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MASTER THESIS

PREKYBOS TARIFŲ MAKROEKONOMINIAI EFEKTAI. JAV IR KINIJOS PREKYBOS KARO ĮTAKA JUNGTINIŲ AMERIKOS VALSTIJŲ EKONOMIKAI	MACROECONOMIC EFFECTS OF TRADE TARIFFS. A CASE STUDY OF THE U.S.-CHINA TRADE WAR EFFECTS ON THE ECONOMY OF THE UNITED STATES

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INTRODUCTION

Despite generally diverse scholars' views on global issues, the majority of economists tend to agree that international trade should be free. This perspective dates back to at least Adam Smith's "Wealth of Nations" (1776). Today, the idea of an open international trading system has also been advocated for by the World Trade Organization (WTO). Over the period of the first 25 years following the Second World War, the tariffs on manufactured goods fell to as low as 5% in the industrial countries boosting the growth of the world economy and trade by 5% and 8%, respectively (WTO, 2005). The data indicates a link between the free international trade and the economic growth, backed by a simple theory of a comparative advantage introduced by a classical economist David Ricardo. In general, a free flow of goods and services increases competition, innovation, an efficient allocation of resources, and allows maximizing the output by directing resources to their most productive uses. Freely functioning markets boost trade and prosper economic growth. But what happens when the restrictions for free trade such as trade tariffs are put in place?

At first, it would seem that the imposition of a trade tariff should create a stimulus to the domestic economy by promoting production and employment (Reitz and Slopek, 2005). Apart from that, the governments enforce import tariffs not only to protect the selected industries but also to raise their revenues or to exert their political and economic leverage over another country. For example, in 1980, the US tariffs on Italian wine and French cheese persuaded the European Union (EU) to start negotiations in terms of the Common Agricultural Policy (Fetzer and Schwarz, 2019). Unfortunately, the tariffs can have the unintended side effects. These barriers to free trade trigger the inefficiency of domestic producers, evasion, and reduction in welfare. Most importantly, increased protectionism provokes retaliation resulting in elevated prices, reduced output, and a substantial shock to supply chains, as trades have to be redirected to avoid tariff costs (Furceri et al., 2019). Given the comprehensive theoretical coverage of the issue and painful historical lessons such as The Smoot-Hawley Tariff Act of 1930, the following questions arise: why Governments still do that and what are the economic consequences of trade tariffs for the modern economies?

The economic effects of trade tariffs have always been of primary concern to the society, therefore the US-China trade war has gained a lot of attention. Numerous studies have examined this trade war, yet most of them seem to be theoretical and calibrating different scenarios models or limited to micro-level analysis. The effects of trade war receive even less scholarly attention in the times of the global COVID-19 pandemic. The absence of the empirical evidence on the economic effects of the US-China trade war based on the most recent data was the main stimulus of this paper.

Research Problem

How the United States tariffs on imports from China and China's retaliatory actions affect the U.S. economy?

Research Goal

The thesis aim to ascertain whether and how the bilateral tariffs imposed between the United States and China in 2018 and 2019 have affected the main economic indicators of the US, such as trade diversion from China, trade balance, welfare, and trade intensity.

Research Objectives

1. Study findings, research methods of academic studies analysing macroeconomic effects of trade tariffs and the most recent literature studying US-China trade war economic implications;
2. Present the current situation in the US-China trade war and explain the relevance of the research problem in the light of current events as well as analyse potential economic implications of the COVID-19 pandemic for the global trade flows;
3. Use findings of earlier analysis to choose a methodology for empirical research of this thesis and provide a detailed description of its implementation;
4. Perform research, examine results, explain wider implications, and discuss limitations of the thesis.

Research Methodology

Based on prior studies, a Single Market Partial Equilibrium Simulation Tool (SMART) model using World Bank's World Integrated Trade Solution (WITS) modelling software and United Nations' COMTRADE database on international trade as well as United Nations Conference on Trade and Development (UNCTAD) TRAINS database on tariffs will be built aiming to access the recent trade dispute's effects on the United States trade diversion from China, trade balance, welfare, and trade intensity.

Practical Value

The macroeconomic effects of protectionist policies, most common of which are trade tariffs have always concerned academic society, and many scientific articles are aiming to determine the effects of such policies. However, most of them are limited to the theoretical level as there are not so many actual cases in history that could be assessed empirically. Consequently, the recent US-China trade war has gained a lot of attention. Given the lack of empirical studies on this quite fresh topic, this article aims to fill the gap with the latest available economic data. The outcome of the research is especially important for both policymakers in the United States as well as other countries for identifying the effects that the initiated trade war can have not only for the US economy but for any economy that decides to impose trade tariffs for its trading partners.

Structure of the Research

The paper is structured as follows: literature review, an analysis of the current situation of the US-China trade war, a description of research methodology, the results obtained after applying the SMART model to two trade war scenarios, the interpretation of the results and the comparison with other scientific papers, the robustness analysis based on the sensitivity to changes in elasticity parameters, concluding remarks.

1. MACROECONOMIC EFFECTS OF TRADE TARIFFS THEORETICAL ANALYSIS

The first thesis chapter provides a conceptual framework for further study and supplements the work with a review of scientific papers and research methods that are used by other authors. More specifically, this section of the paper defines trade tariffs, their functions and analyses available academic literature about the effects of trade tariffs, which will later facilitate the choice of empirical methodology and interpretation of results. Then, the infamous Smoot-Hawley Tariff Act of 1930 is assessed, which caused the last global trade conflagration during the Great Depression and the consequences that these unfounded protectionist policies had.

1.1. Defining trade tariffs

A tariff is one of the most common types of trade barriers. Before analysing the effects of tariff imposition on the economies, it is important to understand the definition of tariffs, their types, and main functions. These concepts will be used throughout the paper and will be useful when measuring the independent variable of the interest.

According to the World Trade Organization, trade tariffs are customs duties on imports that are aimed at providing price advantages to domestic goods over similar imported goods. In principle, the WTO bans the use of quantitative barriers to trade as a tool to protect domestic industries but permits using trade tariffs for the same purpose with its supervision. The World Bank in collaboration with the United Nations Conference on Trade and Development (UNCTAD), International Trade Center, United Nations Statistical Division (UNSD) and WTO have developed the World Integrated Trade Solution (WITS) software that provides a lot of useful information about trade and tariffs. According to WITS, there are three main types of tariffs: most-favoured-nation tariff (MFN), bound tariff (BND) and effectively applied tariff (AHS). MFN tariff is one general tariff that a country, member of WTO, promises to impose for all imports from other WTO members. However, if members join preferential trade agreements, they can agree to lower import tariffs below the MFN level. BND tariff is the maximum MFN tariff level that WTO member governments commit to applying for a given commodity line. In practice, bound tariffs are not necessarily the rates that countries actually impose on other WTO members: they still have the flexibility to increase or decrease tariff rates unless it does not exceed their bound levels (the gap between the MFN and BND is called binding overhang). If one

WTO member were to exceed the pre-committed BND, other countries can take it to WTO dispute settlement and get compensation in the form of higher tariffs of their own. Lastly, AHS tariff is the lowest available tariff that is actually applied to a particular import. To connect theory and WTO rules to the current US-China trade war, the United States evidently breached the BND levels when imposing new trade tariffs for WTO member China. However, the United States claims to have done it based on General Agreement on Tariffs and Trade (GATT) Article 21 "Security Exception", which has never been employed in practice prior to the Trump Administration. China has immediately retaliated (without WTO approval) and has opened several trade disputes at WTO (DS587, DS565, DS563, DS562, DS544, etc.), which can take several years to process and settle. Despite its main role to ensure smooth and free international trade flows, currently, the WTO is seen as paralysed and unable to represent the kind of disputes it was created to resolve. To spice things up, according to The New York Times article "W.T.O. Allows China to Impose Trade Sanctions on the US Goods" published on November 1, 2019, at very inconvenient time, the WTO made a final decision in a case China brought against the US back in 2012 during the Obama's ruling and allowed China to impose new sanctions on up to 3.6 billion USD of American products, which further escalates the already harsh trade war between the two countries.

Moving further, according to WITS, tariffs can take several forms. The most widely used is an ad valorem tariff, where the customs duty is calculated as a fixed percentage of the monetary value of the good. Countries also use different types of non-ad valorem tariffs. Another form of tariff, is a specific tariff that places a fixed amount of duty that is set based on the physical quantity of the products, such as weight. Mixed tariffs are imposed based on either an ad valorem rate or specific rate depending on which will generate more (or less) tariff revenue. Compound tariffs charge both ad valorem and specific rates, for instance, Pakistan charges Rs. 0.88 per liter of some petroleum types in addition to the 25% ad valorem rate. Lastly, tariff-rate quotas is a mix of two trade barriers with the tariff rate increase, when the imported quantity reaches the pre-determined level. Generally, non-ad valorem tariffs are less transparent and more distorting. The trade tariffs that were recently imposed by the United States to the imports from China are ad valorem tariffs. Consequently, despite the academic literature analyses effects of different forms of tariffs, further study will focus on ad valorem tariffs assessment only.

According to the Ministry of Economy, Trade and Industry of Japan website, there are three primary functions of trade tariffs: to be a source of revenue for Governments, to protect interests of domestic industries, and to correct trade distortions. Historically, the revenue function was the main reason, why countries imposed tariffs. Nowadays, developed economies more frequently use tariffs to fight foreign competition and unfair trading partners' practices. If the opponent decides to retaliate, the tit-for-tat exchange of tariffs can even lead to a trade war as in the case of the US and China. As there is no set definition of a "trade war", economists agree that "trade wars" often refer to "sustained, protracted, and high-intensity international conflicts where states interact, bargain, and retaliate primarily over economic objectives directly related to the traded goods or service sectors of their economics, and where the means used are restrictions on the free flow of goods and services" (Zeng, 2004). Prior to imposing protectionist policies, countries should measure not only the possible benefits it can bring to targeted industries but also the risk for the overall economy if retaliation measures will be taken. In his famous Tweet, President Donald Trump wrote: "Trade wars are good, and easy to win". Time has already shown that this particular trade war with China will not be easy to win for the United States. Nevertheless, this research aims to assess whether it already had the most common macroeconomic (often-negative) effects of trade tariffs found in the academic literature that is explicitly reviewed in the following subsection of the paper.

1.2. Macroeconomic implications of trade tariffs

Many pieces of research about the effects of trade tariffs are microeconomic in nature and focus on individual industries. This makes sense as tariffs have gradually decreased since World War II and later were more commonly targeted to specific industries. What is more, many economists abhor the use of international commercial policy as a macroeconomic tool because of the other feasible tools such as a monetary and fiscal policy that is available. In addition, the broad imposition of tariffs is expected to create many unfavourable effects such as offsetting changes in exchange rates (Furceri et al., 2019). However, some countries have started using commercial policy for attaining macroeconomic objectives again. The recent US-China trade war example is quite extraordinary in magnitude and thus calls for the assessment of the macroeconomic effects. The following section of the paper briefly surveys the existing theoretical literature on the subject and summarizes the main effects on the macroeconomy.

Prices. Amiti et al. (2019) explicitly discussed import tariffs impact on prices (Figure 1). In the absence of tariffs, $S*$ rises with prices because higher prices encourage foreign producers to increase production and, consequently, foreign consumers reduce spending. At the same time, D falls with prices because higher prices reduce domestic demand but increase domestic production. Consequently, markets clear at $p_0 = p_0^*$ when imports equal to m_0. Now, if the ad valorem import tariff τ is imposed, the price of the imported good in the domestic market will rise to $p^*(1 + \tau)$. The higher price will reduce the demand for imports to m_1. At m_1, the collected per-unit tariff ($p_1^*\tau$) equals to a gap between the price paid by domestic consumers p_1 and the price charged by foreign producers p_1^*. Consequently, home consumers will lose regions A + B, and the Government will gain regions A + C as tariff revenue. As the region A will simply reflect the part of the tariff cost domestic consumers will be forced to bear, according to Amiti et al. (2019), the sign of C (gain in terms of trade) – B (deadweight welfare loss) will reveal if the domestic economy actually benefits from the import tariff imposition or no.

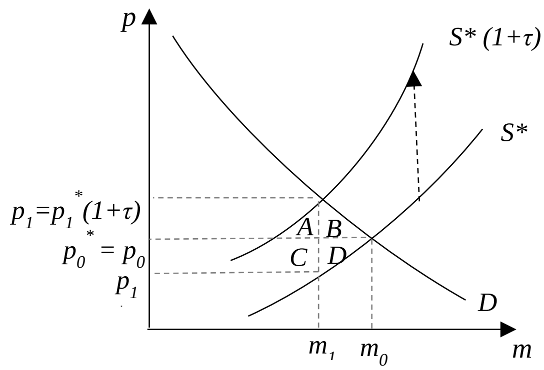

Figure 1. Impact of a tariff on prices (horizontal axis *m* – the quantity of home imports; vertical axis *p* – import prices; *p** - foreign exporter prices; *S** - foreign export supply curve; *D* – home import demand).

Source: compiled by author, according to Amiti et al. (2019).

The other view to the above case would be assuming that imports have a perfectly elastic supply and thus the supply curve of the foreign country exports is horizontal. In such a case, tariff increase would have no effect on foreign prices and it would be fully observed by home consumers. As a result, Amiti et al. (2019) highlighted that in order to understand the short-run welfare implications one has to look at whether after the tariff imposition prices received by foreign exporters increased or remained unchanged. In addition to prices received by foreign exporters, tariffs can affect both firms and consumers through their impact on mark-ups. It is generally agreed, that with more competition and more foreign firms in the market, domestic firms are forced to drop prices and mark-ups. Import tariff imposition threatens to reduce the competition for domestic firms and thus, increase domestic producer prices that will further hurt domestic consumers. If the home economy is big, this reduced demand could even decrease the world prices of such imports (Metzler, 1949). If imports have a perfectly elastic supply and the supply curve of the foreign country exports is horizontal, the tariff increase has no effect on foreign prices and is fully observed by home consumers.

Real income. Amiti et al. (2019) assumed that the reduction in real income due to the tariff imposition is equal to the deadweight welfare cost that is calculated through Figure 1. The region B triangle (deadweight welfare loss) can be measured by either way of the two:

$$\frac{1}{2}p_1^*\tau(m_0 - m_1) = \frac{1}{2}(p_1^*m_1)\tau(m_0 - m_1)/m_1, \tag{1}$$

where $p_1^*\tau$ is the collected per-unit tariff, $(m_0 - m_1)$ is the decrease in imports, $p_1^*m_1$ is the value of imports after the imposition of tariffs, τ is the tariff rate and $(m_0 - m_1)/m_1$ is the percentage change of the imports caused by trade tariffs. If previously it was found that prices received by foreign exporters did not change after import tariffs imposition – tariff revenue collected by the government will be a pure transfer from domestic consumers. In such a case, according to Amiti et al. (2019), if the government would use the proceeds from collected revenues to generate social welfare benefits equal to the tax burden, "the reduction in welfare from the tariff for the economy as a whole is captured by the deadweight loss, while the cost to the consumer and importer equals the sum of the deadweight welfare loss and the tariff revenue transferred to the government".

