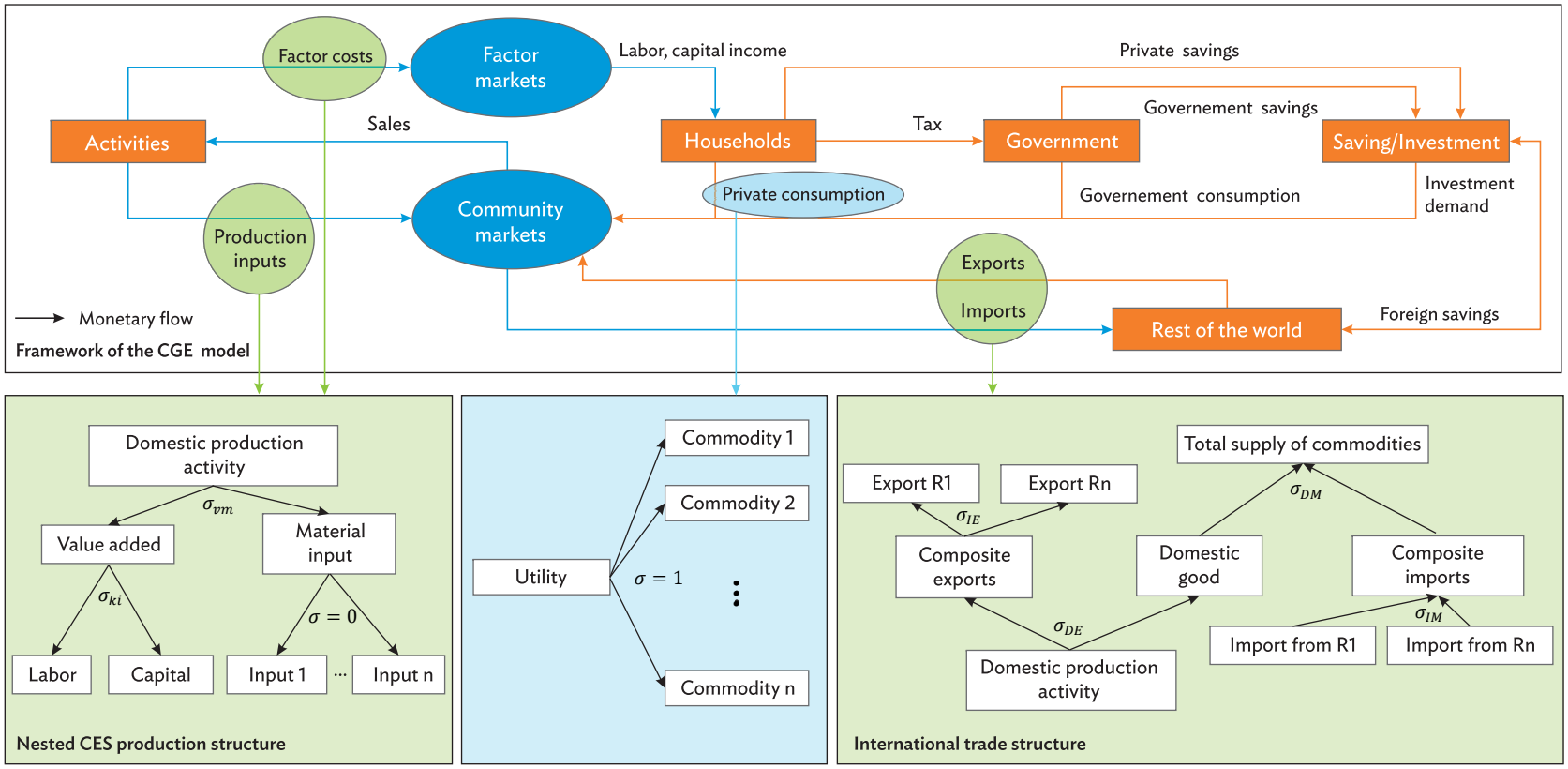
In this paper, we adopt the simple model structure in Koesler and Pothen (2013), which is a basic CGE model of the WIOD dataset. It is a static model with perfect competition and homogeneous firms, and it does not distinguish sectors considering investment sources from FDI or not. We make two main contributions. First, we show that a simple framework (with limited data and computing power needs) can yield reliable results that are consistent with those from more sophisticated models. This is particularly helpful when working with developing economies, for which available data is notoriously scant. Second, we use the 2017 ADB MRIOT, which is the latest base year in global IO databases to our knowledge.

IV. THE MODEL

CGE models solve for the general equilibrium in an economy where all the factor and commodity markets clear, and all the accounts are balanced in terms of income and expenditure. In this paper, the CGE model is formulated in the General Algebraic Modeling System software of the MS Windows 24.3.3 version. It is solved as a mixed complementarity problem using the PATH solver (Ferris and Munson 2000) and Mathematical Programming System for General Equilibrium Analysis solvers (Rutherford 1999).

In the model, the household account in each region owns the labor endowment and the capital endowment. Households earn factor income, which is spent on consumption and savings, by supplying their labor and capital endowment on the factor markets. Factor inputs, as well as other intermediate inputs, are used to produce commodities that are used for consumption, exports, and savings. As for the government in each region, its income comes from all kinds of taxes and its expenditures include the purchase of commodities, transfer payments, and savings. There are also accounts representing other regions, and the import and export activities among different regions are balanced by the foreign savings for simplification.

Figure 6: A Simplified Computable General Equilibrium Framework



CES = constant elasticity of substitution, CGE = computable general equilibrium.

Source: Authors.

Figure 6 illustrates the multilayer nested structure of the production module, which follows the constant elasticity of substitution (CES) production function in the first layer and a mix of Leontief (for material inputs) and CES production functions (for value-added inputs) in the second. This two-layer production structure is common practice in CGE models (Koesler and Pothen 2013), and it is based on the idea that value-added inputs and material inputs have different substitutability.

In the top layer, total sectoral output is determined by the composite of value-added inputs and the composite of material inputs with elasticity of substitution $\sigma_{j,r}^{vm}$. The producer of sector j maximizes its profit by choosing the appropriate output level and intermediate inputs as follows:

$$\max \pi_{j,r} = PX_{j,r} \cdot QX_{j,r} - PMA_{j,r} \cdot QMA_{j,r} - PVAE_{j,r} \cdot QVAE_{j,r}$$

subject to

$$QX_{j,r} = \alpha_{j,r}^{vm} \cdot \left(\delta_{j,r}^{vm} \cdot QMA_{j,r}^{-\rho_{j,r}^{vm}} + \left(1 - \delta_{j,r}^{vm}\right) \cdot QVAE_{j,r}^{-\rho_{j,r}^{vm}}\right)^{-\frac{1}{\rho_{j,r}^{vm}}}$$

where

- $\pi_{j,r}$ is the profit of sector j in region r;
- $PX_{j,r}$ is the output price of commodity j in region r;
- $QX_{j,r}$ is the output quantity of sector j in region r;
- $PMA_{j,r}$ is the price of the aggregated material inputs in region r;
- $QMA_{j,r}$ is the quantity of the aggregated material inputs in region r;
- $PVAE_{j,r}$ is the price of the aggregated value-added inputs in sector j in region r;
- $QVAE_{j,r}$ is the quantity of the aggregated value-added inputs in sector j in region r;
- $\alpha_{j,r}^{vm}$ and $\delta_{j,r}^{vm}$ are the parameters in CES functions;
- $\rho_{j,r}^{vm}$ is the substitution parameter in the CES function, and the corresponding elasticity of substitution is $\frac{1}{1+\rho_{j,r}^{vm}}$ which equals to $\sigma_{j,r}^{vm}$.

In the second layer, the model assumes a Leontief production function among different material inputs to the aggregate material input $QMA_{j,r}$.:

$$\max \pi_{j,r}^{pro} = PMA_{j,r} \cdot QMA_{j,r} - \sum_{i} P_{i,r} \cdot X_{i,j}^{r}$$

subject to

$$QMA_{j,r} = \min_{i}\left(\frac{X_{i,j}^{r}}{a\_x_{i,j}^{r}}\right)$$

where

- $\pi_{j,r}^{pro}$ is the profit in material input activities of sector j in region r;
- $P_{i,r}$ is the supply price of commodity i in the domestic market in region r; the supply price is a function of the output price PX_j^r, import price, and export price;
- $X_{i,j}^{r}$ is the intermediate input of commodity i in the production processes of sector j in region r;
- $a\_x_{i,j}^{r}$ is the input coefficient of commodity i in the production processes of sector j in region r, which follows the linear production assumption in Leontief input-output analysis.

The composite $QVAE_{j,r}$ is aggregated by labor and capital with elasticity of substitution $\sigma_{j,r}^{vae}$. Similarly, the mathematical formulation is as follows.

$$\max \pi_{j,r}^{va} = PVAE_{j,r} \cdot QVAE_{j,r} - PL_r \cdot QL_{j,r} - PK_r \cdot QK_{j,r}$$

subject to

$$QVAE_{j,r} = \alpha_{j,r}^{vae} \cdot \left(\delta_{j,r}^{vae} \cdot QL_{j,r}^{-\rho_{j,r}^{vae}} + \left(1 - \delta_{j,r}^{vae}\right) \cdot QK_{j,r}^{-\rho_{j,r}^{vae}} \right)^{-\frac{1}{\rho_{j,r}^{vae}}}$$

where

- $\pi_{j,r}^{va}$ is the profit of the subsector of value-added inputs in sector *j* in region *r*;
- PL_r is the labor price in region *r*;
- $QL_{j,r}$ is the input of labor in sector *j* in region *r*;
- PK_r is the capital price in region *r*;
- $QK_{j,r}$ is the input of capital in sector *j* in region *r*;
- $\alpha_{j,r}^{vae}$ and $\delta_{j,r}^{vae}$ are the parameters in CES functions;
- $\rho_{j,r}^{vae}$ is the parameter in the CES function, and the corresponding elasticity of substitution is $\frac{1}{1+\rho_{j,r}^{vae}}$, which equals to $\sigma_{j,r}^{vae}$.

Households receive factor income from labor and capital. After paying tax and savings, and receiving transfers from the government, they use the rest of their income to maximize their utility in consumption activities. Figure 6 shows the households' utility structure, which is aggregated by all kinds of commodities into a Cobb–Douglas utility function. Households maximize utility subject to a budget constraint as follows.

$$\max U_r^h = \prod_i (X_{i,r}^h)^{\alpha_{i,r}}$$

subject to

$$HE_r = \sum_i X_{i,r}^h P_{i,r} = PL_r \cdot hendl_r + PK_r \cdot hendk_r - hsav_r - HTax_r$$

where

- U_r^h stands for the Cobb–Douglas utility function for the aggregate of all households in region *r*;
- $X_{i,r}^h$ is the household consumption of commodity *i* in region *r*;
- $\alpha_{i,r}$ is the parameter in the Cobb–Douglas function and $\sum_i \alpha_{i,r} = 1$;
- HE_r is the total expenditure of the aggregate of all households in region *r*;
- $P_{i,r}$ is the supply price of commodity *i* in the domestic market in region *r*;
- $hendl_r$ is household's labor endowment in region *r*;
- $hendk_r$ is household's capital endowment in region *r*;
- $hsav_r$ is household's savings in region *r*;
- $HTax_r$ is household's tax to the government based on fixed tax ratios.