Deadweight and welfare loss is the allocative economic inefficiency that occurs when equilibrium for a given good or service is not achieved in the given market. It can occur in case of market interference such as taxes, subsidies, tariffs, price ceilings, price floors, and different externalities. In the case of tariffs, deadweight loss is the excess burden generated due to loss of benefit for different trade participants. The loss in welfare occurs due to a shift to less efficient market outcomes as participants are forced to waste or underutilize resources (Evans, 2019). Harberger's triangle created by Arnold Harberger is often used as a tool to measure the deadweight loss that is created by the government intervening in a market.

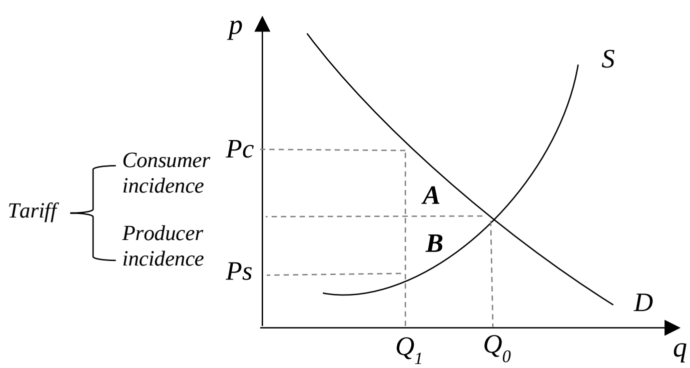

Figure 2. The Harberger's triangle.

Source: compiled by author, according to Evans (2019).

Evans (2019) used Figure 2 to illustrate that the first round of tariffs on 34 billion USD of Chinese imports means that the market equilibrium will shift and consumers will have to pay more for the Chinese goods and the traded quantity will shrink. The shaded triangle is the Harberger's triangle that represents the total welfare loss: loss of welfare to consumers (top triangle) plus loss of welfare to sellers (lower triangle). Otherwise, it is simply equal to $\frac{1}{2}\ (Q^{*} -\ Q_{t})(P_{c} - P_{s})$, where Q^{*} is quantity before tariff, Q_{t} – quantity after the tariff, P_{c} – consumer's price and P_{s} – seller's price. Feldtstein (1999) highlighted that these triangles can negatively affect economic trends and contribute to significant losses in the long-run.

Optimal tariff. There are some arguments suggesting that trade tariff imposition will not necessarily lead to welfare losses. Theoretically, an optimal tariff could result in an increased nation's welfare when the domestic economy is large and has monopsony power in the market, which forces the exporters to reduce their prices to maintain the same export size and allows the importing countries to capture the revenue that the exporters previously received (Irwin, 2014). In such a case, the marginal gain in terms of trade is equal to the marginal loss from the distortion of consumption and production (Krugman and Obstfeld, 2009). Naito (2019) developed a new optimal tariff theory after employing a dynamic Dornbusch-Fischer-Samuelson (DFS) Ricardian model. In this model, the import tariff long-run welfare effects consisted of direct revenue, indirect revenue, and growth effects. The author concluded that the optimal tariff of a domestic country is positive but declining in its absolute advantage parameter. In addition, the larger and more technologically advanced economies have lower optimal tariffs.

Trade balance. The theory does not deliver any strong conclusion of what would be the effect of trade tariff imposition on the trade balance. The most popular approaches to this are reviewed in more detail below. Therefore, it will be even more interesting to analyse this variable in the scope of the US-China trade war as the outstandingly negative the US trade balance with China was one of the main reasons to initiate the trade conflict.

The income-expenditure approach. According to Ostry and Rose (1992), under the income-expenditure approach, a small economy, with fixed prices and exchange rates but the flexible output is assumed. This country produces a good Y at a price P and consumes both domestic and foreign goods. The price of the foreign good (P^*) expressed in domestic currency is equal to eP^* where e is the exchange rate. Then, imports are a function of relative prices $q = EP^* / P$. If M^* denotes foreign imports and *M* denotes domestic imports from the rest of the world, the balance of trade (*BT)* for the country of interest will be equal to:

$$BT = M^{*}(q) - qM(q, Y). \tag{2}$$

As the output is the sum of domestic expenditure *E(Y)* and net exports, it can be then expressed by the equation:

$$Y = E(Y) + BT(q, Y). \tag{3}$$

If ad valorem tariff would be imposed on imports at a rate τ, this would push the domestic relative price of imports up to $q\ (1+\tau)$. If the Government choose not to distribute its tariff revenues, then the new output equation will be:

$$Y = E(Y) + BT(q, \tau, Y) - \tau q M(q(1+\tau), Y). \tag{4}$$

Only if import demand is sufficiently price elastic - output will rise. The tariff will switch expenditure from foreign to domestic goods, which in turn will improve the trade balance. However, it is important to access some of the model's assumptions that are not true in the real world. Here, exchange rates were assumed to be fixed but in reality, they most likely would appreciate and output would remain unchanged (Ostry and Rose, 1992). Also, it was assumed that foreigners do not retaliate against the tariff. If they would, the effects on output, trade balance, and real exchange rate, in general, would be ambiguous.

The monetary approach. An alternative approach is a monetary approach to the balance of payments by Mussa (1974). It assumes that the economy's long-run equilibrium is given by the Heckscher-Ohlin model. In this model, import tariffs for certain products will increase relative prices of domestic goods that used to compete with them. This will further result in increased domestic production and fallen consumption of imported goods. Consequently, under the monetary approach, tariffs reduce the volume of imports. In addition, tariffs also decrease the value of exports as consumers use up part of the goods meant for export and producers start to produce less of exportables. Generally, the main effect of tariffs in such a model is reduced trade but no difference to the trade balance.

The intertemporal approach. Razin and Svensson (1983) considered a small open economy, which produces and consumes two goods every period (fixed world prices and interest rates). In this model, the effects of trade tariffs were determined to depend on whether the tariff is temporary or permanent. Under the temporary tariff, consumers cut spending in the present for increased spending in the future.

Consumption is substituted by lending in the international capital markets and the economy starts to run a trade balance surplus. On the other hand, permanent tariffs will not lead to an intertemporal consumption substitution and thus tariffs will have negligible effects on the trade balance.

Unemployment and real wages. According to a Ricardian model increased import tariffs or closing up to trade lead to a reduction in the domestic price of goods and therefore reduced real wages for workers and higher unemployment. In such a model, labor is the only factor of production. According to the Heckscher-Ohlin model, where labor and capital are the factors of production, import tariff imposition in a capital abundant country increases wages and decreases unemployment. In the case of a labor-abundant country, tariffs reduce wage rates and increase unemployment. Dutt et al. (2008) tested both of the models using data for 92 countries over the period from 1990 to 2000. Under a Ricardian model test, more protectionist countries experienced higher rates of unemployment. The correlation was positive and significant at a 1% significance level. Next, the authors divided the set of countries into labor-abundant and capital-abundant countries and did not find support for the Hecksher-Ohlin proposition. Barbosa et al. (2020) studied 36 member states of the Organisation for Economic Co-operation and Development (OECD) data from 1994 to 2018 and found that higher openness to trade (measured by an average weighted tariff rate) resulted in a higher structural rate of unemployment when controlling for business cycle and labor market structure effects. Specifically, a 1 percentage point increase in an average weighted tariff rate on average resulted in a 0.055 percentage point decrease in the unemployment rate.

Financial markets. Most importantly, trade restrictions have indirect effects on the financial markets. First of all, not even the import tariff imposition but a news announcement about it has immediate effects on the market expectations and the stock prices in the first place. Wang et al. (2020) studied the Chinese stock market reactions to the US-China trade war in 2018-2019 and discovered market-wise negative reactions with even more significant cross-sectional variations. The negative effects were the most significant for non-state firms. Selmi et al. (2020) examined the reactions of sectoral U.S. stock prices to the news of import tariffs and found that some sectors such as industrials, technology information, consumer discretionary, energy, and consumer staples responded more adversely. Authors have also calculated that the marked increase in the short-term systematic risk (via beta) was the most sizeable in these sectors. For instance, the beta before and after the announcement of the China tariffs changed from 0.16 to 0.33 and from 0.17 to 0.72 in consumer staples and technology sectors, respectively. The market expectations reverberate through the financial markets by influencing the expected returns on different asset classes, high-yield spreads, and long-term interest rates. Ozdagli (2019) concluded that the news about US-China trade war that moved the VIX index by one unit (increase annualized implied volatility by 1%) increased high-yield spreads and flattened the yield curve (mostly due to a reduction in the 10-year Treasury note interest rate). Trade tariff imposition potentially creates uncertainty among investors whether companies will be able to export and import goods and how their cost structure will be affected. This uncertainty in turn inhibits the information efficiency of stock prices. Contrary to that, Baig et al. (2020) argued that the liberalization of trade promotes efficient financial markets. They found that free trade is inversely related to Hou and Moskowitz price delays and Hasbrouck pricing errors.

The trade tariffs can have indirect impact on the financial markets through their effects on different macroeconomic indicators. Antonakakis et al. (2018) used a time-varying approach to analyse the dynamic correlations between stock market returns and the trade balance in the United States. Based on the period of 1792 to 2013 data, they found that the correlations are statistically significant (positive between 1800 and 1870 but significantly negative later). The negative correlation in recent years was partially explained by the trade balance being an inflationary measure that invokes the monetary authority to increase interest rates which in turn negatively affects the stock returns. However, it is very important to take into account country specifics and underlying reasons for changes in the trade balance. Talking specifically about the US-China trade war, Huang et al. (2018) emphasized that given a trade tariff shock, results could drastically differ depending on the extent of industries' participation in the bilateral trade. For example, industries that have higher imports from or exports to China might experience relatively lower stock returns, weaker bond performance, and higher default risks due to the increased bilateral trade tariffs. Berthou et al. (2018) also concluded that companies facing higher uncertainty around changes in trade policies find it more costly to fund new investments – borrowing risk premium for such firms increase by 50-100 basis points.

Researchers found that the effects of tariffs significantly depend on many additional economic factors that should be taken into account by governing bodies prior to inflicting protectionist trade policies. For example, Reitz and Slopek (2005) found that the level to which trade tariffs will affect the domestic and foreign economies depends on the expected duration of the tariff shock, elasticity values, degree of capital mobility, and the behaviour of real wages and exchange rates. What is more, in their study, Furceri et al. (2019) demonstrated that advanced economies that choose to impose import tariffs, face more extreme decreases in domestic output and labour productivity when compared to emerging markets and developing economies. In addition, the research paper suggested that the degree of the effect that tariffs imposition will have on the domestic economy depends a lot on the stage of the business cycle. Furceri et al. (2019) found that when tariffs increase by a standard deviation, the medium-term losses in output and labour productivity are more sizeable when the economy is in an upturn rather than in a recession. One of the plausible explanations for this lays in the effects that tariffs have on inflation and the role of monetary policies. Trade tariffs tend to boost inflation during expansions; monetary policies are tightened in response, which further magnifies the negative impact of tariffs. As the United States is an advanced economy, which currently is in the late expansionary state of the business cycle (according to Fidelity Investment Fund Business Cycle update, issue of September 2019) - it might experience more severe negative economic effects from the trade war with China than in other circumstances. Eichengreen (2020) studied why the impact of the US-China trade war has not been greater on the world GDP until this moment. The author drew three possible explanations. First of all, import tariff effects on relative prices might have been offset by changes in the exchange rate. If the domestic supply for goods is inelastic, the appreciated exchange rate left relative prices unchanged. Secondly, macroeconomic effects of the trade tariffs might have been offset, in total or in part, by changes in fiscal and monetary policies. For example, trade restrictions in the United States were followed by the Tax Cuts and Jobs Act of December 2017 while China reduced income and value-added taxes as well as pension contribution rates in 2018 and 2019. Assuming that the tax cuts translated into additional business investments in the U.S. and the increased after-tax income resulted in more expenditures rather than savings in China – the negative macroeconomic effects have only been delayed. According to Eichengreen (2020), one more explanation why the modest negative effects of the trade war might have been delayed is that companies anticipated supply distortions and took on an initiative to build inventories in advance.

To sum up, the main variables that appeared to be affected by the import tariffs imposition within the academic literature were prices received by foreign exporters, domestic producer prices, deadweight and welfare loss, real income, trade balance, unemployment and real wages. What is more, new trade restrictions seem to have immediate indirect effects on the financial markets through the news announcements. Also, industries affected by the tariffs experience relatively lower stock returns, weaker bond performance, and higher default risks. The further section also looks into the actual empirical evidence from different models, which will allow to make a decision, which variables should be analysed in this research paper.

1.3. Empirical evidence

After analysing the relevant academic literature, it can be concluded that researchers tend to use two main types of analysis when assessing the economic effects of trade tariffs: partial or general equilibrium models that usually focus on different trade war scenarios to project future economic variables and regression analysis that is central to the actual economic data to assess correlations. A further section of the thesis reviews the main methods and hypotheses that are employed and empirical results of these studies. Lastly, the actual economic effects of the Smoot-Hawley Act that was passed in 1930 are studied to draw comparisons to the recent US-China trade war case.

1.3.1. Partial and general equilibrium models

Li et al. (2019) suggested that the general equilibrium simulation model[1] is the standard tool to use when measuring the economic effects of trade barriers. For instance, Kawasaki (2018) used a Computable General Equilibrium (CGE) model of global trade to identify the economic impact of the US import tariffs on steel and aluminium. The CGE model was built in the Global Trade Analysis Project (GTAP) database using a static version of the GTAP model[2] benchmarked to 2014. The research assumed a 25% tariff hike on all metal imports rather than actual tariffs and found that such trade barriers would decrease metal imports in the US by 45.9%, improve the US metal trade balance by 59.4 billion USD and the US metal production would increase by 9%. Nevertheless, sectors using metals as intermediate goods would be significantly hurt: US exports of automobiles, electronics, and other machines would drop by 3.4%, 5.1%, and 5.8%, respectively. Consequently, the overall improvement of the trade balance would be relatively small (only 1.3 billion USD). In addition, the US total production and real GDP was estimated to drop by 0.2% each. Such simulation confirms the

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[1] According to Shoven and Whalley (1992), the general equilibrium model of an economy includes markets for each of *N* commodities and consistent optimization occurs as part of the equilibrium. Demand-side of the model consists of consumers that maximize their utility under a constrained budget and the supply-side of the model consists of producers aiming to maximize their profits. In equilibrium, demand will be equal to supply for all commodities and in the “constant returns to scale case zero-profit conditions are satisfied for each industry”. To conclude, the general equilibrium theory explains the functioning of the macro economy as a whole instead of a collection of separate markets.

[2] According to the GTAP website: “the standard GTAP Model is a multi-region, multi-sector, computable general equilibrium model, with perfect competition and constant returns to scale. Since its inception in 1993, GTAP has rapidly become a common “language” for many of those conducting global economic analysis”.

theoretical view that despite the fact that import tariffs can help to protect targeted sectors, trade barriers often hurt the economy at the macro level.