In our model, governments are treated similarly to households: after deducting tax, transfers, savings, and investments from their income, they determine how to allocate government spending among different commodities using a Cobb–Douglas function.

Finally, Figure 6 shows the structure of the nested international trade module. There are two layers in both import and export activities. The first layer is between domestic products and aggregated foreign products; the second layer is among the import (export) products from (to) different regions. We follow the standard approach in CGE models and apply CES functions to the import part and constant elasticity of transformation (CET) functions to the export part.

The profit maximization problem for the first layer of imports is the following:

$$\max \pi_{i,r}^{aggimp} = P_{i,r} \cdot Q_{i,r} - AGGPM_{i,r} \cdot AGGQM_{i,r} - PD_{i,r} \cdot QD_{i,r}$$

subject to

$$Q_{i,r} = \alpha_{i,r}^{aggimp} \cdot \left(\delta_{i,r}^{aggimp} \cdot AGGQM_{i,r}^{-\rho_{i,r}^{aggimp}} + \left(1 - \delta_{i,r}^{aggimp}\right) \cdot QD_{i,r}^{-\rho_{i,r}^{aggimp}} \right)^{-\frac{1}{\rho_{i,r}^{aggimp}}}$$

where

- $\pi_{i,r}^{aggimp}$ is the profit in the import activities for commodity i in region r;
- $P_{i,r}$ is the supply price of commodity i in the domestic market in region r;
- $Q_{i,r}$ is the supply of commodity i in the domestic market in region r;
- $AGGPM_{i,r}$ is the aggregated price of imported commodity i in region r;
- $AGGQM_{i,r}$ is the aggregated imported quantity of commodity i in region r;
- $PD_{i,r}$ is the price of commodity i which is both produced and sold in the domestic market in region r;
- $QD_{i,r}$ is the quantity of commodity i which is both produced and sold in the domestic market in region r;
- $\alpha_{i,r}^{aggimp}$ and $\delta_{i,r}^{aggimp}$ are the parameters in the Armington function;
- $\rho_{i,r}^{aggimp}$ is the parameter in the Armington function, and the corresponding elasticity of substitution $\sigma_{i,r}^{aggimp}$ is $\frac{1}{1+\rho_{i,r}^{aggimp}}$.

For the second layer of imports which distinguishes imports from different regions, we use the general CES function since there are more than two regions. The profit maximization problem for the second layer is the following:

$$\max \pi_{i,r}^{imp} = AGGPM_{i,r} \cdot AGGQM_{i,r} - \sum_{rr \neq r} \left(1 + trf_{i,rr,r}\right) \cdot PM_{i,rr,r} \cdot QM_{i,rr,r}$$

subject to

$$AGGQM_{i,r} = \alpha_{i,r}^{imp} \cdot \left(\sum_{rr \neq r} \delta_{i,rr,r}^{imp} \cdot QM_{i,rr,r}^{-\rho_{i,r}^{imp}} \right)^{-\frac{1}{\rho_{i,r}^{imp}}}$$

where

- $\pi_{i,r}^{imp}$ is the profit in the second layer of imports for commodity i in region r;
- $PM_{i,rr,r}$ is the price of imported commodity i from region rr to region r;

- $QM_{i,rr,r}$ is the imported quantity of commodity i from region rr to region r;
- $trf_{i,rr,r}$ is the tariff level of imported commodity i from region rr to region r;
- $\alpha_{i,r}^{imp}$ and $\delta_{i,rr,r}^{imp}$ are the parameters in the general CES function, and $\sum_{rr} \delta_{i,rr,r}^{imp} = 1$;
- $\rho_{i,r}^{imp}$ is the parameter in the general CES function, and the elasticity of substitution is $\frac{1}{1+\rho_{i,r}^{imp}}$.

For exports, the profit maximization problems are similar to the import structure but in CET forms. In the first layer, we have:

$$\max \pi_{i,r}^{aggexp} = AGGPE_{i,r} \cdot AGGQE_{i,r} + PD_{i,r} \cdot QD_{i,r} - PX_{i,r} \cdot QX_{i,r}$$

subject to

$$QX_{i,r} = \alpha_{i,r}^{aggexp} \cdot \left(\delta_{i,r}^{aggexp} \cdot AGGQE_{i,r}^{\rho_{i,r}^{aggexp}} + \left(1 - \delta_{i,r}^{aggexp}\right) \cdot QD_{i,r}^{\rho_{i,r}^{aggexp}} \right)^{\frac{1}{\rho_{i,r}^{aggexp}}}$$

where

- $\pi_{i,r}^{aggexp}$ is the profit in the first layer of exports for commodity i in region r;
- $AGGPE_{i,r}$ is the aggregated price of exported commodity i in region r;
- $AGGQE_{i,r}$ is the aggregated exported quantity of commodity i in region r;
- $\alpha_{i,r}^{aggexp}$ and $\delta_{i,r}^{aggexp}$ are the parameters in the CET function;
- $\rho_{i,r}^{aggexp}$ is the parameter in the CET function, and the elasticity of substitution is $\frac{1}{\rho_{i,r}^{aggexp}-1}$.

For the second layer of exports, we also use a general CET function to represent the exports to different regions:

$$\max \pi_{i,r}^{exp} = \sum_{rr \neq r} PE_{i,r,rr} \cdot QE_{i,r,rr} - AGGPE_{i,r} \cdot AGGQE_{i,r}$$

subject to

$$AGGQE_{i,r} = \alpha_{i,r}^{exp} \cdot \left(\sum_{rr \neq r} \delta_{i,r,rr}^{exp} \cdot QM_{i,r,rr}^{\rho_{i,r}^{exp}} \right)^{\frac{1}{\rho_{i,r}^{exp}}}$$

where

- $\pi_{i,r}^{exp}$ is the profit in the second layer of exports;
- $PE_{i,r,rr}$ is the price of exported commodity i from region r to region rr;
- $QE_{i,r,rr}$ is the exported quantity of commodity i from region r to region rr;
- $\alpha_{i,r}^{exp}$ and $\delta_{i,r,rr}^{exp}$ are the parameters in the CET function, and $\sum_{rr} \delta_{i,r,rr}^{exp} = 1$;
- $\rho_{i,r}^{exp}$ is the parameter in the CET function, and the elasticity of substitution is $\frac{1}{\rho_{i,r}^{exp}-1}$.

Additional constraints are needed to ensure the equilibrium of import and export flows:

$$QE_{i,r,rr} = QM_{i,rr,r}$$

$$PE_{i,r,rr} = PM_{i,rr,r}$$

In the macro-equilibrium, we assume that all the commodity markets and the capital market clear, and expenditure equals income for all accounts. Moreover, we assume the sticky labor price condition for the labor market, that is, that wages will stay stable to the real consumer price index.

In the commodity market:

$$Q_{i,r} = \sum_j X_{i,j}^r + X_{i,r}^h + X_{i,r}^g + X_{i,r}^{inv}$$

where

- $Q_{i,r}$ is the supply of commodity i in the domestic market in region r;
- $X_{i,j}^r$ is the intermediate input of commodity i in sector j in region r;
- $X_{i,r}^h$ is the household consumption of commodity i in region r;
- $X_{i,r}^g$ is the government consumption of commodity i in region r;
- $X_{i,r}^{inv}$ is the investment and savings consumption of commodity i in region r;

In the factor markets:

$$PL_r = HU_r$$

$$\sum_j QK_{j,r} = hendk_r$$

where

HU_r is the utility price per unit in region r and equals to $\frac{\sum_i (X_{i,r}^h \cdot P_{i,r})}{\sum_i X_{i,r}^h}$, which will vary as the commodity prices change.

V. DATA AND CALIBRATION

The IO table takes a snapshot of the flows of income and expenditure to and from all sectors and final demand accounts in an economy at a given point in time. As such, it is the most important data source for a CGE model.

In this paper, we use the ADB MRIOT, which is one of the most up-to-date and detailed IO tables, covering most Asian economies. To balance the level of detail and the model complexity, this paper aggregates the original ADB MRIOT, consisting of 63 regions and 35 industries, into 19 regions

and 19 industries, as shown in Table A3 in the Appendix. The aggregation methods follow the standard approach described in Koesler and Pothen (2013).

Based on the ADB MRIOT, we compiled the multiregional SAM, which adds the monetary flows among different final demand accounts to the IO framework. A template of the three-region SAM is shown in Appendix Table A4.

The World Bank's World Integrated Trade Solution database is the source for tariff data in different economies. Needless to say, there are various types of tariffs in international trade, including the most favored nation tariff, bound tariff, the effectively applied tariff, and enormous specific regulations. To simplify, we apply the weighted average of the effectively applied tariff in the year 2017 and aggregate the tariff data according to the 19-sector classification. The tariff levels of all the imports and exports from the US and the PRC are shown in Tables A5–A8 in the Appendix.

The elasticities of substitution measure the substitutability between different goods and are key parameters in the CES functions in CGE models. This paper mainly introduces the elasticities of substitution in the sectoral production functions and the Armington functions in the import structure. The elasticities in the production functions include the elasticity of the aggregate intermediate inputs and value-added inputs, the elasticity among the intermediate inputs, and the elasticity among factor inputs. The elasticities in the import structure include the elasticity between domestic products and the aggregated imported goods, and the elasticity among the imported goods from different regions.

This paper relies on elasticity data from previous studies of the WIOD project (Koesler and Schymura 2012) and the GTAP project (Hertel and van der Mensbrugghe 2016). Koesler and Pothen (2013) proposed a method to aggregate the elasticities during sectoral aggregation in CGE models, by calculating the weighted sum of the elasticities according to their value shares of sectoral output. Following their method, we construct the elasticity parameters in our 19-region and 19-sector CGE model. Tables A9–A11 in the Appendix list all the parameters used in the calibration of our model.

VI. SCENARIOS AND RESULTS

Based on the timeline of the ongoing trade dispute, we conduct static simulation analysis, and construct two policy scenarios in addition to a baseline scenario. The baseline or BAU scenario replicates the economic situation in 2017, according to the monetary inflows and outflows stored in the ADB MRIOT. Scenario 1 represents tariff measures implemented as of May 2019 between the US and the PRC. In this scenario, the US imposes an additional 25% tariff on $250 billion worth of goods imported from the PRC. In response, the PRC imposes 25% more tariffs on about $110 billion worth of goods imported from the US.

Scenario 2 is a full-scale tariff war. In this scenario, the US and the PRC impose an additional 25% tariff on all the goods imported from each other. However, as the PRC already imposes additional tariffs on almost all imports from the US, extra retaliation measures from the PRC are not considered in scenario 2.

The top panel of Table 4 shows the impact of the trade dispute on key macroeconomic indicators for the US. Compared to the baseline scenario (pre-tariff conflict stage), the US is expected to suffer a GDP loss of 0.17% in scenario 1. It is worth noting that 0.17% of $19.39 trillion—the US GDP in 2017—is $33 billion, which is roughly 86% of total federal income from customs duties of 2017 (BEA 2019).

Table 4: Impact of the United States–People's Republic of China Trade Dispute on Macroeconomic Indicators

	GDP	Employment	Trade	Exports	Imports	Consumption
United States						
Scenario 1	−0.17%	−0.24%	−2.34%	−2.49%	−2.23%	−0.14%
Scenario 2	−0.22%	−0.31%	−2.74%	−2.82%	−2.68%	−0.18%
People's Republic of China						
Scenario 1	−0.36%	−0.40%	−3.38%	−3.07%	−3.79%	−0.20%
Scenario 2	−0.47%	−0.55%	−4.05%	−3.75%	−4.46%	−0.21%

GDP = gross domestic product.

Source: Authors.

Under scenario 2, the GDP loss for the US would be 0.22%, and the annual GDP growth rate would decrease to 2.08%. Since most economic shocks come from trade with the PRC, US import and export volumes are projected to decrease remarkably more than GDP. Impacts on consumption, investment, and employment are relatively smaller. However, it should be noted that the model does not consider the impact of the tension on investor and consumer confidence, and the results might be worse if we consider these behavioral changes.

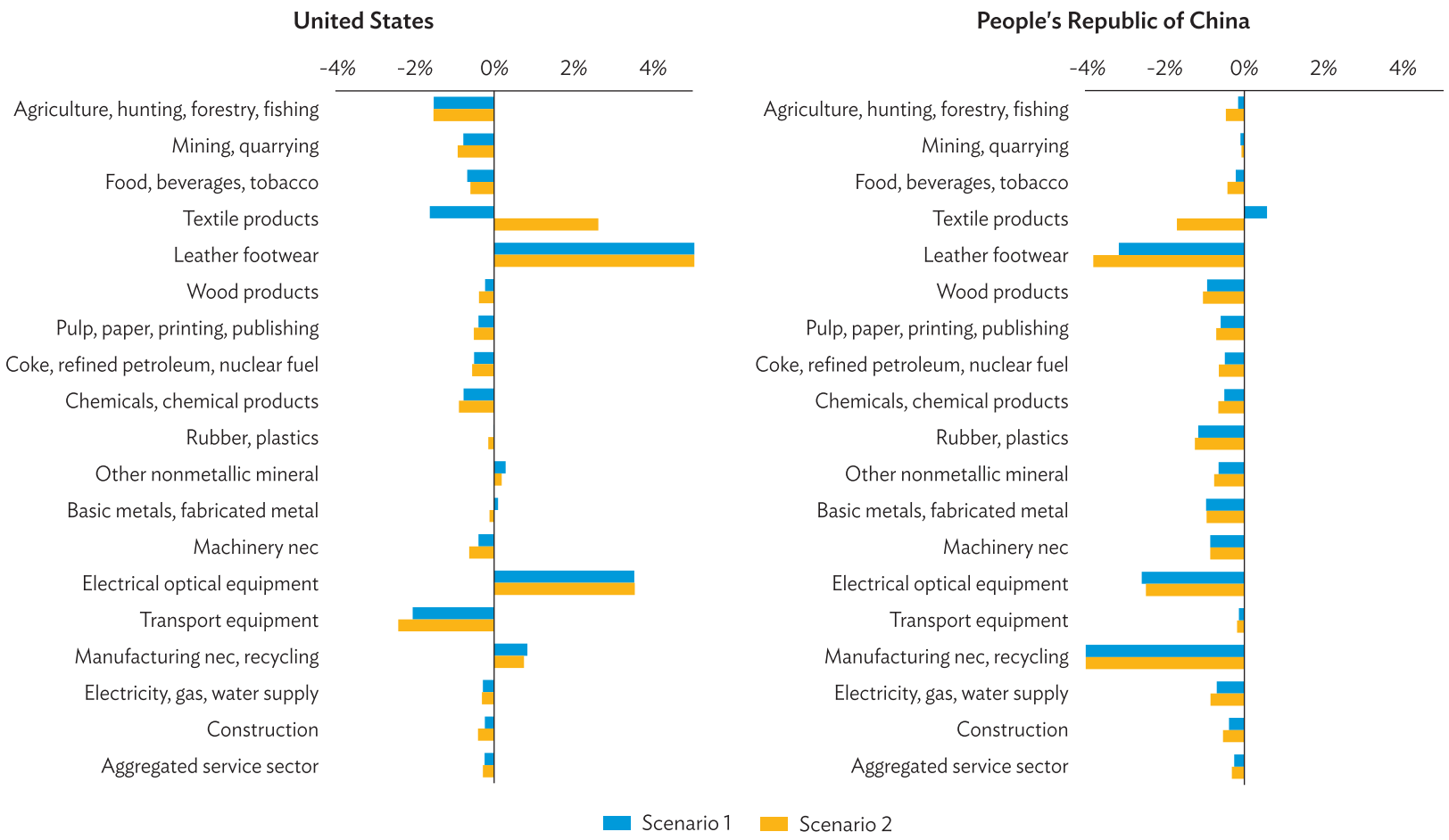
The left panel of Figure 7 shows how the impact of the trade dispute is expected to vary across sectors in the US economy. In scenario 1, manufacturing, electrical, optical equipment, and leather footwear would enjoy output growth. This is because when imports from the PRC are levied high tariffs, US products become more price competitive. However, output levels in most sectors are expected to decrease, including other sectors that enjoy protection from Chinese imports, for example, wood products. That is because the positive impact on the sectoral output due to increasing price competitiveness is not enough to cover all the losses caused by the decrease in total consumption and trade demands. The textile sector is expected to contract under scenario 1, but its output is expected to increase by about 3% in scenario 2, albeit at the cost of increasing product prices.

The bottom panel of Table 4 shows the economic impact of the trade dispute on the PRC. In scenario 1, the expected contraction of GDP for the PRC is 0.36%, or $44 billion, which is visibly larger than the US. Imports and exports are also expected to be heavily affected, with a resulting contraction in employment by 0.40% or 3.6 million jobs.[5] A full-scale tariff war (scenario 2) is associated with a 0.47% and 0.55% contraction in GDP and employment, respectively.

Although the PRC has become the world's second-largest economy in 2010, and its economic structure increasingly more resilient, the trade dispute will bring much pressure on economic

[5] In 2017, 900 million individuals participated in the PRC labor force (National Bureau of Statistics of China). 0.40% of 900 million is roughly 3.6 million jobs. But these job losses are calculated assuming no change to the labor price in the short term, and the same labor price across all sectors.

Figure 7: Sectoral Output Changes



nec = not elsewhere classified.

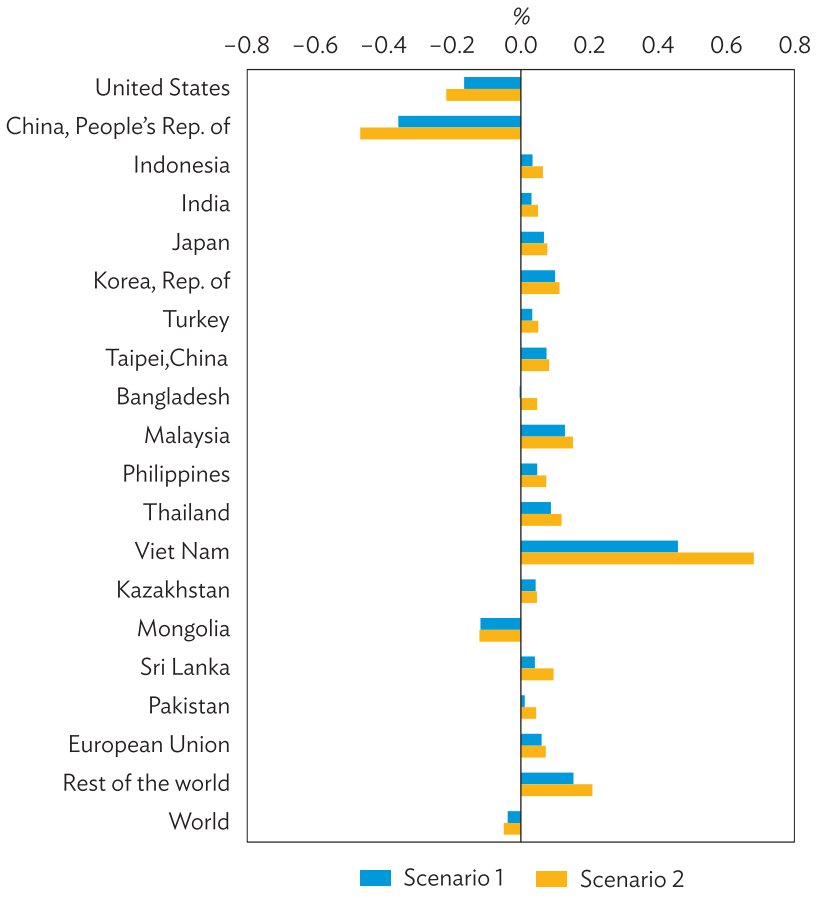
Source: Authors.

prospects, especially considering that economic growth was already slowing down after 4 decades of exceptional growth.

The right panel of Figure 7 shows sectoral output changes in the PRC. All sectors are projected to contract, except for the textile sector, which is not yet affected in scenario 1. As the "factory of the world," the PRC's economy is closely linked to international trade, especially in the traditional trade sectors like manufacturing and textiles. As shown in Figure 7, higher import tariffs in the US will negatively affect manufacturing, electrical, and leather footwear in the PRC due to decreasing overseas demand. Their US counterparts, on the other hand, will benefit most. It should also be noted that the most heavily affected sectors in the PRC were already declining since 2010. Many textile or assembly factories have already been moved to Southeast Asia or Africa due to rising labor costs in the PRC, and these changes did happen before the trade dispute (Blair and Xiangyi 2018, Gong 2019).

In Figure 8, we show the simulation results for all 19 regions in our model. Most Asian economies stand to benefit from the trade dispute, and Japan, Malaysia, the Republic of Korea, and Viet Nam might benefit the most. Viet Nam's GDP is projected to increase by about 0.7% under scenario 2, almost one-tenth of its GDP growth rate in 2017. However, Mongolia is expected to suffer a

Figure 8: Impacts on the Gross Domestic Product of Other Asian Economies



Source: Authors.

GDP loss, mainly because the PRC is Mongolia's largest export market. This is consistent with recent trade data, which show evidence of trade redirection (ADB 2019).

In Table 5, we select three countries to show the sectoral impacts of the tariff conflict in a full-scale tariff war (scenario 2). Japan represents a developed economy and benefits a little from the trade conflict between the US and the PRC. Viet Nam represents a fast-developing new economy and a strong competitor of the PRC in the exports of low-end and labor-intensive products. Therefore, the trade dispute will allow Viet Nam to compete with the PRC, especially in the leather footwear sector. Mongolia represents an economy which relies more on exports to the PRC. Mongolia is rich in natural resources, and its exports to the PRC are used in infrastructure construction. As the PRC slows down amidst trade tensions, Mongolia's exports to the PRC are expected to decrease and drag the overall performance of its GDP.