Itakura (2019) analysed the effects of the recent trade war and built a dynamic computable general equilibrium (CGE) model using GTAP database version 9 benchmarked to the year 2011 as a baseline. In addition, the author designed three additional scenarios for the time span from 2011 to 2035. Under Scenario 1, the US, China, India, Canada, and Mexico raised import tariffs in 2018 and 2019 and these increased tariffs were held constant throughout the simulation period until 2035. Under Scenario 2, the trade war was assumed to increase economic uncertainty and decrease foreign direct investment by 19.6%. In addition to the two above scenarios, scenario 3 also included decreased productivity in connection with trade openness reduction. Itakura (2019) used a GEMPACK modelling software to implement and compare the baseline scenario to three trade war scenarios and interpret results. The trade war was found to reduce almost all sectoral imports from the United States and China. Protected by the trade barrier, the US was able to increase its production of machinery and electric equipment. However, this increase in domestic production disappeared under scenarios 2 and 3. Generally, real GDP in the US decreased by 317 billion USD (1.35%) and in China by 427 billion USD (1.41%). Despite some of the trades were relocated, world real GDP still fell by 374 billion USD (0.3%). In addition, the trade deficit in the United States was significantly reduced and the trade surplus was increased in China over the short-run. Nevertheless, over the simulation period (long-run) the trade war worsened the US trade deficit and China's trade surplus.

Bollen and Rojas-Romagosa (2018) estimated the global and national economic effects of four different trade war scenarios using a Computational General Equilibrium model of the world economy WorldScan[3] developed by the Netherlands Bureau for Economic Policy Analysis. The time span of the model was from 2011 to 2030. It included 29 goods and services sectors and 30 countries and regions. The United States, China, the EU, the Netherlands, Canada, Mexico and Japan were modelled separately. As for the sectoral aggregation, it succeeded in reflecting some of the main goods that were targeted by the US import tariff increases such as steel and aluminium. To start with, authors adopted tariff rates that were originally applied to individual products since they were modelling at

[3] WorldScan is a global trade CGE model, which provides detailed outcome results on global, regional and national macroeconomic changes such as GDP, sectoral production and employment, consumption for a wide scope of countries and sectors. Such a model allows assessing the effects of tariff increases between bilateral partners. Also, it allows assessing the general equilibrium effects to other countries' economies that are affected indirectly. Worldscan model is part of GTAP-class CGE models (Bollen and Rojas-Romagosa, 2018).

an aggregated sectoral level. They calculated sectoral trade-weighted average tariff by combining information about the announced import tariff on a good with the share of imports of the targeted products in the total imports of that sector. Later, authors built four trade war scenarios: the US unilateral steel and aluminium tariffs; Scenario 1 plus retaliation over these tariffs; Scenario 2 plus US-China trade war and Scenario 3 plus the US 25% tariffs on motor vehicles from EU. In general, authors studied effects on five major macroeconomic indicators: real GDP, export volume, import volume, terms-of-trade and real average wage. They found that the US import tariffs on steel and aluminium and retaliation to it had only minor negative effects on the US and its trading partners (mainly) electronic equipment, other machine equipment and agriculture sectors. Under the full-scale US-China trade war scenario, WorldScan simulations suggested that China would experience a 1.2% GDP loss while the US would experience only a 0.3% loss. This asymmetric result was explained by the more significant export value losses on the China side. Lastly, authors performed sensitivity analysis to assess how different parameters and specification in the CGE model (average trade elasticities, perfect/imperfect competition and endogenous/exogenous labour markets) affected the results.

Rosyadi and Widodo (2018) also used a Computable General Equilibrium model to simulate two trade war between the US and China scenarios. Under Scenario 1, the United States imposed a 45% import tariff on all commodities from China and China retaliated. Under Scenario 2, the United States imposed a 45% import tariff on manufacturing commodities from China and China retaliated. Under Scenario 1, the US and China's GDP dropped by 1.22% and 5.4%, respectively, while under Scenario 2, by 0.98% and 4.3%, respectively. The authors presented a new variable for measuring changes in welfare – equivalent variation. Under both scenarios, these two countries faced significant welfare losses but that of the US was somewhat greater. Contrary to Donald Trump's aim of increasing US employment, this model predicted less than 1% change in both skilled and unskilled labor.

Moving further, Macera and Divino (2015) studied the case of Brazil that from 2010 to 2013 imposed high import tariffs on more than 100 products. Authors used a small open economy version of a dynamic stochastic general equilibrium (DSGE) model that included import tariffs and incomplete pass-through. Results suggested that 20% of import tariff shock increased the domestic price of the imported goods by 15% indicating incomplete pass-through from import tariffs to domestic prices. In addition, the authors found a 0.5% increase in overall consumer price inflation. Interestingly, after the shock, these variables took about five quarters to converge to the steady-state equilibrium. Macera and Divino (2015) concluded that such protectionism form as import tariffs has a high social cost because it affects inflation and economic activity, which might further affect public policies associated with income distribution.

Chang et al. (2020) compiled actual China's exports, imports, and duty rates monthly data from January 2018 to December 2019 and simulated the trade war effects for the Chinese economy using a general equilibrium model. This model took into account regional heterogeneity in employment, input-output linkages, and sector specialization. The authors concluded a 17.093 billion USD (0.141% of China's GDP) decrease in economic welfare for Chinese producers and exporters. This finding indicates that the diversion of demand away from Chinese products dominated the potential reallocation towards products from China. A 1.3% decrease in the export price index and the welfare losses would have been lower if China would have not lowered its non-US MFN import tariffs. On the other hand, the decline in the export prices would have been even more severe if China did not retaliate against the US. In addition, results showed that Chinese buyers of imports lost an aggregate of 8.132 billion USD (0.067% of GDP) in economic welfare. Also, Chinese tariff revenues increased by 3.589 billion USD (0.030% of GDP). Lastly, due to the tariff war, the share imports from the US dropped from 9.09% to 8.16%. At the same time, the share of exports to the US decreased from 19.21% to 18.11%. The main destination countries for the diverted trades were in Europe (as sources of imports) and Asia (as markets for exports). All of the above, imply substantial negative consequences for the Chinese producers and consumers.

The recent article by Tu et al. (2020) suggested that Single Market Partial Equilibrium Simulation Tool (SMART) developed by the World Bank has a lot of advantages when comparing to regular GE models. This is true because the SMART model requires minimal data and is capable of analysing the macroeconomic effects on disaggregated product lines whereas a GE model divides an economy into a limited number of broader sectors (the last version of GTAP software has 57 sectors). Consequently, the GE model's results could have an aggregation bias. Contrary to that, the SMART model offers precision which is essential when identifying particular trade policy scenarios and trade war impact on an ex-ante basis. In addition, most GE analyses are based on hypothetical scenarios and their effects on broad sectors rather than actual tariff rates and lists of products. Consequently, Tu et al. (2020) choose to run SMART simulation. They suggested that the US-China tariff war should result in US imports from China and China's imports from US reduction by 91,459 and 36,706 million USD, respectively. Also, these tariff measures could generate welfare losses of 1,437 million USD in the US and 2.193 million USD in China. In addition, a total of 36,783 million USD US imports and

17,207 million USD of Chinese imports could be diverted from China or the US respectively to other countries.

Archana (2020) also employed the partial equilibrium SMART model but studied two hypothetical scenarios: one where China and the United States completely reduce all their import tariffs to zero and one where China and the U.S. impose a 25% tariff on their major import items. The model simulations were performed on the 2018 trade data from the United Nations COMTRADE database. Under the first scenario, the total trade (trade creation versus trade diversion) would increase by 35.57 and 34.76 billion USD in the US and China, respectively. In addition, the gains in welfare would amount to 1.85 billion USD and 2.86 billion USD, respectively. Under the second scenario, the losses in total trade for the US and China would amount to 236.23 and 49.72 billion USD while the welfare losses would equal to 13.10 and 2.66 billion USD, respectively. The research results indicate the counter-productiveness of the trade war for the United States in terms of economic welfare.

1.3.2. Regression models

In their study, Furceri et al. (2019) used the local projection method (LPM) to estimate impulse-response functions on the 151 countries dataset from 1963 to 2014. They focused on domestic consequences only and use a time horizon of up to 5 years. The baseline regression was

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \gamma_t + \beta \Delta T_{i,t} + v X_{i,t} + \varepsilon_{i,t}, \tag{5}$$

where $y_{i,t+k}$ is the dependent variable of interest (log of output, Gini coefficient, unemployment rate, productivity, log real exchange rate or trade balance in percent of GDP) for country i at time $t+k$; α_i – country fixed effects that control for unobserved cross-country heterogeneity; γ_t – time fixed effects that control for global shocks; $\Delta T_{i,t}$ – change in the tariff; v – vector for nuisance coefficients and $X_{i,t}$ – vector of control variables, including two lags of each (the tariff, log output, changes in the dependent variable, log of real exchange rates and trade balance to GDP). The selection of variables of interest was meant to reflect the four most important indicators of the healthy real macroeconomy according to the authors: GDP, unemployment, productivity, and inequality. Tariff rate (T) was based on the data at the product level that was later aggregated by calculating weighted averages based on weights given by the import share of each product. The research results suggested that one standard deviation increase in import tariffs led to a significant 0.4% decrease in output five years later and this mainly happened due to a 0.9% decrease in labour productivity. In addition, tariff increases led to more inequality (becoming significant after 2 years) but had a statistically marginal effect on increased unemployment. In addition, authors found that increased tariffs led to an appreciation of the real exchange rate in the short term but had a small and statistically insignificant effect on the trade balance.

Ostry and Rose (1992) prepared another research of high interest for this thesis. They estimated vector autoregressions (VARs) that modelled four aggregate variables: domestic real output, foreign real output, the real balance of trade, and the real exchange rate as functions of lags of the endogenous variables. Authors aimed to discover a stable relationship between tariffs and the macroeconomy rather than to build a structural model that reflects the transmission mechanism. “Tariff revenues divided by the value of dutiable imports and tariff revenues divided by the sum of both dutiable and non-dutiable imports” were used as measures of tariff rate. The main VAR equation employed was the following:

$$\Delta x_t = \alpha + \beta(L)\Delta x_{t-1} + \delta u_{t-1} + \varphi(L)\Delta\tau_{jt} + \varepsilon_t, \tag{6}$$

where L is the lag operator; Δ is the difference operator (1 – L); $x_t = (BT, q, y, y^*)$ with BT as one of the two measures of the real bilateral trade balance, q as the log of the real bilateral exchange rate, y as the log of the US (domestic) production index and y^* as the log of the foreign industrial production index; τ_j is the log of the jth measure if the bilateral tariff rate. 24 monthly lags were included in the basic VAR results. Ostry and Rose (1992) concluded that they were unable to track statistically significant effects of the tariff rate on bilateral trade flows, output, and the real exchange rate. Nevertheless, tariffs appeared to have a statistically discernible impact on the volume of international trade. Also, they raised the idea that the most important effects of trade tariffs are not macroeconomic but distributional in nature.

Amiti et al. (2019) took the US customs data until October 2019 and the applicable duty rates to calculate tariff-inclusive import prices that were then inserted into the regression. They used an event-study specification to measure the effects of trade tariffs on the U.S. import values and prices at the source country (i), HS10 product (j), month (t) level. The log import values (lnx_{ijt}) were regressed on interactions between treatment month indicator (II_{ijs}) and log change in tariffs according to the equation:

$$\ln x_{ijt} = \eta_{ij} + \sum_{s=-\underline{T}}^{\overline{T}} \beta_s \left(\mathbb{I}_{ijs} \times \ln\left(\frac{1+\tau_{ijs}}{1+\tau_{ij0}}\right)\right) + \delta_{jt} + \mu_{it} + u_{ijt}, \tag{7}$$

where μ_{it} were the country-time fixed effects, δ_{jt} were the HS10-time fixed effects and η_{ij} were the country-product fixed effects. The specification had a "difference-in-differences" interpretation, where "the first difference is between treated and untreated product-countries, and the second difference is before and after the tariffs are applied." The theory suggests that trade tariffs imposed by a large economy such as the United States should cause foreign firms to lower their prices. Surprisingly, the empirical results suggested that approximately 100% of the import taxes passed on to the United States and not China's importers and consumers. What is more, between 2017 and 2019 the U.S. import price index for all imported goods from China fell by 1.4% - a substantially lower amount than would be expected given the 25% tariffs on Chinese goods. Despite the negligible effects on foreign export prices, the import tariffs had a significant impact on the United States import volumes. Interestingly, researchers concluded that it took on average a year for companies to reorganize their supply chains so that the import tariffs be avoided.

All things considered, partial and general equilibrium models were found to be used more widely when solving complex trade policy issues than econometric regression models. The SMART model seems to be the most appealing to this thesis. Academic studies suggested that trade tariffs imposition tend to reduce both domestic and foreign real GDP and total production, reduce labour productivity and welfare, increase unemployment, domestic prices and trade diversion, appreciate real exchange rate, and significantly affect the trade balance.

1.3.3. A case study of the Smoot-Hawley Act

A chairman of the Senate Finance Committee Reed Smoot and a representative of the House Ways and Means Committee Willis C. Hawley who sponsored the Tariff Act of 1930 gave a name to the tariff bill, which significantly increased US tariffs on more than 20,000 imported goods on June 18, 1930 - the eve of Great Depression. At the time, the bill was the subject for heated debate, 1,028 economists petitioned Congress not to sign the new legislation. Nevertheless, the Smoot-Hawley act was passed, raising import tariffs on agricultural products and manufactured goods (that were already relatively high after the Fordney-McCumber Act, imposed in 1922) by an additional 20%. Tariffs were imposed in reaction to the harsh economic distress faced by the United States agricultural sectors and were aimed to defend domestic producers and domestic wages from foreign competition by demanding foreign producers to pay for the right to access the American market (Irwin, 1998). The Smooth-Hawley tariff has been popularly blamed for turning a modest recession into the Great Depression. The volume of the US imports dropped by 41.2% (almost the same amount as exports), real GNP declined by 29.8% from the second quarter of 1930 to the third quarter of 1932 and global trade totally plummeted by 65% after a worldwide wave of retaliatory measures (Irwin, 1996).

However, after analysing several studies that try to determine the degree to which the Smoot-Hawley act contributed to the US trade and economy decline in 1930 and consecutive years, it becomes evident that the actual effect of the tariff act might have been not that modest. On average, import duties increased by about 20%, turning into a 5% to 6% increase in import prices. Using partial and general equilibrium assessments, Irwin (1996) found that the tariff itself reduced imports only by 4% to 8% in the two years after the Smoot-Hawley act imposition (ceteris paribus). The main impact of the act comes from the combined effect of the type of enforced tariffs - specific duties (a dollar amount per imported quantity) - and price deflation of early 1930, which drove the effective tariff rate to increase by an additional 30%. Feldstein (1994) expanded on the topic, highlighting that the real burden of the Smooth-Hawley tariff significantly increased in the period from 1930 to 1932 when both import and domestic prices plummeted. This happened because tariffs were specific rather than ad valorem (percentage of import value). Thus, it was concluded that the rise in the tariff that was induced by deflation far exceeded that one induced by the new legislation (a significant increase in the effective tariff rate would have happened even if the Smoot-Hawley had never come into force). Lastly, Irwin (1996) used a general equilibrium model to estimate that the tariff bill contributed to 60-430 million USD (in 1929 dollars) welfare losses, which accounts only for 0.1-0.4% of GNP. Consequently, efficiency losses caused by the Smoot-Hawley act were small when compared to output losses typically generated by business cycle fluctuations.