Table 5: Sectoral Impacts on Other Economies under Scenario 2

	Japan	Viet Nam	Mongolia
Agriculture, hunting, forestry, fishing	0.03%	0.04%	0.24%
Mining, quarrying	0.09%	-1.28%	-0.90%
Food, beverages, tobacco	0.04%	0.01%	0.14%
Textile products	-0.83%	2.32%	0.25%
Leather footwear	-1.33%	13.29%	0.30%
Wood products	-0.10%	0.12%	0.04%
Pulp, paper, printing, publishing	0.09%	1.32%	-0.07%
Coke, refined petroleum, nuclear fuel	0.08%	0.13%	0.24%
Chemicals, chemical products	0.03%	0.30%	-0.27%
Rubber, plastics	0.12%	1.33%	-0.03%
Other nonmetallic mineral	0.01%	0.34%	-0.10%
Basic metals, fabricated metal	0.05%	-0.35%	-0.47%
Machinery	0.35%	-0.03%	0.04%
Electrical optical equipment	0.11%	-1.34%	0.00%
Transport equipment	0.96%	0.58%	0.83%
Manufacturing, recycling	-0.04%	0.08%	0.41%
Electricity, gas, water supply	0.11%	0.75%	-0.15%
Construction	0.15%	0.84%	-0.20%
Aggregated service sector	0.06%	0.47%	0.11%
Total output	**0.11%**	**0.73%**	**-0.17%**

Source: Authors.

Tables 6 and 7 show the impact of the trade conflict in the form of an international trade matrix. The number in each entry represents the change in the trade volume from the economy in the row to the economy in the column. When the row and the column represent the same economy, the number represents the change of the total value of the products both produced and consumed in that economy.

Table 6: Trade Flow Change in Scenario 1

(%)

	US	PRC	BAN	IND	INO	JPN	KAZ	KOR	MAL	MON	PAK	PHI	SRI	TAP	THA	TUR	VIE	EU	ROW
US	−0.2	−43.8	−0.6	−0.2	0.1	−0.1	−0.1	0.0	0.6	−1.5	−0.5	0.4	−0.3	0.0	−0.1	−0.3	0.5	−0.1	0.0
PRC	−37.6	−0.5	2.9	3.3	3.3	2.8	2.8	3.0	3.3	1.2	2.4	2.9	2.7	3.1	3.1	3.4	3.0	3.0	2.7
Indonesia	1.1	−1.4	0.0	−0.1	0.3	−1.0	0.4	−0.4	0.1	−1.0	−0.2	0.0	−0.1	−0.3	0.3	−0.1	1.6	−0.2	−0.3
India	3.0	−1.1	−0.3	0.0	−0.2	−0.2	−0.4	−0.2	−0.1	−1.2	−0.4	−0.1	−0.5	−0.1	−0.2	−0.1	0.1	−0.1	0.0
Japan	6.9	−1.2	−0.6	−0.3	0.0	−0.4	−0.2	−0.2	−0.1	−1.3	−0.6	−0.2	−0.7	−0.2	−0.3	−0.3	0.0	−0.2	−0.1
Korea, Rep. of	4.9	−1.2	−0.3	−0.5	−0.4	0.1	0.0	−0.5	−0.1	−1.4	−0.8	−0.2	−0.7	−0.5	−0.2	−0.3	−0.2	−0.2	−0.1
Turkey	2.4	−2.1	−0.2	−0.1	0.1	0.1	0.0	−0.1	0.2	−1.0	−0.2	0.1	−0.2	0.1	0.3	0.1	0.3	0.3	0.3
Taipei,China	5.8	−1.2	−0.2	−0.3	0.1	−0.2	−0.1	0.1	0.0	−1.3	−0.6	0.0	−0.4	−0.3	−0.2	−0.3	0.2	0.0	0.0
Bangladesh	10.2	−1.0	−0.3	−0.3	−0.1	−0.2	−0.2	−0.2	0.1	−1.5	−0.5	0.1	−0.5	−0.3	−0.1	−0.2	0.1	−0.1	0.0
Malaysia	1.0	−0.8	0.5	0.8	0.8	0.9	0.9	1.5	0.9	−0.1	0.5	0.8	0.6	0.8	1.0	0.7	1.3	1.2	1.0
Philippines	1.3	−1.5	0.0	0.1	0.3	−0.1	−0.5	0.0	0.2	−0.8	0.0	0.1	0.0	0.0	0.2	0.1	1.6	0.1	0.0
Thailand	4.5	−0.9	−0.3	−0.2	0.0	−0.2	0.0	−0.1	0.1	−1.2	−0.5	0.1	−0.4	−0.2	0.0	−0.2	0.2	0.0	0.0
Viet Nam	0.4	−0.6	−0.1	−0.1	0.2	−0.1	0.1	0.0	0.2	−0.8	−0.3	0.1	0.0	0.1	0.2	−0.1	0.4	0.1	0.1
Kazakhstan	6.7	−1.2	−0.2	−0.2	−0.1	−0.3	0.1	−0.3	0.1	−1.3	−0.5	0.1	−0.4	0.1	0.0	−0.1	0.2	0.0	−0.1
Mongolia	2.7	−1.3	−0.5	−0.3	−0.1	−0.1	−0.1	−0.2	−0.2	−1.6	−0.6	−0.3	−0.6	−0.2	0.1	−0.1	0.0	0.0	0.0
Sri Lanka	3.4	−1.5	−0.1	0.1	0.3	−0.3	−0.2	−0.2	0.1	−1.4	−0.4	0.0	−0.2	0.1	0.2	0.0	0.3	0.0	0.0
Pakistan	9.0	−1.7	−0.9	−0.3	−0.2	−0.5	0.5	−0.4	−0.3	−1.6	−0.9	−0.4	−0.8	−0.4	−0.4	−0.2	0.4	0.2	−0.3
EU	2.8	−0.5	−0.4	−0.5	−0.4	−0.4	−0.3	−0.4	−0.2	−1.5	−0.7	−0.3	−0.8	−0.4	−0.2	−0.3	−0.1	0.1	−0.1
ROW	3.3	−1.5	−0.3	−0.1	0.0	0.0	−0.1	−0.1	0.1	−1.3	−0.4	0.0	−0.4	−0.1	0.0	−0.1	0.1	0.0	0.2

BAN = Bangladesh; EU = European Union; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; KOR = Republic of Korea; MAL = Malaysia; MON = Mongolia; PAK = Pakistan; PHI = Philippines; PRC = People's Republic of China; ROW = Rest of the world; SRI = Sri Lanka; TAP = Taipei,China; THA = Thailand; TUR = Turkey; US = United States; VIE = Viet Nam.

Source: Authors.

Table 7: Trade Flow Change in Scenario 2

(%)

	US	PRC	INO	IND	JPN	KOR	TUR	TAP	BAN	MAL	PHI	THA	VIE	KAZ	MON	SRI	PAK	EU	ROW
US	−0.2	−44.4	−0.2	−0.5	−0.5	−0.5	−0.7	−0.5	−0.7	0.2	0.1	−0.5	0.3	−0.5	−2.3	−0.5	−0.9	−0.4	−0.3
PRC	−47.7	−0.6	4.4	4.3	3.6	3.9	4.3	3.9	4.1	4.4	4.0	4.1	4.2	3.7	1.9	4.1	3.4	4.0	3.6
Indonesia	10.0	−1.9	0.0	−0.3	−0.6	−0.3	−0.3	−0.3	−0.3	−0.3	−0.3	−0.4	0.2	−0.2	−1.8	−0.4	−0.7	−0.3	−0.1
India	5.2	−1.8	−0.2	0.0	−0.4	−0.4	−0.2	−0.2	−0.1	−0.3	−0.3	−0.3	0.1	−0.5	−1.7	−0.5	−0.5	−0.3	0.0
Japan	5.7	−1.8	−0.4	−0.4	0.1	−0.6	−0.3	−0.6	0.0	−0.1	−0.2	−0.2	0.0	0.1	−1.7	−0.6	−0.8	−0.2	0.0
Korea, Rep. of	6.9	−1.7	0.3	−0.2	−0.3	0.1	−0.3	−0.4	0.2	0.1	0.0	−0.1	0.6	−0.1	−1.6	−0.1	−0.6	0.1	0.0
Turkey	5.6	−2.2	0.3	0.1	−0.5	−0.3	0.0	0.1	0.1	0.0	−0.1	0.2	0.4	−0.3	−1.9	−0.1	−0.4	0.0	−0.1
Taipei,China	8.1	−1.8	0.0	−0.1	−0.4	−0.4	0.0	0.1	0.3	0.2	0.2	0.1	0.6	0.2	−1.6	0.0	−0.4	0.1	0.0
Bangladesh	9.7	−2.4	−0.1	−0.4	−1.9	−1.0	−0.6	−0.7	0.0	−0.4	−0.6	0.0	2.8	0.1	−1.7	−0.1	−0.4	−0.7	−0.9
Malaysia	11.6	−1.6	0.0	−0.2	−0.3	−0.2	−0.2	−0.4	0.0	0.2	0.0	−0.1	0.3	−0.2	−1.9	−0.3	−0.4	−0.1	0.0
Philippines	5.9	−1.5	0.0	−0.2	−0.3	−0.2	−0.3	−0.5	−0.1	0.0	0.1	0.0	0.5	0.0	−1.6	−0.3	−0.5	0.0	0.0
Thailand	4.1	−2.0	−0.1	−0.3	−0.2	−0.3	−0.1	−0.3	−0.2	−0.3	−0.3	0.1	0.2	−0.1	−2.1	−0.4	−0.6	0.0	0.1
Viet Nam	13.4	−2.7	−0.4	−0.4	−0.8	−0.8	−0.3	−0.7	−0.1	−0.6	−0.5	−0.6	0.6	0.6	−2.3	−0.3	−0.5	0.2	−0.3
Kazakhstan	3.0	−2.8	0.2	−0.1	0.0	−0.2	0.2	0.0	0.1	0.2	0.1	0.3	0.5	0.0	−1.4	0.0	−0.2	0.4	0.4
Mongolia	1.7	−1.0	1.1	1.1	1.2	1.9	1.0	1.1	1.0	1.2	1.0	1.2	1.9	1.2	−0.1	1.2	0.8	1.6	1.3
Sri Lanka	5.5	−1.6	−0.1	−0.5	−0.5	−0.3	−0.1	−0.4	−0.2	−0.2	−0.4	−0.2	−0.4	−0.2	−1.2	0.1	−0.6	−0.1	−0.1
Pakistan	7.7	−2.4	0.2	0.1	−0.4	−0.2	−0.1	−0.3	0.2	−0.1	−0.2	0.0	2.6	−0.8	−1.2	0.1	0.0	−0.1	−0.2
EU	3.4	−1.2	−0.5	−0.5	−0.5	−0.5	−0.4	−0.6	−0.2	−0.4	−0.5	−0.2	0.0	−0.4	−2.0	−0.7	−0.7	0.1	−0.1
ROW	4.5	−2.2	0.0	−0.1	−0.1	−0.1	−0.2	−0.3	0.0	0.0	−0.1	0.0	0.2	−0.1	−1.8	−0.2	−0.4	0.0	0.3

BAN = Bangladesh; EU = European Union; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; KOR = Republic of Korea; MAL = Malaysia; MON = Mongolia; PAK = Pakistan; PHI = Philippines; PRC = People's Republic of China; ROW = Rest of the world; SRI = Sri Lanka; TAP = Taipei,China; THA = Thailand; TUR = Turkey; US = United States; VIE = Viet Nam.