To conclude, the Smoot-Hawley tariff definitely had many negative economic consequences for the US but they were not that significant in the light of already poor health of the economy. This case illustrates how dangerous trade protectionism can be to the United States' own as well as the global economy. Nevertheless, exports comprised only about 5% of the gross domestic product back in 1930. According to the economic data from the Federal Reserve Bank of St. Louis (FRED), exports of goods and services accounted for 12.2% of GDP in 2018. Therefore, increased trade protectionism that was advocated by President Donald Trump could have effects that are even more devastating in modern times.

2. ANALYSIS OF THE US-CHINA TRADE WAR SITUATION

The following chapter of the thesis focuses on analysing the situation around the US-China trade war that has evolved from 2017 when the US first started investigations of China's potentially unlawful market practices. First of all, the reasons why the United States initiated this trade war are analysed. Then, the main events and tit-for-tat tariff exchange between the two countries are reviewed including the latest Phase 1 deal. It happened so that this extraordinary trade war is taking place during the global COVID-19 pandemic that has even more significant effects on economies. This calls for the assessment of potential COVID-19 economic effects that is also included into this section.

2.1. Analysis of the Trump administration's trade war

During his campaign rally in 2016, Donald Trump accused China of the greatest theft in the world and promised to fight unfair trading partners' practices if he was elected. After Donald Trump took the office, Section 232 of the Trade Expansion Act of 1962 investigations were launched in June 2017 that concluded that the imported steel and aluminium "were threatening to impair the national security" and recommended to "take action to protect a long-term viability of the nation's steel and aluminium industries" (Presidential Memorandum, 2018). It was also found that China pressured technology transfer from the United States companies to Chinese entities, weakened global competitiveness of American firms, used the computer networks of the US companies to get an unauthorized access to "intellectual property, trade secrets, or confidential business information, including technical data, negotiating positions, and sensitive and proprietary internal business communications". The method selected to fight unfair trading partners' practices – import tariffs – breached global trading rules and put the idea of free trade on a test. The import tariffs on all steel and aluminium imports amounting to nearly 18 billion USD were implemented in March 2018. The first China-specific tariffs were imposed after the Section 301 of the Trade Expansion Act of 1974 investigation on July 6, 2018.

In addition to China's treats for the United States national security and intellectual property rights, President Trump highlighted the outstanding trade balance figures between the two countries. Another rationale for the protectionist US trade policy was an aim to reduce the trade deficit that has dramatically increased over the recent years as evident from Figure 3.

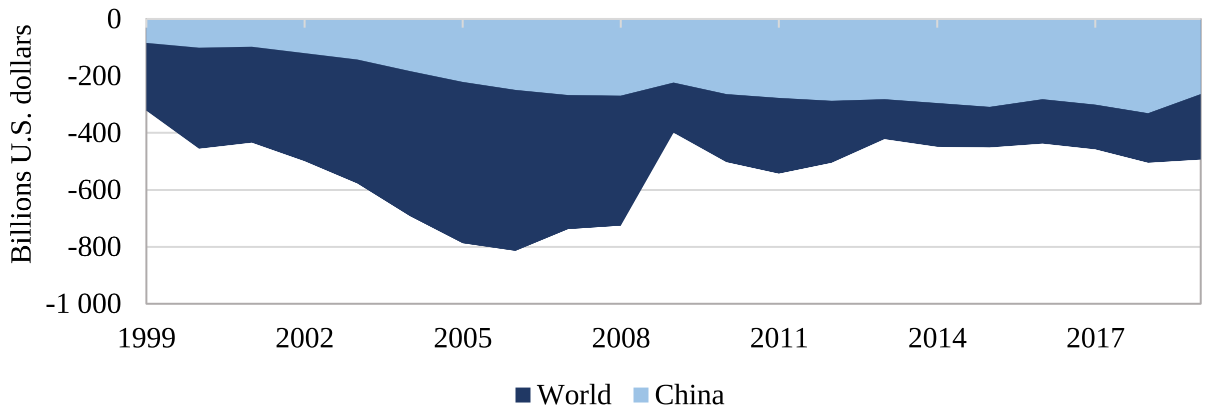

Figure 3. Real trade balance of the US with the world and China.

Source: compiled by the author, based on the data of the US Bureau of Economic Analysis and International Monetary Fund.

Not only the downward trend of the trade balance with China seems to worry the US officials but also the changing nature of imports from this country. In the 1990s, nearly all imported goods were low-value, labour-intensive products such as textiles and apparel, footwear, consumer electronics, etc. However, according to the US Census Bureau, advanced technology products accounted for 33.8% of total merchandise imports from China in 2017. The biggest part of imported ATP consisting of information and communication products. This trend looks concerning as it indicates the advancing international competitiveness of China in high technology (Ibrahim and Benjamin, 2019).

Overall, the economists see the current trade deficit (Figure 1) as a weak argument for the US to start a trade war. The study prepared by Oxford Economics (2017) to the US-China Business Council demonstrated that the negative aspects of trade with China were overstated. First of all, despite huge efforts to move up the value-added chain, China still uses roughly 50% of the intermediate goods in computer equipment, electronics, and electrical machinery assembly imported from foreign countries. Consequently, the US trade deficit with China adjusted for the value-added content is twice lower. Also, despite the trade deficit in goods, the US actually experiences a significant and growing trade surplus in services. The intention to get Beijing to widely open its market for American goods and services to provide American companies with more favourable conditions and curb the Chinese high-tech sectors that are backed by the state via the "Made in China 2025" strategy is seen as a more realistic rationale to start the trade war (Ibrahim and Benjamin, 2019).

After reviewing the possible reasons why the United States got involved in a trade war, the following part of the chapter focuses on the actual tariffs that were imposed, whether and how trading partners retaliated and what the outlook for the future is. To start with, Table 1 summarizes the import tariffs imposed by the US on the whole world under the Section 232 of the Trade Expansion Act of 1962 (exceptions for the steel import tariffs include Argentina, Australia, Brazil and Korea, exceptions for the aluminium import tariffs – Argentina and Australia (Kawasaki, 2018)) and China-specific tariffs imposed under the Section 301 of the Trade Expansion Act of 1974.

Table 1

The U.S. import tariffs imposed under Sections 232 and 301

Investigation	Effective date	Imposed tariffs
Section 232	March 23, 2018	Tariffs on all imports of steel (25%) and aluminium (10%).
Section 301	July 6, 2018	25% tariffs on 34 billion USD of Chinese goods. List 1.
	August 8, 2018	25% tariffs on 16 billion USD of Chinese goods. List 2.
	September 18, 2018	10% tariffs on 200 billion USD of Chinese goods. List 3.
	May 13, 2019	Tariffs increased to 25% for List 3 (200 billion USD worth of products).
Section 301	September 1, 2019	Part of the remaining goods get 15% tariff. List 4A starts (112 billion USD worth of products).
	December 15, 2019*	15% tariffs on the remaining List 4B goods (*suspended indefinitely).
	February 14, 2020	Tariff rate was reduced from 15% to 7.5% for List 4A goods.

Source: compiled by the author, data retrieved from Li, M. (2018) CARD Trade War Tariffs Database. Accessed on 25th of April, 2020.

The Chinese products that were targeted first belong to such strategic sectors as machinery, mechanical appliances, electrical equipment, information technology, robotics, high-technology medicine, and health care. Later, import tariffs were also targeted to intermediate outputs and consumer goods. China responded with kind of tit-for-tat retaliation, targeting not necessarily the same (but also strategic) industries and products and smaller amounts of total imports from the US. The complete lists of Chinese goods targeted by US tariffs and China's retaliation measures are provided at a disaggregated HS product codes levels in from Li, M. (2018) CARD Trade War Tariffs Database.

Both the countries have already experienced the increasingly negative effects of the trade war that particularly hit the farmers - a very important political constituency for President Trump. For that reason, a subsidy program was created under which the farmers received 8.5 and 14.3 billion USD for 2018 and 2019, respectively. No trade-related subsidies were paid out for 2020. In the context of the forthcoming U.S. presidential election campaign, the pressure for the President to reach a consensus with China increased, and the negotiations to start phasing out the import tariffs started. On January 15, 2020, the US and China signed Phase 1 deal that cut the US tariffs for List 4A[4] goods by half in exchange for China's pledge to increase the purchases of American products and services by at least 200 billion USD over the next two years. The tariffs on List 4B[5] that were scheduled to come into effect on December 15, 2019, were suspended indefinitely as well as China's retaliatory actions to them.

The main features of the trade war make it a great natural experiment for measuring the economic effects of tariffs. First of all, an increase in import tariffs was highly unanticipated, as most observers believed that Hillary Clinton, with a supposedly different approach to the trade policy, would win the election. In addition, import tariffs extensively vary across products and time. This specific feature simplifies the measurement of import tariff economic effects using conventional datasets (Amiti et al., 2019).

2.2. Assessment of the potential COVID-19 economic impact

COVID-19 economic effects cannot be overlooked when talking about the trade war and calls for the additional assessment. Compared to the "regular" recessions, the recent downturn is extraordinary in a way that it originated not from the financial markets. COVID-19 effects are felt far beyond the health sector. The quarantines and lockdowns were enforced around the globe aiming to stop this novel virus from spreading further. These measures froze the economies with unprecedented force and speed. Recently, a large set of papers was published trying to capture the macroeconomic issues surrounding the COVID-19 pandemic. McKibbin and Fernando (2020) used a hybrid global intertemporal general equilibrium model with heterogeneous agents and found that even a low-end pandemic would reduce global real GDP by around 2.4 trillion USD and a more serious outbreak

[4] List 4A consists of 3,230 Harmonized Tariff Schedule of the US (HTSUS) subheadings, mainly iron and steel products, consumer electronics, motor vehicle products, telecommunications equipment, beverages, chemicals, clothing, and footwear.

[5] List 4B consists of 540 HTSUS subheadings, mainly clothing, toys, chemicals, cell phones, laptop computers, small appliances, watches, and sports equipment.

would reduce global real GDP by over 9 trillion USD in 2020. Dynamic results (percentage deviation from baseline) for the United States suggested that the real GDP would shrink by 0.1% to 8.4%, investment would decrease by 0.5% to 17%, consumption – by 0.2% to 11% and trade balance as a proportion of GDP might change by -0.9% to 0.75% in 2020 depending on the severity of the COVID-19 outbreak. Ludvigson et al. (2020) attempted to quantify the dynamic impact of costly and deadly disasters over the sample of 1980-2019 in the United States using VAR. Authors found that the macroeconomic impact of COVID-19 will be larger than any catastrophic event in the past four decades. Even under a rather optimistic scenario without nonlinearities, multi-period shock could result in a 12.75% drop in industrial production and a 17% increase in service sector unemployment.

The COVID-19 effects on the international trade are of the biggest interest for this paper. Generally speaking, international trade is one of the leading mechanisms through which the virus damages domestic economies. The international trade flows are very sensitive to demand shocks (falls in purchases) and supply shocks (falls in production). According to Baldwin and Weder di Mauro (2020), the COVID-19 implications on the international trade flows are clear. The supply shocks – factory closures, border closings, travel bans – will reduce exports. In addition, COVID-19 is a demand shock and thus the imports will fall. Boone (2020) suggested that under the best-case scenario (where the epidemic is contained in China with limited clusters elsewhere) global trade will shrink by 0.9% in 2020, while under the downside scenario it could decline by around 3.75% in 2020, by hitting exports in all economies. According to Baldwin and Tomiura (2020), it is noteworthy to rely on the historical lessons from global trade shocks when trying to estimate the impact of the COVID-19 pandemic (Figure 4).

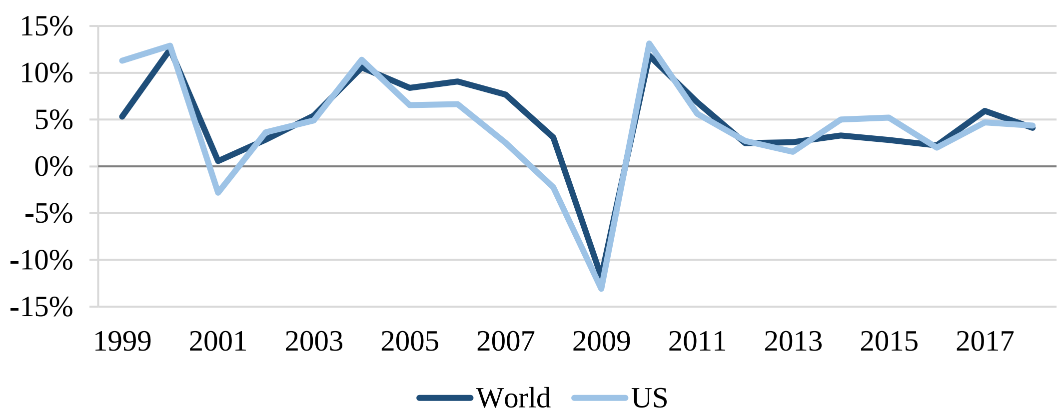

Figure 4. Imports of goods and services (annual percentage growth).
Source: compiled by the author, data retrieved from the Worldbank database.

According to the Wolrdbank database, at the time of the dotcom bubble in 2001, world imports maintained slight growth of 0.58% while US imports fell by 2.8%. Meanwhile, during the financial crisis of 2009 global imports fell by 11.79% and the imports in the US dropped by 13.08%. During the global crisis of 2009, the hit on the global trade was by far the biggest in the recorded history. Baldwin and Tomiura (March, 2020) pointed out that it is unlikely that global trade would be hit so severely this time. However, their article was published in March 2020 when the COVID-19 clusters outside of Asia were still negligible and there was still some hope that the pandemic could be maintained within Asia. Consequently, given the current situation bigger than 10% drop in the US imports during 2020 is not that highly unlikely. Based on those conclusions, the author assumed that global trade during 2020 might shrink from 5% to 15%.

3. METHODOLOGY FOR RESEARCHING MACROECONOMIC EFFECTS OF THE US-CHINA TRADE WAR

The theoretical justification part provided a sufficient basis to build on the research methodology and ultimately reach the main objective of the thesis – perform empirical research to identify whether and how import tariffs imposed in the recent US-China trade war will affect the United States economy. The Research methodology section specifies the main objectives and hypotheses of the empirical research. Further, research methods including the modelling strategy and analysed scenarios are described in detail. Then, the main variables are selected and the dataset for the input into economic models is constructed. Lastly, specific steps on how the research was performed are explained as well as the measures that were taken to evaluate results and their credibility.