Source: Authors.

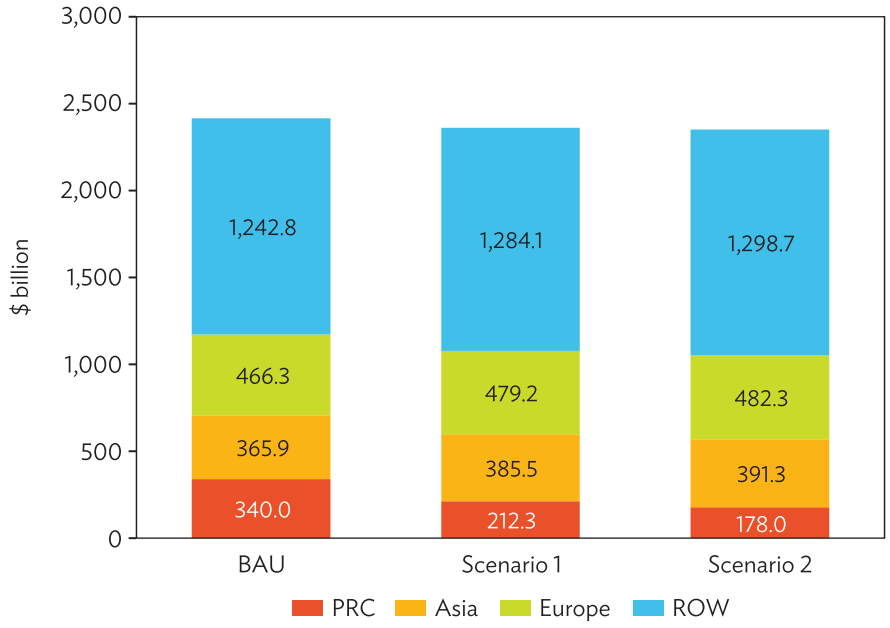
The results show that bilateral trade between the US and the PRC will be nearly halved in a full-scale tariff war (scenario 2), including both the imports from and exports to the PRC, and that these imports or exports will find their substitutes. For the PRC's exports to the US, the PRC's share will mainly be replaced by Indonesia, Malaysia, and Viet Nam. On the other hand, almost all the economies enjoy an expansion of their exports to the PRC as substitutes for PRC imports from the US.

VII. DISCUSSION

The trade deficit with the PRC is one of the main reasons why the Trump administration started the trade dispute. However, according to the simulation results, though the tariffs do improve the US trade balance with the PRC, total net exports for the US increase by only 1.3% and 2.2% in scenario 1 and scenario 2, respectively. This is because most of the imports originally from the PRC would be simply redistributed to other economies.

As shown in Figure 9, total imports to the US would decrease, which is expected in a tariff escalation scenario. US imports from the PRC would decrease by roughly 38% in tariff scenario 1 and 48% in scenario 2. As a result, the US trade imbalance with the PRC would be reduced by 34.8% in scenario 1, and further to 49.1% in scenario 2. However, the US imports from the rest of the world would increase. In other words, the tariff hikes would only shift US imports from the PRC to other countries, not helping much on reducing total imports.

Figure 9: United States Import Structure under the Model Scenarios



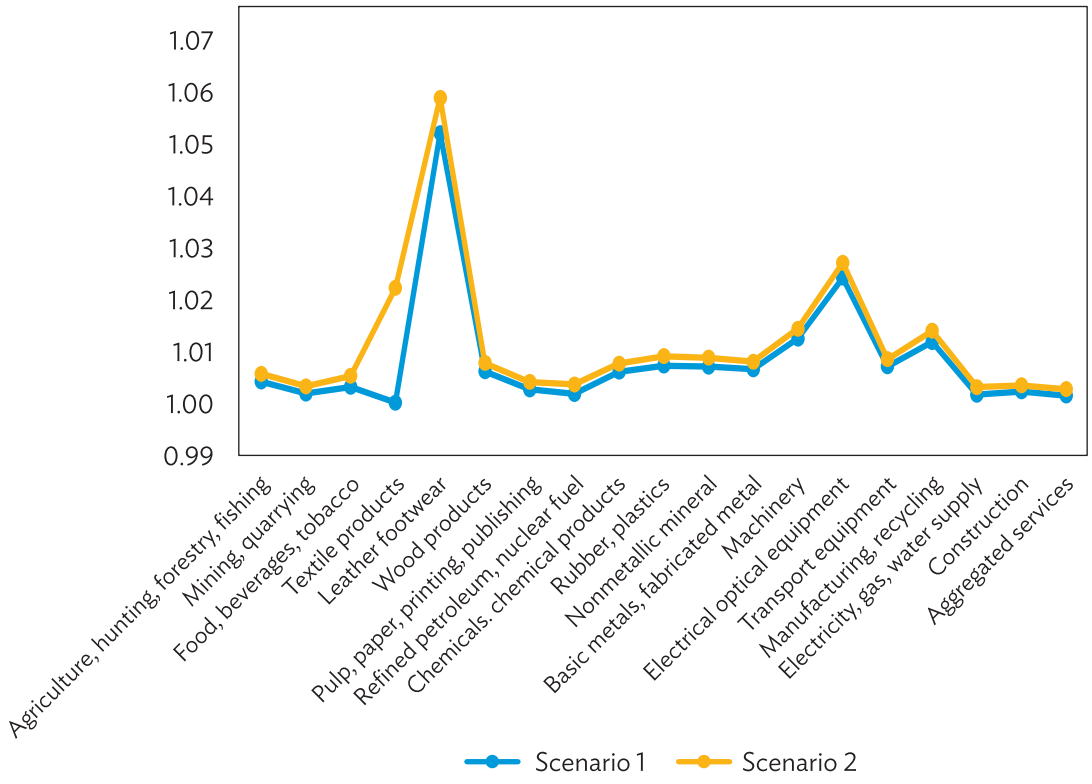
BAU = business as usual, PRC = People's Republic of China, ROW = Rest of the world.

Source: Authors.

It is worth discussing the cost of the trade dispute compared to the limited benefits that it is expected to yield. The current international trade structure is the result of market choices under the international division of labor. The choice of the PRC as the "world's factory" is due to its low material and labor costs (although labor costs are now increasing), huge market, complete industrial chain, and relatively stable and competitive business environment. However, as the tariff shocks move into the system, the most intuitive outcome is that commodities will become more expensive.

Figure 10 shows price levels for all 19 sectors under both scenarios, where the baseline (BAU) price levels are set as one in each sector. The results show that the trade dispute is expected to increase price levels ranging from 1% to 7% in different sectors. For those sectors where the US levy heavy tariffs on the PRC, and the US is heavily reliant on imports from the PRC, the price level increase is more pronounced. For example, as the PRC provides about 43.8% of all the leather and footwear sector products consumed in the US, the additional 25% tariff will increase prices in this sector by about 7%, definitely bad news for most shoppers.

Figure 10: United States Price Levels by Sector[a]



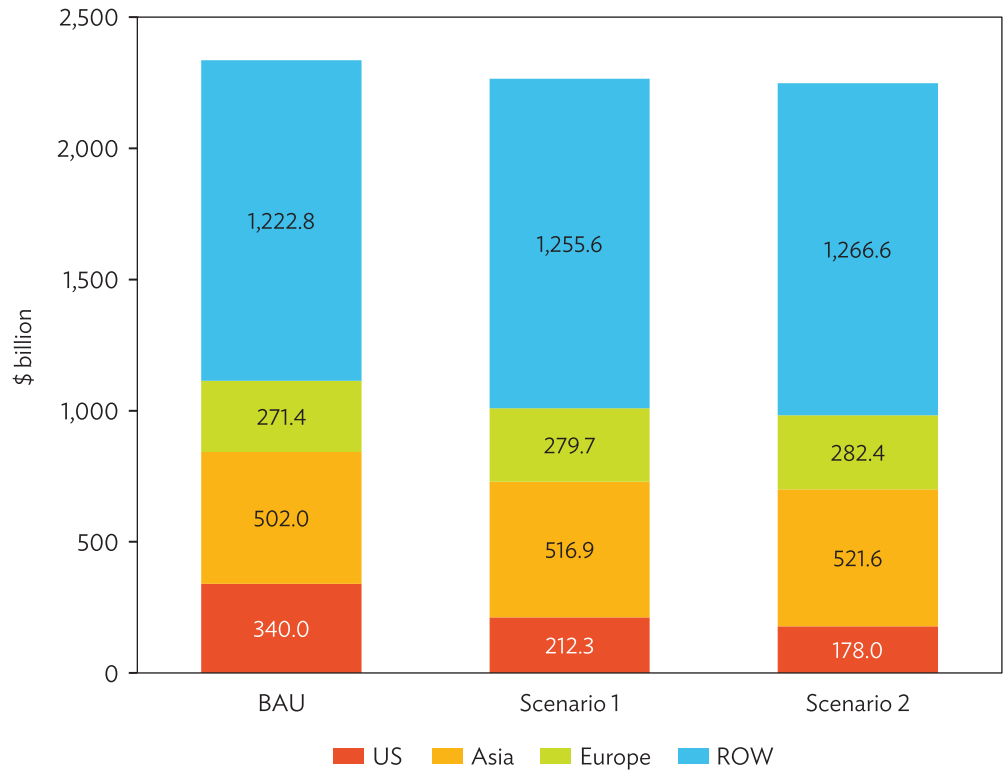
[a] Price levels in the baseline BAU scenario are set to 1.

Source: Authors.

After being turned down by the world's largest economy, an urgent task for the PRC is to find other buyers for those products planned for exports. Otherwise, the declining overseas orders might trigger another wave of factory closures like during the 2007–2008 financial crisis. Figure 11 shows the export structure of the PRC. As the US share of export demand declines, demand from other countries will be essential.

However, it is arguable whether other economies have enough purchasing ability to make up for the declining share of import demand for Chinese products from the US. While the answer is not obvious, the PRC government has taken major initiatives to boost foreign trade. The Belt and Road Initiative, proposed in 2013, involves infrastructure development and investment in 152 countries and organizations. The construction of the free trade network with the Belt and Road partners has been accelerated in recent years, especially the Regional Comprehensive Economic Partnership between the PRC and countries under the Association of Southeast Asian Nations. The PRC is also trying to enlarge the domestic market by reducing tariffs and deepening market reforms. The value-added tax, resident income tax, and corporate income tax have all been reduced since 2018, while many market reforms have been implemented in the financial sector, energy sector, etc. Of course, it remains uncertain whether these measures will allow the PRC to emerge from the shadow of the trade dispute.

Figure 11: People's Republic of China Export Structures under the Model Scenarios



BAU = business as usual, ROW = Rest of the world, US = United States.

Source: Authors.

As mentioned in section VI, the ongoing tensions create a climate of economic uncertainty that could negatively affect investor and consumer confidence. Since it is difficult to quantitatively assess the impact of the trade dispute on investments, we only simulate the impact of a further 1% decrease in investments in the PRC in a full-scale tariff war (scenario 2). The results are shown in Table 8.

Table 8: Gross Domestic Product Performances in Different Economies

	Scenario 1	Scenario 2	Scenario 2 + Investment in the PRC decreases by 1%
United States	−0.17%	−0.22%	−0.22%
People's Republic of China	−0.36%	−0.47%	−1.10%
Indonesia	0.03%	0.06%	0.05%
India	0.03%	0.05%	0.05%
Japan	0.07%	0.08%	0.06%
Republic of Korea	0.10%	0.11%	0.04%
Turkey	0.03%	0.05%	0.04%
Taipei,China	0.07%	0.08%	0.01%
Bangladesh	0.00%	0.05%	0.05%
Malaysia	0.13%	0.15%	0.12%
Philippines	0.05%	0.07%	0.06%
Thailand	0.09%	0.12%	0.10%
Viet Nam	0.46%	0.68%	0.64%
Kazakhstan	0.04%	0.05%	0.03%
Mongolia	−0.12%	−0.12%	−0.21%
Sri Lanka	0.04%	0.10%	0.09%
Pakistan	0.01%	0.04%	0.04%
Europe	0.06%	0.07%	0.06%
Rest of the world	0.15%	0.21%	0.18%
World	−0.04%	−0.05%	−0.16%

PRC = People's Republic of China.

Source: Authors.

Compared to the two model scenarios, the decrease in investment seems to have a large economic impact in the PRC. The negative impact on GDP for the PRC increases to 1.1% if investment further decreases by 1%. This is consistent with the data already showing a halving of investment contribution in the PRC, as US tariffs undermine exports and manufacturing prospects (ADB 2019). Most Asian economies are also expected to suffer: for Taipei,China, the GDP loss is about 0.07%, close to its benefit from substituting PRC exports to the US. This is because Taipei,China, like many other Asian economies, relies a lot on PRC investments or import activities.

CGE models rely on the parameter assumptions in the structures and scenario settings, and sensitivity analysis is needed to test the robustness of the model. In Table 9, we show the results of the sensitivity analysis on the elasticity of substitution among imports from different countries.

Theoretically, when the elasticity among imports is higher, imports would be more easily shifted among different economies, which will benefit economies other than the US and the PRC. In Table 9, 'middle elasticity' refers to the elasticities used in the main analysis and reported in Appendix Table A11; 'low elasticity' means that the elasticities of substitution among imports from different countries all decrease by 50%; 'high elasticity' means that the elasticities of substitution among imports from different countries all increase by 50%. The results are consistent with the analysis that higher elasticity will benefit other economies more because they could replace US or PRC products more easily.

Table 9: Gross Domestic Product Changes in Scenario 2 (Full-Scale Tariff War) with Different Elasticities of Substitution among Imports from Different Economies

	Low Elasticity	Middle Elasticity	High Elasticity
United States	−0.19%	−0.22%	−0.23%
People's Republic of China	−0.40%	−0.47%	−0.50%
Indonesia	−0.01%	0.06%	0.10%
India	0.02%	0.05%	0.06%
Japan	0.03%	0.08%	0.10%
Republic of Korea	0.02%	0.11%	0.15%
Turkey	0.04%	0.05%	0.05%
Taipei,China	0.01%	0.08%	0.12%
Bangladesh	0.03%	0.05%	0.06%
Malaysia	0.08%	0.15%	0.18%
Philippines	0.03%	0.07%	0.09%
Thailand	0.05%	0.12%	0.15%
Viet Nam	0.47%	0.68%	0.78%
Kazakhstan	0.02%	0.05%	0.06%
Mongolia	−0.18%	−0.12%	−0.08%
Sri Lanka	0.07%	0.10%	0.11%
Pakistan	0.03%	0.04%	0.05%
Europe	0.04%	0.07%	0.08%
Rest of the world	0.10%	0.21%	0.26%

Note: "Middle elasticity" refers to the elasticities used in the main analysis (Table A11); "low elasticity" means that the elasticities of substitution among imports from different economies all decrease by 50%; "high elasticity" means that the elasticities of substitution among imports from different economies all increase by 50%.

Source: Authors.

VIII. CONCLUSION

The trade dispute between the US and the PRC is still ongoing, but both academic simulations and real economic performances have already shown the negative impacts on both sides, as well as the global economy, and losses are expected to grow if tensions don't subside.

In this paper, we construct a multiregional CGE model based on the 2017 ADB MRIOT, and we simulate two scenarios: scenario 1 representing the measures implemented as of May 2019, and scenario 2 simulates a full-scale tariff war in which both the US and the PRC impose 25% tariffs on all reciprocal imports. We find that scenario 1 is associated with a 0.17% and 0.36% GDP loss to the US and the PRC, respectively. The losses would increase to 0.22% and 0.47%, respectively if a full-scale tariff war broke out. These results only consider the impact of tariffs, but the negative impact becomes much larger if other channels, for example, investment, are considered.

Also, our analysis reveals that other Asian economies, particularly Japan, Malaysia, the Republic of Korea, and Viet Nam, would benefit from the trade diversion effects in the export-competing sectors to the PRC, although sectors in these countries that are interconnected through supply-chain networks to the PRC stand to suffer.

Our framework has two advantages. First, its simplicity, which is no small feat when studying developing economies that either lack detailed data or present reliability challenges. Second, its reliance on the ADB MRIOT, which are derived directly from each country's supply and use tables and provide the latest base year.

Though informative and consistent with both theoretical predictions and existing literature, this study has four main limitations that should be tackled by future research. First, trade in services is not well analyzed. IO or CGE models specialize in depicting traditional production pathways, and therefore are ill-suited for cross-border services trade. It is worth noting that in 2017 the US was running a $54.1 billion trade surplus with the PRC in the service sector, and the overall US trade deficit with the PRC goes from $375 billion to $321 billion after taking trade in services into consideration. As services play an increasingly important role in international trade, we must bear in mind this weakness of the CGE model when examining the simulation results.

A second limitation to contend with is the fact that there are major gaps in tariff and NTB datasets. Tariff data is only at the national and sectoral level; and even though NTBs are now even more important than tariffs, there is limited open data available on NTBs.

Third, elasticity data is not complete. CGE modeling requires many elasticities in sectoral production functions and trade blocks, but most elasticity datasets are incomplete and outdated, needing further empirical investigations.

Finally, exchange rates play an essential role in international trade and could intensify or offset the effects of tariffs, but they are not considered in this paper. Therefore, exchange rates are a good direction for future extensions of our work.

Although this study predates the COVID-19 crisis, it offers an important policy insight. The pandemic has already significantly slowed global growth and sharply reduced global trade, and imposing protectionist policies borne out of national security and public health concerns will only

worsen the trade slump, delay the global economic recovery, and reduce national incomes for all. If the conflict continues or intensifies, the scope for further redirection in trade and production will increase. It will be imperative to conduct follow-up studies on the consequences of a recent further rise in protectionist sentiments between the US and the PRC, especially after countries experienced significant disruptions to supply chains and shortages at the height of the COVID-19 pandemic.

APPENDIXES

Table A1: Timeline of the United States–People's Republic of China Trade Dispute

Announcement	Implementation	United States	People's Republic of China
		PRELUDE	
20 April 2017		President Trump issued a Presidential Memorandum on Steel Imports and Threats to National Security, initiating a Section 232 investigation into steel imports.	
27 April 2017		President Trump issued a Presidential Memorandum on Aluminum Imports and Threats to National Security, initiating a Section 232 investigation into aluminum imports	
14 August 2017		President Trump issued a Presidential Memorandum Addressing PRC Laws, Policies, Practices, and Actions Related to Intellectual Property, Innovation, and Technology	
17 August 2017		The US Trade Representative initiated a 301 investigation into PRC's technology transfer according to the presidential memorandum	
		START	
8 March 2018	23 March 2018	US imposes 25% additional tariffs on steel and 10% additional tariffs on aluminum imports worth $48 billion effective 23 March 2018.	
22 March 2018		President Trump issued a Presidential Memorandum on Actions by the United States Related to the Section 301 Investigation of PRC Laws, Policies, Practices, or Actions Related to Technology Transfer, Intellectual Property, and Innovation. He instructed USTR to consider additional tariffs on Chinese goods.	
23 March 2018	2 April 2018		PRC imposes 15% additional tariffs on 120 US products worth $1 billion including fruits, nuts, wine and steel pipes and a 25% tax on eight US products worth $2 billion including pork.
		FIGHT	
3 April 2018		On 3 April 2018, USTR announced a proposed list of approximately 1,300 tariff lines valued at an estimated $50 billion.	

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Announcement	Implementation	United States	People's Republic of China
4 April 2018			PRC proposes 25% additional tariffs on a list of 106 US products worth $50 billion.
5 April 2018		US proposes additional tariffs on Chinese products worth $100 billion.	
29 May 2018		The United States will impose a 25% tariff on $50 billion of goods imported from the PRC containing industrially significant technology, including those related to the "Made in China 2025" program.	
15 June 2018	6 July 2018	15 June 2018. Trump declared that the United States would impose a 25% tariff on $50 billion of Chinese exports. US imposes tariffs on the first set of 818 Chinese products worth $34 billion from the original proposed list of 1,333 products published on 6 April.	
15 June 2018	23 August 2018	US proposes second set of 284 Chinese products worth $16 billion that benefit from Chinese industrial policies, including 'Made in China 2025' policy with 25% additional tariff.	
15 June 2018	6 July 2018		PRC imposes 25% tariffs on 545 US products worth $34 billion.
15 June 2018	23 August 2018		PRC imposes 25% tariffs on US products worth $16 billion.
		ESCALATION	
7 October 2018	24 September 2018	In accordance with the direction of President Trump, the additional tariffs will be effective starting 24 September 2018, and initially will be in the amount of 10%. Starting 1 January 2019, the level of the additional tariffs will increase to 25%.	
8 March 2018	24 September 2018		PRC proposes new tariffs on US goods worth $60 billion.
		TRUCE	
1 December 2018	Within 90 days	1 December 2018. The planned increases in tariffs were postponed. The White House stated that both parties will "immediately begin negotiations on structural changes with respect to forced technology transfer, intellectual property protection, nontariff barriers, cyber intrusions and cyber theft."	
14 December 2018	1 January 2019		The PRC suspends tariffs on cars and parts originating in the United States for three months, involving 211 tax items.
2 March 2019		USTR maintained the 10% tariff level until further notice. PRC issued a statement in favor of this.	

continued on next page

Table A1 *continued*

Announcement	Implementation	United States	People's Republic of China
		REFIGHT	
8 May 2019	10 May 2019	USTR instructs CBP to collect 25% duties on products listed on List 3, effective 12:01 am on 10 May 2019. All importers subject to Section 301 tariffs must now pay the increased duty amount of 25% instead of the 10%.	
10 May 2019		USTR is ordered to begin the process of raising tariffs on essentially all remaining imports from the PRC, which are valued at approximately $300 billion.	
13 May 2019	1 June 2019		PRC imposes 25\10\5 percent tariffs on 2,493 US products worth $60 billion.

CBP = customs and border protection, PRC = People's Republic of China, US = United States, USTR = United States Trade Representative.