3.1. The modelling strategy and dataset construction

As discussed in the Theoretical analysis section there are two main ways how the effects of trade tariffs on the selected macroeconomic variables can be assessed empirically – with either equilibrium or regression models. A more widely employed method is to conduct simulations using different general and partial equilibrium models. According to Rosyadi and Widodo (2018), the main advantage of such models is that they provide an economy-wide examination of trade policy. In addition, equilibrium models are found to provide more theoretically sound results in comparison to econometric estimations as these models are also linked to economic theory rather than dependant on the economic data only. Partial equilibrium models are vulnerable to criticism that they are not able to capture the economy-wide effects of trade policy changes (James and Olareagga, 2005). General equilibrium models are more satisfactory in that sense. They are able to take into account second-round effects such as exchange rate and inter-industry effects. Also, in a general equilibrium setup, all markets are modelled simultaneously and interact. On the other hand, general equilibrium models are significantly dependent on extensive underlying assumptions and their results are very sensitive to changes in these assumptions. What is even more important, general equilibrium models work with large inter-industry aggregates and thus are not able to capture intra-industry details. Contrary to that, the partial equilibrium models have the advantage of working at a very fine level of detail and thus avoiding this aggregation bias. These models are extremely useful when working with trade policy changes that are applied to different product classes within the industry and vary between different trading partners. To conclude, the advantages and disadvantages of equilibrium models are presented in Table 2.

Table 2

Advantages and disadvantages of equilibrium models

Advantages	**Disadvantages**
Partial equilibrium models	
1. Analysis at disaggregated product line data allows avoiding aggregation biases.	1. Analysis is performed on a limited number of economic variables.
2. Minimal data requirement (trade flows, tariff rates, elasticities).	2. Results are very sensitive to values of elasticities that are set.
3. Modelling is straightforward and transparent, results can be easily explained.	3. Due to the simplistic approach, important inter-sectoral input/output (upstream/ downstream) linkages might be missed.
General equilibrium models	
1. Model captures economic interactions between markets and second-round effects.	1. Divides an economy into limited number of broad sectors (model results could suffer from aggregation bias).
2. Broad selection of economic variables that can be analysed.	2. Results are significantly dependent on underlying assumptions.
	3. Modelling is sophisticated and requires many economic variables as an input.

Source: compiled by the author, according to WITS.

Tariff rates on imports that were introduced between the United States and China in the recent trade war comprise extensive lists. The rates vary from 5% to 25% among more than 5,300 different six-digit Harmonized System Codes (HS). As the partial equilibrium model is capable of processing such detailed data and the advantages of it seem to outweigh the disadvantages - it is selected for further empirical research. What is more, one of the main shortcomings of the PE model – sensitivity to elasticity values - can be eliminated by checking model results with different elasticity values (robustness analysis). The SMART model is selected for this paper due to its ability to trace the complex effects of multilateral trade conflicts on a very detailed level and its ready availability.

3.1.1. The SMART model

WITS – Single Market Partial Equilibrium Simulation Tool (SMART) is the partial equilibrium (PE) model developed by the World Bank and United Nations Conference on Trade and Development (UNCTAD). It is capable of calculating direct trade effects such as trade creation, trade diversion, welfare effects, consumer surplus, tariff revenues, and other economic variables that are affected by trade policy changes. PE models allow a disaggregated analysis, which is especially handy for this research given the detailed lists of products or services that are eligible for the new trade tariffs in the recent US-China trade war (Tu et al., 2020). As for the elasticity parameters, the SMART model incorporates three kinds of elasticities: import demand, export supply, and import substitution. The import demand elasticity shows how demand responds to a shift in import price. It varies between different HS 6-digit product codes in the SMART model. Further on, the export supply elasticity is considered to be infinite (i.e. 99). This means, that export supply curves are flat and the world prices for each product are given exogenously. This assumption is often called the price taker assumption. In addition, the model assumes that an increase in demand is always matched by the producers and exporters of the good without an increase in the price of a good. Lastly, import substitution elasticity is set to 1.5 by default in SMART (following Armington's assumption). As the import substitution elasticity shows the rate of substitution between two goods of different origin, the value of 1.5 indicates that similar goods from different countries are not perfect substitutes. Consequently, trade policy simulations in SMART do not produce big bang effects. As for the trade and tariff data, the SMART model uses information from TRAINS and COMTRADE databases. If required, the user can choose to modify this data.

Depending on different objectives, researchers tend to approach partial equilibrium models on either supplier or consumer side. The SMART model evaluates trade creation and diversion effects for both exporters and importers, while other economic indicators such as tariff revenue, trade balance, and welfare effects are only calculated for importer (Thu et al., 2018). Consequently, in this paper, the SMART model will be applied to China as an exporter in order to estimate all economic effects to the importer – the US.

UNCTAD has prepared the SMART model's methodology that describes a series of equations and identifiers from which the formulation for the simulations is derived. James and Olareagga (2005) also provide a more detailed mathematical illustration of the SMART model. In the SMART simulation, consumers in the home country can choose to buy products from all over the world. Despite the fact that all countries export at the same price worldwide, the prices that the domestic consumers face can vary due to differences in tariffs. The main underlying assumption in the SMART model is that suppliers in different export markets are willing to produce and sell their products to meet the demand at any price level – supply elasticity is infinite. However, consumers will not choose to import goods only from the cheapest markets where the import tariffs are lowest because the model relies on Armington's assumption of imperfect substitutions between different import sources. Rather, the consumer will follow Armington's two-step optimization process when making consumption decisions. Another important assumption of the model is perfect competition, which means that increases or cuts of tariff rates will be fully reflected in the prices paid by consumers.

Trade creation effect. It results from the changed level of domestic demand for imports from the trading partner after the imported good becomes more or less pricy than the domestically produced substitute depending on whether the tariff rates increase or decrease. The trade creation effect is equivalent to the exporting country's decrease or growth of exports for each commodity class.

Trade diversion effect. Following standard practice, the trade diversion effect refers to the substitution of goods coming from one foreign supplier to another. This results due to changes in import prices and the differential between tariff rates that different foreign suppliers get. Consequently, if prices increase in one overseas country there will be a tendency to purchase fewer goods from that country and buy more from other countries whose exports are unchanged in price. The SMART model captures amounts that will have to be diverted due to trade restrictions as well as specific countries, which will be most likely used as substitutes. Also, greater elasticity of substitution value set in the model will result in higher trade diversion effects. The increase in trade diversion is shown with the negative value in the model output. In the US-China trade war case, both countries will have to source a certain amount of imports from other countries due to the increase in tariffs. This research specifically focuses on the US trade diversion from China only, meaning, the trade war effects on the US as an importer and the amounts of the US imports that will have to be sourced from other trading partners than China. Combining the values of changes in trade diversion from China and imports from China will result in the total effects on US imports with the world. Consequently, it can be said that the trade diversion from China is neutral towards the total trade balance of the US.

The trade balance effect refers to a change in import and export values that result from the trade tariff imposition. The effect on the US trade balance with China is the difference between changes in the US imports and exports from and to China. The change in the US trade balance with the world is comparably smaller because of the trade diversion from the China effect.

The price effect. The model can be also used to compute price effects from trade liberalization or restriction. If the export supply elasticity is infinite then there is no price effect on exports. The planned model simulation will assume the infinite export supply elasticity. Consequently, there will be no price effects.

The revenue effect. The model can be directly used to compute revenue effects from trade liberalization or restriction. Tariff revenue change on a given import flow is calculated by multiplying the ad-valorem tariff rate by the final import value and deducting the initial ad-valorem tariff rate multiplied by the initial import value. If the export supply elasticity is infinite – tariff revenue increases in proportion to the increase in exports. Using the SMART model's internal import demand elasticities the tariff liberalization results in a negative tariff revenue change while the trade restrictions result in a positive tariff revenue change. Notably, tariff revenue change is comprised of two opposite effects: tariff revenue loss through the decrease in imports that decreases the tax base and tariff revenue gain through increased tariffs.

The welfare effect. The model also computes net welfare effects for the country from trade liberalization or restriction. It refers to a change in deadweight loss. Governments can transfer some tariff revenue to compensate for lost consumer and producer surplus. Thus, the welfare effect sums up changes in producer and consumer surplus and changes in tariff revenues. Consumer surplus losses derive from the higher domestic prices after the imposition of tariffs. In addition, the new domestic price does not incline to the full extent of the tariff change.

The trade intensity effect refers to a change in the trade volumes with a given trading partner. Tariffs are expected to reduce the trade intensity between the countries. According to Frankel and Rose (1998), the US trade intensity with China can be calculated by normalising the bilateral trade flows by the total trade (8)

$$Trade\ intensity = \frac{US\ exports\ to\ China + US\ imports\ from\ China}{US\ total\ exports + China\ total\ exports + US\ total\ imports + China\ total\ imports} \qquad (8)$$

or by nominal GDP in the two countries (9)

$$Trade\ intensity = \frac{US\ exports\ to\ China + US\ imports\ from\ China}{US\ nominal\ GDP + China\ nominal\ GDP}. \qquad (9)$$

The SMART model's output is five different reports: exporter view report, market view report, revenue impact report, trade creation effect report, and welfare effect report. The exporter view report provides exports before, exports after, and export change values in $1,000 across selected HS codes and trading partners. The market view report provides imports before, import change, tariff revenue, new tariff revenue, tariff revenue change, and consumer surplus values in $1,000 across selected HS codes. The revenue impact report provides revenue effect, total trade effect, trade values in $1,000, and new and old tariff rates. The trade creation report provides total trade effect, price effect, trade creation, and trade diversion effects. Lastly, the welfare effect report provides total trade effect, welfare, new, and old tariff rates.

The SMART model reports are lengthy and present trade tariff effects per each HS6 product code and trading partner separately. For easier result interpretation, these effects can be consolidated. Two first digits of the HS6 product code represent a HS2 code which can be later merged into 15 broader product categories as per Table 3.

Table 3

Harmonized System (HS2) product categories

HS2	Product categories
01-05	Animal & Animal Products
06-15	Vegetable Products
16-24	Prepared Foodstuffs
25-27	Mineral Products
28-38	Chemicals & Allied Industries
39-40	Plastics / Rubbers
41-43	Raw Hides, Skins, Leather, & Furs
44-49	Wood & Wood Products
50-63	Textiles
64-67	Footwear / Headgear
68-71	Stone / Glass
72-83	Metals
84-85	Machinery / Electrical
86-89	Transport Equipment
90-97	Miscellaneous (medical instruments, arms and ammunition, furniture, toys, works of art, etc.)

Source: compiled by the author, according to Harmonized System 2017 description presented in the UN Trade Statistics website.

All things considered, the SMART model will work well given the detailed US-China tariff rate data that is available and will be able to deliver calculations on trade war effects which are of the main interest in this paper. Also, an immense amount of model output data may be easily consolidated when merging HS6 codes to HS2 codes and broader product categories.

3.1.2. Variable selection and dataset construction

Based on the Theoretical analysis section and the WITS - SMART model capabilities, the empirical research will focus on assessing the trade war effects on three US macroeconomic indicators: trade diversion from China, trade balance, and welfare. The methodology of how these effects are being assessed in the SMART model is presented in the 3.1.1 section of the paper. The effects on trade balance with China will be calculated from the respective model estimations of US imports and exports with China. A combination of this figure and trade diversion from China will result in a change in trade balance with the world. Furthermore, model output values for the selected variables will be compared to the forecasted US real GDP figures to see the bigger picture. On June 2020, International Monetary Fund (IMF) released World Economic Outlook which stated that the United States' real GDP is expected to decline by 8% in 2020 when compared to 2019. According to the U.S. Bureau of Economic Analysis in 2019 real GDP stood at $21,729.1 billion. Consequently, according to IMF predictions, the US real GDP should be around $19,990.8 billion in 2020. This figure will be used as a reference for trade war effects measurement. Further, this section focuses on the three main variables that have to be prepared for the input into the SMART model: trade tariff rates, trade values, and elasticities.

Trade tariff rates. During the US-China trade war, import tariffs were imposed in several waves across 2018 and 2019. In addition, tariff rates were changing for some of the product lines during this period. All of the tariffs that were imposed during the trade war (including the most recent Phase 1 deal) are concluded in Table 1 under the Situation analysis.

In order to conduct the research tariff data has to be generalized. What makes it difficult is that during the recent trade dispute tariff rates were increasing and more and more goods were included which significantly widened the scope. In addition, the US trade partners in most of the cases decided to retaliate but not necessarily, the same goods were targeted by their tariffs. The lists of currently effective trade tariffs are lengthy and difficult to interpret, as they are coded using six-digit Harmonized Codes (HS). Given this dispersed tariff data that creates barriers for conducting further analysis Li (2019) has created a harmonized database - CARD Trade War Tariffs Database - of all tariff increases during the US-China trade war which is made available for a free download. This dataset provides raw tariff increase data collected from official sources aggregated to six-digit HS codes. It was last updated on the 24th of January 2020 and already includes the Phase 1 deal. This data will be used to complement less recent tariff data on UNCTAD's TRAINS database. Generally, all the available tariff data across more than 4,200 HS product codes and different times of introduction are merged. In that way, the most recent tariff rate for each product is reflected. When analysing the summarized tariff data it becomes evident that rates applied by China are much more diverse. For instance, the United States is charging either 7.5% (on more than 1,000 HS codes) or 25% (on more than 3,000 HS codes) while China applies 29 different tariff rates. Interestingly, the majority of the imports from the US get 5%, 10%, and 25% tariff rate, and most of the other rates are charged on one or two HS codes only.

In addition to newly imposed US-China trade tariffs, the model requires current duty rates for all the United States trading partners on six-digit HS product codes level. The information about the import tariff rates that were applicable in 2019 will be extracted from the United Nations' UNCTAD's TRAINS database using sophisticated queries and including multiple partners and products at the same time.

Trade values. Correct trade values at a disaggregated HS codes level is another important element for the successful model simulation and accurate results. All trade values between the US and its trading partners will be extracted from the UN Comtrade database using queries. For the simulations around COVID-19 scenarios, these values will be reduced manually by the selected percentage and inserted back into the system.

Elasticities. The SMART model requires an input of three different elasticities: import demand, export supply, and import substitution. To start with, import demand elasticities are built in the model itself for each different HS product code. These will be not changed and taken as given. Further on, the SMART model presumes infinite export supply elasticity (i.e. 99). Lastly, the SMART model assumes that import substitution elasticity is equal to 1.5 across all different product lines. All of these elasticities will be used in the base case.

After estimating the trade tariff effects on selected macroeconomic variables with base case elasticities, sensitivity analysis will have to be carried out in order to ensure that the SMART simulation output is accurate and that it fulfils main goals of the thesis. In order to conduct sensitivity analysis, scenarios with different substitution elasticities have to be recreated. The elasticities will be halved and then doubled to show the uncertainty around the modelling results as per Table 4.

Table 4

Elasticities used in the sensitivity analysis

Elasticity	Lower bound	Base case	Upper bound	Best case
Substitution elasticity	0.75	1.5	2.25	3
Export supply elasticity	99	99	99	99

Source: compiled by the author, according to Tu et al. (2020).

As shown in Table 4, the base case has the substitution elasticity of 1.5 which is later changed to 0.75, 2.25, and 3. The substitution elasticity almost proportionally affects trade diversion among exporters. Doubling the substitution elasticity is expected to almost double the trade diversion. Export supply elasticity always remains at 99 (as per the default model assumption).

3.2. Analysed scenarios

The SMART model is shocked by the increased trade tariffs in order to analyse effects on the US trade diversion from China, trade balance, and welfare. The empirical research focuses on two main scenarios.