Source: Authors' adaptation of Reuters. 2019. "Timeline: Key Dates in the U.S.-China Trade War." May 8. https://www.reuters.com/article/us-usa-trade-china-timeline/timeline-key-dates-in-the-us-china-trade-war-idUSKCN1SE2OZ and Bloomberg. 2019. "A Timeline of the U.S.-China Trade War." May 14. https://www.bloomberg.com/news/articles/2019-05-14/u-s-china-trade-war-timeline-what-led-up-to-the-stalemate.

Table A2: Ten Rounds of United States–People's Republic of China Trade Negotiations

Round	Dates	Location	Outcome
1	27 Feb 2018–3 Mar 2018	Washington, DC	Some discussion about problems concerning the interest of two parties
2	3 May 2018–4 May 2018	Beijing	Expanding export to the PRC from the US; bilateral trade in services; investment, intellectual property protection; and some other issues about the tariffs. With some agreement
3	15 May 2018–19 May 2019	Washington, DC	Agreement on stopping further trade conflicts, reducing the tariff, agreement on increasing exports from the US to the PRC in the field of agriculture and energy
4	2 Jun 2019–4 Jun 2019	Beijing	Further discussion about the details of the agreement settled in Washington
5	30 Jan 2019–31 Jan 2019	Washington, DC	Discuss the blueprint of the next stage
6	14 Feb 2019–15 Feb 2019	Beijing	A detailed discussion about technology transformation, intellectual property protection, nontariff barrier, service industry, and trade balance between two countries
7	21 Feb 2019–24 Feb 2019	Washington, DC	Make substantial progress by including negotiation about financial industry and exchange rate
8	28 Mar 2019–29 Mar 2019	Beijing	Negotiations on written agreements
9	3 Apr 2019–5 Apr 2019	Washington, DC	Some improvement in technology transformation, intellectual property protection, nontariff barriers, trade in services, and the trade balance between the two countries
10	30 Apr 2019–1 May 2019	Beijing	Focus on trading structure and trade balance

PRC = People's Republic of China, US = United States.

Source: Authors.

Table A3: Economy and Sector Classification in the Model

Code	Description
	A. Economies
US	United States
PRC	People's Republic of China
BAN	Bangladesh
IND	India
INO	Indonesia
JPN	Japan
KAZ	Kazakhstan
KOR	Republic of Korea
MAL	Malaysia
MON	Mongolia
PAK	Pakistan
PHI	Philippines
SRI	Sri Lanka
TAP	Taipei,China
THA	Thailand
TUR	Turkey
VIE	Viet Nam
EU	European Union
ROW	Rest of the world
	B. Sectors
s1	Agriculture, hunting, forestry, fishing
s2	Mining, quarrying
s3	Food, beverages, tobacco
s4	Textile products
s5	Leather footwear
s6	Wood products
s7	Pulp, paper, printing, publishing
s8	Coke, refined petroleum, nuclear fuel
s9	Chemicals, chemical products
s10	Rubber, plastics
s11	Nonmetallic mineral
s12	Basic metals, fabricated metal
s13	Machinery
s14	Electrical optical equipment
s15	Transport equipment
s16	Manufacturing, recycling
s17	Electricity, gas, water supply
s18	Construction
s19	Aggregated service sector

Source: Authors.

Table A4: Structure of Multiregional Social Accounting Matrix

		PRC	US	PRC						US						ROW	Total
		Activities	Activities	Labor	Capital	Household	Government	Saving-investment	Import tax	Labor	Capital	Household	Government	Saving-investment	Import tax	ROW	Total
PRC	Activities	Intermediate input	Intermediate import			Final demand	Final demand	Investment				Final demand	Final demand	Final demand			Output
US	Activities	Intermediate import	Intermediate input			Import	Import	Import				Import	Import	Import			Output
PRC	Labor	Labor input															Factor income
	Capital	Capital input															Factor income
	Household			Labor income	Capital income												Household income
	Government	Production tax				Tax			Import tax								Government income
	Saving-investment					Saving	Saving										Saving
	Import tax	Import tax				Import tax	Import tax	Import tax									Import tax
US	Labor		Labor input														Factor income
	Capital		Capital input														Factor income
	Household									Labor income	Capital income						Household income
	Government		Production Tax									Tax			Import tax		Government income
	Saving-investment						Foreign saving					Saving	Savings				Saving
	Import tax		Import tax									Import tax	Import tax	Import tax			Import tax
ROW	ROW																ROW
Total	Total	Input	Input	Factor expenditure	Factor expenditure	Household expenditure	Government expenditure	Investment	Import tax	Factor expenditure	Factor expenditure	Household expenditure	Government expenditure	Investment	Import tax	ROW	

PRC = People's Republic of China, US = United States, ROW = Rest of the world.

Source: Authors.

Table A5: 2017 Tariff Level of Other Economies' Products Imported to the People's Republic of China

(%)

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	10.75	0.70	12.74	11.63	17.44	0.77	3.84	1.91	6.04	7.21	7.82	7.82	3.53	3.53	21.72	3.53	3.84	3.84	3.84
PRC	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Bangladesh*	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62
India	5.41	0.69	12.86	5.92	16.65	1.91	4.96	3.19	4.87	6.73	2.03	2.03	4.25	4.25	7.82	4.25	4.96	4.96	4.96
Indonesia	0.00	0.00	0.22	0.07	0.00	1.18	0.06	0.00	0.19	10.38	0.00	0.00	0.08	0.08	4.33	0.08	0.06	0.06	0.06
Japan	10.14	3.20	18.73	9.02	17.21	2.81	6.64	6.37	5.36	7.13	8.33	8.33	4.19	4.19	14.89	4.19	6.64	6.64	6.64
Kazakhstan	11.04	0.03	10.39	10.92	16.71	5.45	6.31	0.40	5.49	11.83	3.78	3.78	9.14	9.14	23.84	9.14	6.31	6.31	6.31
Korea, Rep. of	7.42	0.02	15.32	6.56	12.08	4.81	5.55	5.11	3.00	5.50	8.27	8.27	2.28	2.28	8.33	2.28	5.55	5.55	5.55
Malaysia	0.00	0.00	0.31	0.54	0.00	2.11	0.03	0.00	0.06	3.95	0.00	0.00	0.02	0.02	0.57	0.02	0.03	0.03	0.03
Mongolia*	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62
Pakistan	5.08	0.00	3.08	3.35	18.62	4.69	0.60	0.00	2.49	5.12	9.87	9.87	3.50	3.50	0.19	3.50	0.60	0.60	0.60
Philippines*	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62
Sri Lanka	10.65	0.47	14.63	9.94	13.23	3.47	9.92	7.00	6.36	14.43	10.78	10.78	3.32	3.32	3.01	3.32	9.92	9.92	9.92
Taipei,China*	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62
Thailand*	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62
Turkey	11.63	2.57	13.15	13.63	16.90	7.00	5.66	0.00	6.06	9.45	9.13	9.13	10.36	10.36	11.43	10.36	5.66	5.66	5.66
Viet Nam*	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62
EU	11.37	1.19	12.91	12.13	12.98	1.54	4.67	0.70	5.46	7.91	1.81	1.81	5.41	5.41	15.49	5.41	4.67	4.67	4.67
ROW	7.64	0.13	10.32	8.42	10.64	1.00	4.62	0.68	4.39	5.85	2.39	2.39	2.12	2.12	15.84	2.12	4.62	4.62	4.62

EU = European Union, N.A. = not applicable, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

* Due to lack of data, we use the world average level instead.

Source: World Bank World Integrated Trade Solutions. https://wits.worldbank.org/ (accessed July 18, 2019).

Table A6: 2017 Tariff Level of Other Economies' Products Imported to the United States

(%)

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PRC	0.17	0.11	33.26	10.61	12.72	0.75	1.18	0.04	2.39	3.75	4.63	4.63	0.53	0.53	1.45	0.53	1.18	1.18	1.18
Bangladesh	0.31	0.00	103.16	10.56	5.39	2.65	2.34	0.00	1.39	3.03	11.85	11.85	1.17	1.17	1.50	1.17	2.34	2.34	2.34
India	0.08	0.50	18.66	9.13	8.38	1.12	1.66	0.13	1.16	3.43	1.26	1.26	1.52	1.52	0.86	1.52	1.66	1.66	1.66
Indonesia	0.05	0.42	11.00	13.00	12.64	2.83	1.02	0.00	2.71	1.78	6.36	6.36	0.95	0.95	1.20	0.95	1.02	1.02	1.02
Japan	0.91	0.22	21.22	5.25	1.55	0.02	0.92	0.32	1.61	3.39	1.86	1.86	0.97	0.97	1.79	0.97	0.92	0.92	0.92
Kazakhstan	0.00	0.00	0.21	1.79	0.00	0.00	0.28	0.00	2.95	0.00	1.50	1.50	1.36	1.36	0.00	1.36	0.28	0.28	0.28
Korea, Rep. of	0.06	0.00	156.93	0.70	0.97	0.01	0.00	0.00	0.04	0.52	0.12	0.12	0.04	0.04	0.00	0.04	0.00	0.00	0.00
Malaysia	0.57	0.00	9.37	11.94	10.91	1.58	0.34	0.00	2.37	4.29	2.95	2.95	0.15	0.15	0.68	0.15	0.34	0.34	0.34
Mongolia	0.00	0.81	0.86	8.80	10.98	0.00	0.00	0.00	2.37	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pakistan	0.00	0.00	9.10	9.42	5.56	0.23	1.25	0.00	0.23	0.48	0.02	0.02	0.01	0.01	0.02	0.01	1.25	1.25	1.25
Philippines	0.12	0.00	10.67	13.04	6.45	0.84	0.10	0.00	0.06	0.07	0.30	0.30	0.07	0.07	0.01	0.07	0.10	0.10	0.10
Sri Lanka	0.00	0.00	4.08	11.74	5.19	0.10	0.60	0.00	0.00	0.52	0.24	0.24	0.00	0.00	0.00	0.00	0.60	0.60	0.60
Taipei,China*	1.63	0.05	9.18	8.64	12.12	0.37	0.69	0.00	1.02	2.32	1.52	1.52	0.47	0.47	0.94	0.47	0.69	0.69	0.69
Thailand	0.11	0.17	5.79	11.79	9.00	1.36	0.97	0.00	2.98	3.05	5.20	5.20	0.40	0.40	1.00	0.40	0.97	0.97	0.97
Turkey	2.04	0.00	112.55	6.64	8.67	0.22	0.93	0.00	1.39	3.05	4.34	4.34	1.12	1.12	1.43	1.12	0.93	0.93	0.93
Viet Nam	0.07	0.05	24.92	13.01	15.06	1.60	0.21	0.00	0.97	3.20	2.44	2.44	0.47	0.47	0.69	0.47	0.21	0.21	0.21
EU	5.18	0.16	9.33	7.56	8.38	0.29	0.51	0.06	1.04	3.53	2.09	2.09	0.91	0.91	1.58	0.91	0.51	0.51	0.51
ROW	1.63	0.05	9.18	8.64	12.12	0.37	0.69	0.00	1.02	2.32	1.52	1.52	0.47	0.47	0.94	0.47	0.69	0.69	0.69

EU = European Union, N.A. = not applicable, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

* Due to lack of data, we use the world average level instead.