Trade war scenario. The first scenario also called the Trade war scenario, analyses effects that trade tariffs imposed between the United States and China had on the selected variables (including the Phase 1 deal tariff rate reductions). Tariff rates for imports from other trading partners and all trade values for the required six-digit HS codes are extracted from the United Nations' UNCTAD's TRAINS and UN Comtrade databases with 2019 as the base year. These values are taken as given and not modified. In addition, default model elasticities are taken. That is, the substitution elasticity is set to 1.5, the export supply elasticity is set to 99, and import demand elasticities on different HS codes are not adjusted. Lastly, sensitivity analysis is performed as per Table 4.

COVID-19 scenario. The second scenario includes tariffs from the Trade war scenario but data is also shocked by the potential implications of the COVID-19 global pandemic. The SMART model allows simulations using the user's data when trade figures between trade partners can be changed. Consequently, COVID-19 effects that are more explicitly discussed in 3.2 section of the paper will be included in a way of reduced trade flows. Based on Boone (March 2020) and Baldwin and Tomiura (March 2020) global trade might hypothetically decrease by 4% to 13%. For the sake of the empirical research, the simulation will be performed by taking 2019 trade values form the UN Comtrade database figures at disaggregated HS codes level and reducing them by 5% (conservative case), 10% (mild case), and 15% (downside case). The prepared dataset in all three cases will be inserted into the SMART model under the "SMART with User's Data" function. The substitution elasticity is set to 1.5, the export supply elasticity is set to 99, and import demand elasticities are taken as given by the model for each product.

Figure 5 presents the main findings and conclusions from the Theoretical, Situation analysis and Research methodology sections of the paper.

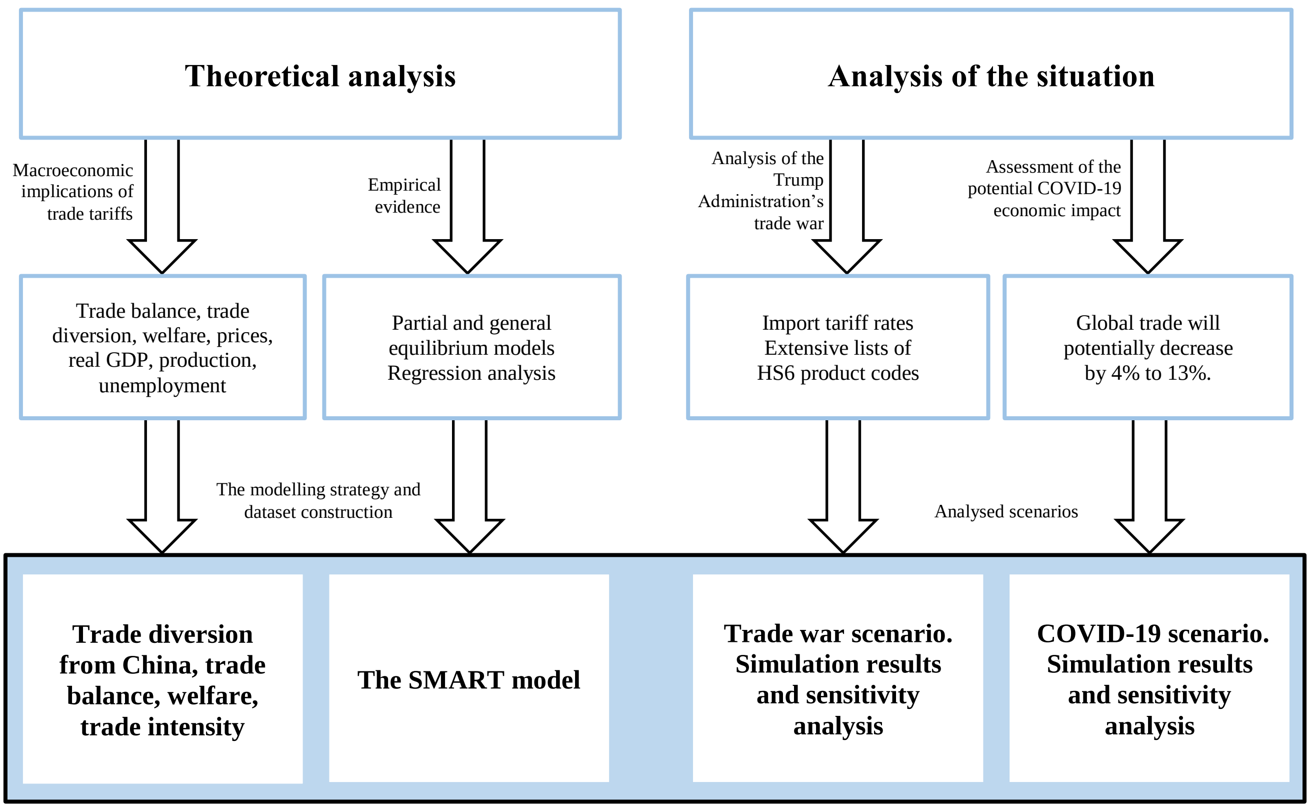

Figure 5. The research scheme.

Source: compiled by the author.

The theoretical analysis chapter concluded the most frequent macroeconomic implications of trade tariffs and research methods used in other scientific articles. The situation analysis chapter gave the base for the scenarios construction. All these things considered, it was decided that the empirical research would evaluate the trade war effects on the US trade diversion from China, trade balance, welfare, and trade intensity using the SMART model under the Trade war and COVID-19 scenarios.

4. MACROECONOMIC EFFECTS OF US-CHINA TRADE WAR EMPIRICAL RESEARCH RESULTS

The final chapter of the thesis focuses on utilizing the SMART model to simulate the impact of the trade war for the United States economy. The results of the two main scenarios are analysed - Trade war scenario and COVID-19 scenario. The model output is then interpreted using supporting conclusions from other scientific papers. In addition, SMART model sensitivity to changes in elasticity parameters is tested in order to ensure accuracy of the results. Lastly, research limitations and future outlook is provided.

4.1. The results of the Trade war scenario simulation and the sensitivity analysis

In this section, results of the SMART model simulation of the Trade war scenario are analysed. The section is divided into two main parts. Firstly, the main model simulation is presented and interpreted. Then, the sensitivity analysis results are analysed.

The utilization of the SMART model to simulate the impact of the trade war on the United States economy (Table 5) revealed, that the trade war entailed significant declines in US exports and imports from China. The tariff increase simulation showed that approximately 43,777 million USD of US imports would have to be obtained from other trading partners than China. The US imports from China were projected to decrease by 108,458 million USD and US exports to China were supposed to decrease by 23,661 million USD, which would make a positive effect on the total US trade balance with China of 84,797 million USD. The significant difference between the changes in imports and exports could be explained by the fact that China had imposed relatively lower tariffs and for shorter lists of products. The US trade balance with the world was calculated to improve by 41,020 million USD. As for the US welfare, it was calculated to decrease by 2,193 million USD in 2020 solely due to the trade war, indicating that the imposed trade tariffs are not optimal. Amiti et al. (2019) suggested deducting welfare losses from the trade balance improvement to reveal if the domestic economy benefited from the import tariff imposition. According to the results shown in Table 5, the United States economy will benefit from the trade war. Also, based on the model results, the author calculated that the US trade intensity with China would decrease by 1.13% and 0.29% when normalising the bilateral trade flows by the total trade and nominal GDPs, respectively.

Table 5

The model output for the Trade war scenario (in millions of USD and % of GDP)

Trade diversion from China	US imports from China	US exports to China	Trade balance with China	Trade balance with world	Welfare
43,777 *(0.22%)*	**-108,458** *(0.54%)*	**-23,661** *(0.12%)*	**84,797** *(0.42%)*	**41,020** *(0.21%)*	**-2,193** *(0.011%)*

Source: compiled by the author, based on SMART model simulations and IMF GDP projections for 2020.

Annex 1 provides more insights into how the different product categories were affected by the trade war. First of all, it is evident that the US machinery and electrical imports from China shrank the most. Even more, approximately 51% of the total trade balance with China improvement came from this product category. Other US sectors that saw up to 10% improvement in the trade balance with China included chemicals and allied industries, metals, plastics, rubbers, and textiles. Nevertheless, the US trade balance with China was significantly reduced in terms of vegetable products - by 8,996 billion USD. In general, it is evident that the US targeted China's machinery and electrical products while China targeted America's agricultural and automobile sector products with its imposed tariffs. The latter consequences were already visible in the market given the many complaints from the US farmers and car producers who claimed that the trade war cost them China's market. On the other hand, it is evident from Annex 1, that the US will significantly improve trade balance with China not only for machinery and electrical products but also for miscellaneous products. This includes medical instruments, arms, and ammunition, furniture, etc. Unfortunately, the US welfare will be hurt the most by the product categories that received the heaviest import tariff burden – machinery, electrical, miscellaneous, plastics, rubbers, and textiles.

Results of this research are close to the results obtained by Tu et al. (2020) who also employed the SMART model on the three lists of the US-China tariffs (List 4 and Phase 1 deal excluded) and found that the US imports from China and the US exports to China were expected to be reduced by 91,459 and 36,706 million USD, respectively and the trade diversion would be 36,783 million USD. In addition, they estimated that the US welfare was likely to shrink by 1,437 million USD. Taking into account that the author of this paper included lengthier import tariff lists, the projected declines in the US imports and welfare were found to be more sizable, accordingly.

The sensitivity analysis of the Trade war scenario presented in Table 6 shows that the lower substitution elasticity resulted in smaller trade war effects on trade diversion and trade balance, and a higher decrease in welfare. The direction of changes in the model values was expected. For example, under the higher substitution elasticity, the loss in welfare was lower and the changes in trade flows were more significant because the consumers could more easily switch to other goods. The lower substitution elasticity had the opposite effect.

Table 6

The sensitivity analysis of the Trade war scenario (in millions of USD and % of GDP)

Substitution elasticity	Trade diversion from China	US imports from China	US exports to China	Trade balance with China	Trade balance with world	Welfare
0.75	**21,575** *(0.11%)*	**-86,256** *(0.43%)*	**-22,479** *(0.11%)*	**63,777** *(0.32%)*	**42,202** *(0.21%)*	**-2,399** *(0.012%)*
1.5 *(base scenario)*	**43,777** *(0.22%)*	**-108,458** *(0.54%)*	**-23,661** *(0.12%)*	**84,797** *(0.42%)*	**41,020** *(0.21%)*	**-2,193** *(0.011%)*
2.25	**66,749** *(0.33%)*	**-130,880** *(0.65%)*	**-24,843** *(0.12%)*	**106,037** *(0.53%)*	**39,288** *(0.20%)*	**-1,831** *(0.009%)*
3	**90,342** *(0.45%)*	**-154,473** *(0.77%)*	**-26,027** *(0.13%)*	**128,446** *(0.64%)*	**38,104** *(0.19%)*	**-1,625** *(0.008%)*

Source: compiled by the author, based on SMART model simulations and IMF GDP projections for 2020.

Annex 2 provides more insights into how the changing substitution elasticity affected different product categories. When comparing with the base case, it can be concluded that the changing substitution elasticity did not affect the weights of each product category in the total change of the macroeconomic indicators significantly. Looking into the specific product categories, it is evident that using the higher substitution elasticity value marginally reduced the trade balance with China improvement coming from the machinery and electrical product categories. At the same time, the US vegetable products exports to China saw a minor increase when comparing to the base case. In addition, using the higher substitution elasticity value relatively reduced welfare losses in machinery, electrical and miscellaneous sectors and increased losses in textiles, plastics and rubbers.

Further on, sensitivity analysis results are compared with the base case and the percentage changes are calculated to identify main trends. Results are presented in Table 7.

Table 7

Changes from the base case in the sensitivity test of the Trade war scenario (by percentage)

Substitution elasticity	**Trade diversion**	**US imports**	**US exports**	**Trade balance**	**Welfare**
0.75	-50.72%	20.47%	4.996%	-24.79%	-9.40%
2.25	52.48%	-20.67%	-4.999%	25.05%	16.51%
3	106.37%	-42.43%	-10.001%	51.47%	25.90%

Source: calculated by the author, based on SMART model simulations.

It can be noted that under the lower bound (0.75 substitution elasticity) and the upper bound (2.25 substitution elasticity) cases, results varied from the base scenario by approximately the same amount. The trade diversion from China was found to be the most sensitive to the selected substitution elasticity value. On the other hand, the changes in the trade balance with the world and welfare adjusted by only 2.88% to 16.51% by halving and doubling the substitution elasticity value. This suggests the robustness of the model results.

The Trade war scenario analysis yields some stark conclusions. In line with the economic theory, the US-China trade war leads to significant decreases in the US bilateral trade flows and trade intensity with China. Both, the US trade balances with China and the whole world were calculated to improve significantly. Moreover, the gains in terms of trade were found to outweigh the losses in the country's welfare. This might be explained by the relatively weak China's retaliatory response in avoiding to deepen the trade conflict. China is still a middle-income economy that greatly relies on the US products, technologies, and the workplaces they create. China's unemployment is relatively high and Beijing is hesitant to take any actions that would cost jobs. The US agricultural and automotive industries were found to be hurt the most by the trade war. Based on Huang et al. (2018), companies in these industries are expected to observe relatively lower stock returns, weaker bond performance and higher default risks.

4.2. The results of the COVID-19 scenario simulation and the sensitivity analysis

In this section, results of the SMART model simulation under the three different cases of COVID-19 scenario are analysed: the case when global trade drops by 5% (optimistic case), 10% (mild case) and 15% (downside case). The section is divided into two main parts: the main model results analysis is followed by the sensitivity analysis.

The utilization of the SMART model to simulate the impact of the trade war on the United States economy under the three different cases of the COVID-19 scenario (Table 8) showed that the potential economic consequences of the COVID-19 pandemic reduced the relative effects of the US-China trade war. Moreover, the harsher the COVID-19 pandemic hits the global trade the smaller impact the trade war is relatively likely to have on the US trade diversion from China, trade balance, and welfare. In all the three cases, the US economy was found to be benefiting from the trade war as gains in terms of trade outweigh welfare losses.

Under the optimistic case when the global trade would be to drop by 5% in 2020, approximately 41,777 million USD of US imports would have to be obtained from other markets due to the trade war with China. In addition, the US imports and exports from China would decrease by 103,224 and 22,478 million USD, respectively. This would result in 80,746 million USD increase in the US trade balance with China. However, US welfare would still decline by 2,016 million USD. Under the mild case when the global trade would be to drop by 10% in 2020, approximately 39,578 million USD of US imports would have to be diverted elsewhere. In addition, US imports and exports from China would respectively decrease by 97,791 and 21,041 USD million. This would result in 76,749 million USD increase in the US trade balance with China. The US welfare would decline by 1,911 million USD. Lastly, under the downside case when the global trade would drop by 15% in 2020, approximately 37,139 million USD of the US imports from China would have to be obtained from other markets. Also, US imports and exports from China would decrease by 91,650 and 20,111 million USD, respectively. This would result in 71,538 million USD increase in the US trade balance with China. The US welfare would decline by 1,773 million USD.

Table 8

The model output for the COVID-19 scenario (in millions of USD and % of GDP)

Trade diversion from China	US imports from China	US exports to China	Trade balance with China	Trade balance with world	Welfare
Optimistic case (-5%)					
41,777	**-103,224**	**-22,478**	**80,746**	**38,969**	**-2,017**
(0.21%)	*(0.52%)*	*(0.11%)*	*(0.40%)*	*(0.19%)*	*(0.010%)*
Mild case (-10%)					
39,578	**-97,791**	**-21,041**	**76,749**	**37,172**	**-1,911**
(0.20%)	*(0.49%)*	*(0.11%)*	*(0.38%)*	*(0.19%)*	*(0.010%)*
Downside case (-15%)					
37,139	**-91,650**	**-20,111**	**71,538**	**34,400**	**-1,773**
(0.19%)	*(0.46%)*	*(0.10%)*	*(0.36%)*	*(0.17%)*	*(0.009%)*

Source: compiled by the author, based on SMART model simulations and IMF GDP projections for 2020.

Annexes 3, 5, and 7 provide the COVID-19 scenario trade effects disaggregated into fifteen product categories. The proportions that each product line contributes to the absolute trade effect value in COVID-19 scenario do not differ much from the Trade war scenario proportions. This can be explained by the fact that the trade tariffs that were used to shock the model remained unchanged. The only thing that was modified in the simulation was the trade values.

Sensitivity analysis results (Table 9) show that with a lower substitution elasticity the SMART model calculates lower trade diversion, imports, exports, trade balance, and welfare values. The opposite is also true. These findings correspond to those of the Trade war scenario and once again prove the accurateness of the model given not only the changing substitution elasticity but also another important simulation input – trade values.

Table 9

The sensitivity analysis of the COVID-19 scenario (in millions of USD and % of GDP)

Substitution elasticity	Trade diversion from China	US imports from China	US exports to China	Trade balance with China	Trade balance with world	Welfare
Optimistic case (-5%)						
0.75	**20,589** *(0.10%)*	**-82,036** *(0.41%)*	**-21,355** *(0.11%)*	**60,681** *(0.30%)*	**40,092** *(0.20%)*	**-2,212** *(0.011%)*
2.25	**63,532** *(0.32%)*	**-124,978** *(0.63%)*	**-23,601** *(0.12%)*	**101,377** *(0.51%)*	**37,846** *(0.19%)*	**-1,804** *(0.009%)*
3	**85,800** *(0.43%)*	**-147,246** *(0.74%)*	**-24,726** *(0.12%)*	**122,521** *(0.61%)*	**36,722** *(0.18%)*	**-1,610** *(0.008%)*
Mild case (-10%)						
0.75	**19,505** *(0.10%)*	**-77,718** *(0.39%)*	**-20,104** *(0.10%)*	**57,614** *(0.29%)*	**38,109** *(0.19%)*	**-2,096** *(0.010%)*
2.25	**60,188** *(0.30%)*	**-118,401** *(0.59%)*	**-21,979** *(0.11%)*	**96,422** *(0.48%)*	**36,233,760** *(0.18%)*	**-1,709** *(0.009%)*
3	**81,284** *(0.41%)*	**-139,497** *(0.70%)*	**-22,918** *(0.11%)*	**116,579** *(0.58%)*	**35,295,322** *(0.18%)*	**-1,525** *(0.008%)*
Downside case (-15%)						
0.75	**18,303** *(0.09%)*	**-72,814** *(0.36%)*	**-19,107** *(0.10%)*	**53,707** *(0.27%)*	**35,405** *(0.18%)*	**-1,948** *(0.010%)*
2.25	**56,477** *(0.28%)*	**-110,988** *(0.56%)*	**-21,117** *(0.11%)*	**89,872** *(0.45%)*	**33,395** *(0.17%)*	**-1,583** *(0.008%)*
3	**76,427** *(0.38%)*	**-130,938** *(0.65%)*	**-22,123** *(0.11%)*	**108,816** *(0.54%)*	**32,389** *(0.16%)*	**-1,408** *(0.007%)*

Source: compiled by the author, based on SMART model simulations and IMF GDP projections for 2020.

Annexes 4, 6, and 8 provide more insights into how the changing substitution elasticity affects different product categories. As under the Trade war scenario, changing the substitution elasticity have only minor effects on the proportions between different product categories.

Moving further, the sensitivity analysis results are compared with the base case and the percentage changes are calculated to identify main trends. Results are presented in Table 10.

Table 10

Changes from the base case in the sensitivity test of the COVID-19 scenario (by percentage)

Substitution elasticity	Trade diversion from China	US imports from China	US exports to China	Trade balance with China	Trade balance with world	Welfare
Optimistic case (-5%)						
0.75	50.72%	20.53%	4.996%	-24.85%	2.881%	-9.70%
2.25	-52.07%	-21.08%	-4.999%	25.55%	-2.883%	10.55%
3	-105.38%	-42.65%	-10.001%	51.74%	-5.769%	20.19%
Mild case (-10%)						
0.75	50.72%	20.53%	4.454%	-24.93%	2.521%	-9.70%
2.25	-52.07%	-21.08%	-4.457%	25.63%	-2.523%	10.55%
3	-105.38%	-42.65%	-8.917%	51.90%	-5.048%	20.19%
Downside case (-15%)						
0.75	50.72%	20.55%	4.995%	-24.93%	2.920%	-9.83%
2.25	-52.07%	-21.10%	-4.999%	25.63%	-2.922%	10.71%
3	-105.79%	-42.87%	-10.001%	52.11%	-5.847%	20.58%

Source: calculated by the author, based on SMART model simulations.

In line with the analysis of the sensitivity results of the Trade war scenario, the changing substitution elasticity did not significantly affect the US exports and the trade balance with the world figures. Consequently, it can be concluded that the US exports and trade balance with the world estimations tend to be robust. In relative terms, the estimations of other trade effects were found to be not significant in absolute terms.

All things considered, the potential economic effects of the COVID-19 global pandemic reduced the US-China trade war effects. Despite that fact, the changes to the US trade diversion from China, trade balance with the world, and welfare still comprised 0.009% to 0.21% of the forecasted 2020 real GDP. Moreover, even taking into account the potential effects of the global COVID-19 pandemic, the US will still able to benefit from the trade war, as under all the three cases, the gains from the improved trade balance were more significant than welfare losses. Nevertheless, the COVID-19 scenario was constructed based on the economists' projections that were made at the beginning of the summer 2020. These predictions might have radically changed with another COVID-19 pandemic wave hitting in the autumn. Thus, the actual picture is prone to change and may overtake the one predicted in the downside case.

4.3. Research limitations, outlook and suggestions

The final objective of this chapter is to discuss the limitations and shortcomings of the performed analysis, provide suggestions and draw possible directions for future studies in this field.

The main shortcoming of the research is related to the model selection. A partial equilibrium model is a very handy tool for assessing the effects of trade tariffs on disaggregated product line data as it allows avoiding aggregation biases. However, at the same time, the partial equilibrium models potentially miss important inter-sectoral input/output (upstream/downstream) linkages. Besides, the SMART model allows for the analysis of a limited number of economic variables only. What is more, the empirical research results are sensitive to the selected elasticities. The SMART model requires an input of import demand, export supply, and import substitution elasticities. Despite the fact, that elasticities for this research were selected according to the most recent studies, most of them still rely on the simplistic underlying assumptions of the SMART model. These assumptions might have changed over time and thus, the simulation results might be imprecise. What is more, the SMART model assumes that all markets are perfectly competitive and economies function without frictions. In reality, these assumptions might not be real making the impact of a trade war look superficially smaller.

Another research limitation is that the COVID-19 scenario was built on the assumption that the pandemic's impact is limited to the decrease in global trade. In fact, the global pandemic also affects production, consumption, unemployment, investment, etc. Consequently, the actual COVID-19 economic effects could decrease the relative US-China trade war effects even more. Also, decrease in the global trade was estimated based on the global economic situation in early spring 2020 and the actual situation might be sizeably different.

This paper shed some light on the implications of the most recent trade policy moves of the United States and China, with a focus on the United States economy. It was found that the protectionist policies initiated by the United States significantly hurt the bilateral trade between the two countries, which in result allowed to improve the total trade balance of the US. However, trade war effects were uneven across different sectors. Most importantly, it was discovered that the trade tariffs were not optimal and the economic welfare of the US was hurt. The main suggestion for policymakers in the United States as well as in other countries is that trade tariffs, only if optimal, can be a handy protectionist tool which has to be used carefully. The complexity of today's trade relations raises unprecedented challenges and requires a thorough trade policy analysis prior to inflicting it on the trading partner. The possible effects on the country's trade flows, welfare, and supply chains have to be examined. What is more, policymakers have to carefully consider the possibility of the trading partner to respond with retaliatory measures. This research paper provides solid grounds on how the initial protectionist trade policy analysis could be performed.

Looking ahead, discussed thesis shortcomings suggest that it would be insightful to assess the US-China trade war macroeconomic effects using general equilibrium models and compare the results with those of the partial equilibrium model. The general equilibrium model results would be expected to include second-round and inter-industry effects. This paper has focused on some of the trade war macroeconomic implications for the United States. The further work could usefully focus on studying direct effects on the other US macroeconomic variables. For instance, according to Li et al. (2019) who use a general equilibrium model, trade tariff effects on production and real GDP could be studied. Also, it would be insightful to examine the import tariff effects for the China economy. In that way, the question who benefited from the trade war could be answered.

CONCLUSIONS

1. The theoretical analysis chapter supplemented the paper with a comprehensive review of the relevant academic literature. It was found that the trade tariff imposition tends to reduce domestic and foreign real GDP and total production, reduce labour productivity and welfare, increase unemployment, domestic prices and trade diversion, appreciate real exchange rate, and significantly affect the trade balance. What is more, the magnitude of the trade tariff effects was found to depend on many additional factors. For instance, advanced economies that impose trade tariffs see relatively bigger decreases in domestic output and labour productivity than developing economies. Besides, the degree of the effect that tariffs imposition will have on the domestic economy depends a lot on the stage of the business cycle. Specifically, medium-term losses in output and labour productivity are more sizeable when the economy is expanding rather than declining. Also, it was identified that the domestic industries that will be hurt the most by the trade war will also experience relatively lower stock returns, weaker bond performance and higher default risks.

2. In the situation analysis chapter, developments around the US-China trade war were analysed. The main reasons for the US to initiate the trade conflict were found to be China's unfair market practices, treats for the national US security, intellectual property rights, increasing trade deficit between the two countries and concerns around growing China's power. The countries have exchanged six tranches of import tariffs. On January 2020 the United States and China reached an agreement known as a Phase 1 deal which reduced part of the US import tariffs in exchange for China's pledge to buy at least 200 billion USD in products and services. The scope of this research includes the most recent trade tariffs and the recent deal. In addition, the situation analysis section analysed how the current COVID-19 pandemic can influence trade war effects. It was found that global trade might potentially decline by 4% to 13%.

3. The empirical evidence from the previous researches was examined to find two main methods for the analysis of trade tariff effects: partial or general equilibrium models and regression analysis. The exceptional performance of the partial equilibrium models on disaggregated trade and tariff rate data was noted. Accordingly, the SMART model was identified as the most appealing to this thesis given that the US and China imposed tariffs on the Harmonized System product code level. Based on the findings in the theoretical analysis section and the SMART model capabilities, four main US variables

were selected for further research: trade diversion from China, trade balance, welfare, and trade intensity. Lastly, according to findings in situation analysis two main scenarios were selected: Trade war and COVID-19 scenarios. The Trade war scenario includes the most recent US-China import tariffs while the COVID-19 scenario includes tariff rates from the first scenario but also have global trade values reduced by 5% (optimistic case), 10% (mild case), and 15% (downside case).

4. This study examined how the United States tariffs on imports from China and China's retaliatory actions affected the US economy in terms of trade diversion, trade balance, welfare, and trade intensity. The partial equilibrium SMART model simulations suggest that the United States' total trade balance will improve by 41,020 million USD (0.21% of real GDP) in 2020, while 43,777 million USD (0.22% of real GDP) of US imports will have to be sourced from other countries. In addition, the welfare will decrease by 2,193 million USD (0.011% of real GDP), indicating that the imposed trade tariffs are not optimal. The US trade intensity with China will decline by 1.13% and 0.29% when normalising bilateral trade flows by the total trade and nominal GDPs, respectively. The potential COVID-19 economic consequences were found to reduce the trade war's relative effects. Under optimistic, mild, and downside cases, the US-China trade war effects on trade diversion, trade balance, and welfare were relatively lower than compared with the Trade war scenario results. The model estimations passed the robustness tests.

As for the wider implications, the US seems to benefit from the trade war. This is mainly associated with the greater US market power and a relatively weak China's retaliatory response – a fear to escalate the trade conflict that would further hurt its domestic companies and employment figures. However, the trade war effects between the US industries are uneven. The US agricultural and automotive industries are hurt more than others. If the trade conflict continues to escalate, not only the consumers will suffer from the increasing prices but also the fractured input-output linkages and the economic uncertainty will hurt some industries even further. This research is especially important for policymakers considering the potential effects of the trade tariffs imposition. The success of such protectionist policies is proven to considerably depend on the trading partner's retaliatory actions. In addition, a careful examination of the trade policy's possible effects on the country's welfare, supply chains, and trade flows should be performed before taking any actions. After all, trade wars are neither good nor easy to win.

The performed analysis shortcomings include the SMART partial equilibrium model's inability to trace important inter-sectoral linkages and study trade tariffs effects on a wider selection of economic variables. Also, the simulation results are sensitive to the selected elasticities. Besides, the COVID-19 scenario was built on the main assumption that the global pandemic economic impact will be limited to a decrease in global trade. Looking ahead, the US-China trade war macroeconomic effects could be assessed using general equilibrium models aiming to compare the results with this research. Also, trade war effects on additional economic variables such as production and real GDP could be analysed.

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PREKYBOS TARIFŲ MAKROEKONOMINIAI EFEKTAI. JAV IR KINIJOS PREKYBOS KARO ĮTAKA JUNGTINIŲ AMERIKOS VALSTIJŲ EKONOMIKAI

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SANTRAUKA

50 puslapių, 10 lentelių, 5 paveikslai, 69 šaltiniai.

Pagrindinis magistro baigiamojo darbo tikslas – ištirti, kaip prekybos tarifai, nustatyti tarp Jungtinių Amerikos Valstijų ir Kinijos 2018 ir 2019 metais, paveikė JAV ekonominius rodiklius - prekybos srauto perorientavimą iš Kinijos, prekybos balansą, ekonominę gerovę bei prekybos intensyvumą.

Magistro baigiamasis darbas sudarytas iš penkių dalių: teorinės analizės, padėties vertinimo, tyrimo metodologijos, empirinio tyrimo rezultatų ir išvadų.

Teorinės analizės skyriuje apžvelgiami prekybos tarifų makroekonominiai efektai ir moksliniuose darbuose naudojami tyrimo metodai. Padėties vertinimo skyriuje analizuojami pagrindiniai prekybos karo aspektai ir COVID-19 pandemijos įtaka pasaulio prekybai. Remiantis šių skyrių išvadomis, empiriniam tyrimui pasirenkamas dalinės pusiausvyros SMART modelis ir sukonstruojami Prekybos karo ir COVID-19 scenarijai.