Source: World Bank World Integrated Trade Solutions. https://wits.worldbank.org/ (accessed July 18, 2019).

Table A7: 2017 Tariff Level of the People's Republic of China Products Exported to Other Economies

(%)

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	0.17	0.11	33.26	10.61	12.72	0.75	1.18	0.04	2.39	3.75	4.63	4.63	0.53	0.53	1.45	0.53	1.18	1.18	1.18
PRC	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Bangladesh*	10.00	12.91	15.22	22.37	25.00	22.01	15.39	15.69	5.85	16.13	21.50	21.50	8.75	8.75	14.43	8.75	15.39	15.39	15.39
India	26.97	4.48	34.13	11.43	10.00	9.31	8.22	4.21	7.31	8.92	9.47	9.47	3.28	3.28	10.84	3.28	8.22	8.22	8.22
Indonesia	0.00	0.00	4.35	0.60	3.68	0.00	0.52	0.00	0.65	5.86	0.84	0.84	0.09	0.09	5.11	0.09	0.52	0.52	0.52
Japan	4.56	0.16	10.43	7.69	27.98	0.92	0.18	0.00	0.09	0.27	0.28	0.28	0.00	0.00	0.00	0.00	0.18	0.18	0.18
Kazakhstan	2.27	3.51	7.99	8.13	0.78	4.94	6.54	5.00	4.62	6.54	10.10	10.10	1.60	1.60	7.04	1.60	6.54	6.54	6.54
Korea, Rep. of	10.60	1.53	19.38	7.64	6.78	2.09	2.64	0.46	1.59	2.79	4.67	4.67	1.55	1.55	3.51	1.55	2.64	2.64	2.64
Malaysia*	8.64	2.92	23.80	11.33	11.89	6.57	7.81	3.02	4.13	8.46	8.04	8.04	3.77	3.77	7.07	3.77	7.81	7.81	7.81
Mongolia*	8.64	2.92	23.80	11.33	11.89	6.57	7.81	3.02	4.13	8.46	8.04	8.04	3.77	3.77	7.07	3.77	7.81	7.81	7.81
Pakistan*	8.64	2.92	23.80	11.33	11.89	6.57	7.81	3.02	4.13	8.46	8.04	8.04	3.77	3.77	7.07	3.77	7.81	7.81	7.81
Philippines	0.00	0.00	1.40	0.92	3.58	0.00	0.15	0.00	0.02	4.47	0.24	0.24	0.26	0.26	10.92	0.26	0.15	0.15	0.15
Sri Lanka	12.61	8.90	19.40	0.13	5.34	9.77	12.59	3.68	1.46	13.19	20.79	20.79	3.16	3.16	4.59	3.16	12.59	12.59	12.59
Taipei,China	8.64	2.92	23.80	11.33	11.89	6.57	7.81	3.02	4.13	8.46	8.04	8.04	3.77	3.77	7.07	3.77	7.81	7.81	7.81
Thailand*	8.64	2.92	23.80	11.33	11.89	6.57	7.81	3.02	4.13	8.46	8.04	8.04	3.77	3.77	7.07	3.77	7.81	7.81	7.81
Turkey	10.61	0.14	28.86	6.88	10.86	0.20	2.09	0.01	4.96	5.49	5.86	5.86	1.56	1.56	3.23	1.56	2.09	2.09	2.09
Viet Nam*	0.00	4.43	10.20	6.11	9.63	1.20	1.92	6.41	1.01	1.30	6.93	6.93	0.73	0.73	2.61	0.73	1.92	1.92	1.92
EU	5.67	2.28	14.43	5.25	2.80	2.69	3.82	2.00	3.36	5.26	6.85	6.85	1.38	1.38	3.80	1.38	3.82	3.82	3.82
ROW	8.64	2.92	23.80	11.33	11.89	6.57	7.81	3.02	4.13	8.46	8.04	8.04	3.77	3.77	7.07	3.77	7.81	7.81	7.81

EU = European Union, N.A. = not applicable, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

* Due to lack of data, we use the world average level instead. Some of the 2017 data is not available, we use the 2016 data instead.

Source: World Bank World Integrated Trade Solutions. https://wits.worldbank.org/ (accessed July 18, 2019).

Table A8: 2017 Tariff Level of United States Products Exported to Other Economies

(%)

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
PRC	10.75	0.70	12.74	11.63	17.44	0.77	3.84	1.91	6.04	7.21	7.82	7.82	3.53	3.53	21.72	3.53	3.84	3.84	3.84
Bangladesh*	10.46	5.87	3.53	4.39	25.00	7.64	2.98	15.81	8.20	6.44	18.83	18.83	4.92	4.92	8.28	4.92	2.98	2.98	2.98
India	30.01	4.50	40.04	2.38	10.00	4.96	6.37	2.38	7.52	8.72	10.21	10.21	6.78	6.78	6.39	6.78	6.37	6.37	6.37
Indonesia	4.81	4.36	7.61	0.63	9.71	0.61	5.24	5.00	4.14	6.32	6.15	6.15	4.92	4.92	2.27	4.92	5.24	5.24	5.24
Japan	32.16	0.01	12.21	5.05	28.95	0.13	0.11	0.01	1.17	2.82	1.74	1.74	0.00	0.00	0.02	0.00	0.11	0.11	0.11
Kazakhstan	34.44	4.85	7.36	5.54	2.76	3.95	1.88	5.00	4.79	4.96	10.61	10.61	2.03	2.03	6.38	2.03	1.88	1.88	1.88
Korea, Rep. of	17.47	0.00	18.58	0.00	0.00	0.05	0.00	0.00	0.13	0.00	0.00	0.00	0.12	0.12	0.00	0.12	0.00	0.00	0.00
Malaysia*	19.71	1.66	16.52	6.67	8.94	3.72	4.18	2.69	4.76	5.51	4.11	4.11	3.63	3.63	7.54	3.63	4.18	4.18	4.18
Mongolia*	19.71	1.66	16.52	6.67	8.94	3.72	4.18	2.69	4.76	5.51	4.11	4.11	3.63	3.63	7.54	3.63	4.18	4.18	4.18
Pakistan*	19.71	1.66	16.52	6.67	8.94	3.72	4.18	2.69	4.76	5.51	4.11	4.11	3.63	3.63	7.54	3.63	4.18	4.18	4.18
Philippines	14.29	1.18	5.04	7.51	7.49	4.30	2.75	0.01	2.60	9.32	5.74	5.74	1.54	1.54	5.10	1.54	2.75	2.75	2.75
Sri Lanka	55.77	0.37	19.81	0.33	4.01	4.42	1.16	5.87	3.03	6.32	6.30	6.30	3.62	3.62	0.62	3.62	1.16	1.16	1.16
Taipei,China	19.71	1.66	16.52	6.67	8.94	3.72	4.18	2.69	4.76	5.51	4.11	4.11	3.63	3.63	7.54	3.63	4.18	4.18	4.18
Thailand*	19.71	1.66	16.52	6.67	8.94	3.72	4.18	2.69	4.76	5.51	4.11	4.11	3.63	3.63	7.54	3.63	4.18	4.18	4.18
Turkey	4.46	0.02	9.73	0.47	4.27	0.04	0.96	0.02	2.29	4.91	1.35	1.35	1.69	1.69	2.76	1.69	0.96	0.96	0.96
Viet Nam*	9.41	1.91	6.83	1.22	8.73	1.13	1.08	10.73	3.11	3.33	15.67	15.67	1.35	1.35	3.56	1.35	1.08	1.08	1.08
EU	37.91	1.53	12.20	2.19	3.06	1.51	0.76	0.02	1.88	4.09	0.33	0.33	1.36	1.36	4.00	1.36	0.76	0.76	0.76
ROW	19.71	1.66	16.52	6.67	8.94	3.72	4.18	2.69	4.76	5.51	4.11	4.11	3.63	3.63	7.54	3.63	4.18	4.18	4.18

EU = European Union, N.A. = not applicable, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

* Due to lack of data, we use the world average level instead. Some of the 2017 data is not available, we use the 2016 data instead.

Source: World Bank World Integrated Trade Solutions. https://wits.worldbank.org/ (accessed July 18, 2019).

Table A9: Elasticity of Substitution between Material Inputs and Value-Added Inputs

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.35
PRC	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.40
Bangladesh	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.43
India	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.45
Indonesia	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.47
Japan	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.38
Kazakhstan	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.47
Korea, Rep. of	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.37
Malaysia	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.48
Mongolia	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.45
Pakistan	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.49
Philippines	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.43
Sri Lanka	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.43
Taipei,China	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.41
Thailand	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.41
Turkey	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.47
Viet Nam	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.43
EU	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.38
ROW	0.24	0.20	1.12	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.68	1.41

EU = European Union, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

Source: Hertel, Thomas W., and Dominique van der Mensbrugghe. 2016. "Behavioral Parameters." In *GTAP 9 Data Base Documentation*, Center for Global Trade Analysis.

Table A10: Elasticity of Substitution between Labor Inputs and Capital Inputs

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.64
PRC	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.03
Bangladesh	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.95
India	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.96
Indonesia	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.60
Japan	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.93
Kazakhstan	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.91
Korea, Rep. of	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.04
Malaysia	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.17
Mongolia	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.20
Pakistan	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.63
Philippines	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.87
Sri Lanka	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.52
Taipei,China	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.89
Thailand	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	0.80
Turkey	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.19
Viet Nam	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.32
EU	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.07
ROW	1.07	0.79	0.22	0.10	10.00	0.12	0.12	0.24	0.24	0.12	0.20	0.18	0.48	0.10	0.18	0.23	10.00	0.17	1.04

EU = European Union, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

Source: Koesler, Simon, and Michael Schymura. 2012. "Substitution Elasticities in a CES Production Framework - An Empirical Analysis on the Basis of Non-linear Least Squares Estimations." ZEW Discussion Paper No. 12-007.

Table A11: Elasticity of Substitution between Domestic Goods and Aggregated Imported Goods

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	s16	s17	s18	s19
US	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
PRC	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Bangladesh	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
India	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Indonesia	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Japan	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Kazakhstan	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Korea, Rep. of	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Malaysia	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Mongolia	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Pakistan	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Philippines	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Sri Lanka	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Taipei,China	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Thailand	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Turkey	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
Viet Nam	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
EU	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90
ROW	2.50	4.13	3.00	3.73	4.05	3.40	2.95	2.10	3.30	3.30	2.90	3.75	4.05	4.40	3.55	3.75	2.80	1.90	1.90

EU = European Union, PRC = People's Republic of China, ROW = Rest of the world, US = United States.

Source: Hertel, Thomas W., and Dominique van der Mensbrugghe. 2016. "Behavioral Parameters." In *GTAP 9 Data Base Documentation*, Center for Global Trade Analysis.

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Assessing the Impact of the United States–People's Republic of China Trade Dispute Using a Multiregional Computable General Equilibrium Model

The paper uses a computable general equilibrium model based on the 2017 Asian Development Bank Multiregional Input-Output Tables to quantify the cost of the trade dispute that started in 2017 between the United States and the People's Republic of China for the countries involved and the global economy.

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