Tyrimo rezultatai atskleidžia, kad dėl prekybos karo su Kinija 2020 metais JAV prekybos balansas pagerės 41 020 mln. JAV dolerių (0,21% realiojo BVP), o 43 777 mln. JAV dolerių (0,22% realiojo BVP) produktų turės būti importuojami iš kitų šalių. JAV ekonominė gerovė bei prekybos intensyvumas su Kinija sumažės. Atliktas tyrimas rodo, kad potenciali COVID-19 pandemijos įtaka pasaulio ekonomikai sumažina prekybos karo makroekonominius efektus. JAV ekonomikai šis prekybos karas pasirodo esantis naudingas abiejų tyrimo scenarijų atveju. Vis dėlto JAV žemės ūkio ir automobilių pramonės sektoriai nukenčia labiausiai. Tyrimo išvados yra svarbios ne tik JAV, bet ir kitų šalių ekonomistams bei įstatymų leidėjams, besistengiantiems įvertinti potencialią prekybos tarifų įtaką šalies ekonomikai bei nustatyti optimalų tarifų lygį.

Remiantis magistro baigiamuoju darbu, moksliniame žurnale „Organizations and Markets in Emerging Economies“ 2020 gruodžio 30 dieną buvo publikuotas straipsnis.

ANNEXES

Annex 1. The model output for the Trade war scenario (in thousands of USD)

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	268,900	**0.61%**	-766,032	**0.71%**	-159,629	**0.67%**	606,402	**0.72%**	-29,559	**1.35%**
Chemicals & Allied Industries	1,721,716	**3.93%**	-4,158,034	**3.83%**	1,038,063	**-4.39%**	5,196,096	**6.13%**	-94,298	**4.30%**
Foodstuffs	389,213	**0.89%**	-800,328	**0.74%**	-2,089,189	**8.83%**	-1,288,861	**-1.52%**	-15,380	**0.70%**
Footwear / Headgear	688,315	**1.57%**	-1,952,965	**1.80%**	-61,402	**0.26%**	1,891,563	**2.23%**	-74,077	**3.38%**
Machinery / Electrical	19,902,644	**45.46%**	-45,894,726	**42.32%**	-2,944,410	**12.44%**	42,950,316	**50.65%**	-575,179	**26.23%**
Metals	3,236,708	**7.39%**	-9,067,614	**8.36%**	-1,174,336	**4.96%**	7,893,278	**9.31%**	-167,167	**7.62%**
Mineral Products	124,673	**0.28%**	-315,833	**0.29%**	-540,092	**2.28%**	-224,258	**-0.26%**	-5,707	**0.26%**
Miscellaneous	5,935,357	**13.56%**	-14,129,402	**13.03%**	-1,246,242	**5.27%**	12,883,161	**15.19%**	-343,744	**15.68%**
Plastics / Rubbers	2,304,735	**5.26%**	-7,030,268	**6.48%**	759,085	**-3.21%**	7,789,353	**9.19%**	-241,264	**11.00%**
Raw Hides, Skins, Leather, & Furs	860,391	**1.97%**	-2,218,253	**2.05%**	-73,713	**0.31%**	2,144,539	**2.53%**	-116,838	**5.33%**
Stone / Glass	977,512	**2.23%**	-3,093,063	**2.85%**	-257,087	**1.09%**	2,835,976	**3.34%**	-76,728	**3.50%**
Textiles	2,393,209	**5.47%**	-6,895,839	**6.36%**	-104,279	**0.44%**	6,791,559	**8.01%**	-258,485	**11.79%**
Transportation	3,983,717	**9.10%**	-8,008,579	**7.38%**	-6,384,090	**26.98%**	1,624,489	**1.92%**	-120,804	**5.51%**
Vegetable Products	176,710	**0.40%**	-470,868	**0.43%**	-9,466,951	**40.01%**	-8,996,083	**-10.61%**	-6,831	**0.31%**
Wood & Wood Products	812,905	**1.86%**	-3,655,894	**3.37%**	-956,282	**4.04%**	2,699,612	**3.18%**	-66,582	**3.04%**
TOTAL	**43,776,706**	**100%**	**-108,457,697**	**100%**	**-23,660,554**	**100%**	**84,797,143**	**100%**	**-2,192,644**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 2. The sensitivity analysis of the Trade war scenario (in thousands of USD)

Lower bound with a substitution elasticity of 0.75

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-131,075	**0.61%**	-628,206	**0.73%**	-121,176	**0.54%**	507,030	**0.79%**	-31,833	**1.33%**
Chemicals & Allied Industries	-848,549	**3.93%**	-3,284,867	**3.81%**	101,182	**-0.45%**	3,386,048	**5.31%**	-102,492	**4.27%**
Foodstuffs	-196,732	**0.91%**	-607,847	**0.70%**	-2,100,647	**9.35%**	-1,492,800	**-2.34%**	-16,385	**0.68%**
Footwear / Headgear	-340,177	**1.58%**	-1,604,827	**1.86%**	-53,049	**0.24%**	1,551,778	**2.43%**	-73,986	**3.08%**
Machinery / Electrical	-9,831,430	**45.57%**	-35,823,512	**41.53%**	-2,169,920	**9.65%**	33,653,592	**52.77%**	-656,115	**27.35%**
Metals	-1,587,643	**7.36%**	-7,418,549	**8.60%**	-934,212	**4.16%**	6,484,337	**10.17%**	-184,268	**7.68%**
Mineral Products	-61,374	**0.28%**	-252,534	**0.29%**	-424,188	**1.89%**	-171,655	**-0.27%**	-6,145	**0.26%**
Miscellaneous	-2,882,910	**13.36%**	-11,076,955	**12.84%**	-916,517	**4.08%**	10,160,438	**15.93%**	-384,102	**16.01%**
Plastics / Rubbers	-1,139,162	**5.28%**	-5,864,695	**6.80%**	142,244	**-0.63%**	6,006,939	**9.42%**	-260,726	**10.87%**
Raw Hides, Skins, Leather, & Furs	-412,801	**1.91%**	-1,770,662	**2.05%**	-139,362	**0.62%**	1,631,300	**2.56%**	-122,562	**5.11%**
Stone / Glass	-483,995	**2.24%**	-2,599,546	**3.01%**	-223,510	**0.99%**	2,376,036	**3.73%**	-80,326	**3.35%**
Textiles	-1,207,263	**5.60%**	-5,709,892	**6.62%**	-210,058	**0.93%**	5,499,834	**8.62%**	-260,800	**10.87%**
Transportation	-1,952,822	**9.05%**	-5,977,684	**6.93%**	-5,580,583	**24.83%**	397,101	**0.62%**	-139,107	**5.80%**
Vegetable Products	-87,347	**0.40%**	-381,506	**0.44%**	-9,079,926	**40.39%**	-8,698,420	**-13.64%**	-7,132	**0.30%**
Wood & Wood Products	-411,799	**1.91%**	-3,254,788	**3.77%**	-768,856	**3.42%**	2,485,932	**3.90%**	-72,754	**3.03%**
TOTAL	**-21,575,080**	**100%**	**-86,256,071**	**100%**	**-22,478,578**	**100%**	**63,777,493**	**100%**	**-2,398,734**	**100%**

Source: compiled by the author, based on SMART model simulations.

Higher bound with a substitution elasticity of 2.25

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-415,707	**0.62%**	-912,367	**0.70%**	-198,089	**0.80%**	714,278	**0.67%**	-26,843	**1.47%**
Chemicals & Allied Industries	-2,636,586	**3.95%**	-5,072,903	**3.88%**	1,974,612	**-7.95%**	7,047,515	**6.65%**	-78,607	**4.29%**
Foodstuffs	-598,390	**0.90%**	-1,009,505	**0.77%**	-2,077,790	**8.36%**	-1,068,285	**-1.01%**	-10,172	**0.56%**
Footwear / Headgear	-1,104,027	**1.65%**	-2,368,678	**1.81%**	-69,758	**0.28%**	2,298,920	**2.17%**	-69,498	**3.80%**
Machinery / Electrical	-29,961,932	**44.89%**	-55,587,751	**42.47%**	-3,718,938	**14.97%**	51,868,813	**48.92%**	-461,773	**25.22%**
Metals	-4,970,425	**7.45%**	-10,756,910	**8.22%**	-1,414,482	**5.69%**	9,342,428	**8.81%**	-140,290	**7.66%**
Mineral Products	-189,684	**0.28%**	-380,844	**0.29%**	-655,974	**2.64%**	-275,130	**-0.26%**	-5,244	**0.29%**
Miscellaneous	-9,201,865	**13.79%**	-17,294,360	**13.21%**	-1,576,009	**6.34%**	15,718,351	**14.82%**	-287,439	**15.70%**
Plastics / Rubbers	-3,614,536	**5.42%**	-8,340,069	**6.37%**	1,375,915	**-5.54%**	9,715,984	**9.16%**	-194,799	**10.64%**
Raw Hides, Skins, Leather, & Furs	-1,364,909	**2.04%**	-2,722,770	**2.08%**	-8,065	**0.03%**	2,714,705	**2.56%**	-102,183	**5.58%**
Stone / Glass	-1,499,020	**2.25%**	-3,581,237	**2.74%**	-290,664	**1.17%**	3,290,572	**3.10%**	-62,055	**3.39%**
Textiles	-3,727,050	**5.58%**	-8,229,680	**6.29%**	1,419	**-0.01%**	8,231,099	**7.76%**	-229,226	**12.52%**
Transportation	-6,039,417	**9.05%**	-10,062,727	**7.69%**	-7,187,705	**28.93%**	2,875,023	**2.71%**	-95,920	**5.24%**
Vegetable Products	-265,450	**0.40%**	-557,045	**0.43%**	-9,853,982	**39.66%**	-9,296,937	**-8.77%**	-5,614	**0.31%**
Wood & Wood Products	-1,160,371	**1.74%**	-4,003,360	**3.06%**	-1,143,799	**4.60%**	2,859,561	**2.70%**	-60,988	**3.33%**
TOTAL	**-66,749,370**	**100%**	**-130,880,205**	**100%**	**-24,843,310**	**100%**	**106,036,895**	**100%**	**-1,830,652**	**100%**

Source: compiled by the author, based on SMART model simulations.

Best case with a substitution elasticity of 3

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-580,986	**0.64%**	-1,077,646	**0.70%**	-236,554	**0.91%**	841,092	**0.65%**	-23,732	**1.46%**
Chemicals & Allied Industries	-3,521,676	**3.90%**	-5,957,994	**3.86%**	2,910,833	**-11.18%**	8,868,827	**6.90%**	-72,136	**4.44%**
Foodstuffs	-796,019	**0.88%**	-1,207,134	**0.78%**	-2,066,451	**7.94%**	-859,317	**-0.67%**	-9,545	**0.59%**
Footwear / Headgear	-1,491,315	**1.65%**	-2,755,965	**1.78%**	-78,118	**0.30%**	2,677,848	**2.08%**	-69,580	**4.28%**
Machinery / Electrical	-40,588,897	**44.93%**	-66,214,716	**42.86%**	-4,493,507	**17.26%**	61,721,210	**48.05%**	-373,099	**22.96%**
Metals	-6,770,496	**7.49%**	-12,556,981	**8.13%**	-1,654,654	**6.36%**	10,902,327	**8.49%**	-121,003	**7.45%**
Mineral Products	-258,017	**0.29%**	-449,177	**0.29%**	-771,836	**2.97%**	-322,659	**-0.25%**	-4,750	**0.29%**
Miscellaneous	-12,588,026	**13.93%**	-20,680,521	**13.39%**	-1,905,817	**7.32%**	18,774,704	**14.62%**	-245,366	**15.10%**
Plastics / Rubbers	-4,804,790	**5.32%**	-9,530,323	**6.17%**	1,992,733	**-7.66%**	11,523,056	**8.97%**	-181,019	**11.14%**
Raw Hides, Skins, Leather, & Furs	-1,889,550	**2.09%**	-3,247,412	**2.10%**	57,583	**-0.22%**	3,304,994	**2.57%**	-95,197	**5.86%**
Stone / Glass	-2,049,760	**2.27%**	-4,131,976	**2.67%**	-324,244	**1.25%**	3,807,732	**2.96%**	-58,296	**3.59%**
Textiles	-5,025,439	**5.56%**	-9,528,068	**6.17%**	107,038	**-0.41%**	9,635,106	**7.50%**	-226,460	**13.94%**
Transportation	-8,124,342	**8.99%**	-12,147,652	**7.86%**	-7,991,426	**30.70%**	4,156,227	**3.24%**	-82,322	**5.07%**
Vegetable Products	-357,770	**0.40%**	-649,365	**0.42%**	-10,241,015	**39.35%**	-9,591,650	**-7.47%**	-5,274	**0.32%**
Wood & Wood Products	-1,495,012	**1.65%**	-4,338,001	**2.81%**	-1,331,406	**5.12%**	3,006,594	**2.34%**	-56,931	**3.50%**
TOTAL	**-90,342,097**	**100%**	**-154,472,932**	**100%**	**-26,026,840**	**100%**	**128,446,092**	**100%**	**-1,624,711**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 3. The model output for the COVID-19 (-5%) scenario (in thousands of USD)

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-255,455	**0.61%**	-727,730	**0.71%**	-151,648	**0.67%**	576,082	**0.71%**	-28,081	**1.39%**
Chemicals & Allied Industries	-6,627,026	**15.86%**	-17,276,810	**16.74%**	986,159	**-4.39%**	18,262,970	**22.62%**	-213,417	**10.58%**
Foodstuffs	-59,724	**0.14%**	-190,950	**0.18%**	-1,984,729	**8.83%**	-1,793,779	**-2.22%**	-782	**0.04%**
Footwear / Headgear	-33,999	**0.08%**	-87,227	**0.08%**	-58,332	**0.26%**	28,895	**0.04%**	-821	**0.04%**
Machinery / Electrical	-2,062,063	**4.94%**	-7,451,890	**7.22%**	-2,797,183	**12.44%**	4,654,707	**5.76%**	-209,377	**10.38%**
Metals	-3,339,301	**7.99%**	-9,299,409	**9.01%**	-1,115,619	**4.96%**	8,183,790	**10.14%**	-270,318	**13.40%**
Mineral Products	-1,055,148	**2.53%**	-3,049,247	**2.95%**	-513,087	**2.28%**	2,536,159	**3.14%**	-38,584	**1.91%**
Miscellaneous	-2,682,154	**6.42%**	-6,926,918	**6.71%**	-1,183,929	**5.27%**	5,742,989	**7.11%**	-228,898	**11.35%**
Plastics / Rubbers	-6,547,624	**15.67%**	-14,289,314	**13.84%**	721,130	**-3.21%**	15,010,444	**18.59%**	-182,373	**9.04%**
Raw Hides, Skins, Leather, & Furs	-2,400,294	**5.75%**	-5,749,041	**5.57%**	-70,026	**0.31%**	5,679,015	**7.03%**	-119,948	**5.95%**
Stone / Glass	-324,473	**0.78%**	-925,240	**0.90%**	-244,233	**1.09%**	681,008	**0.84%**	-23,890	**1.18%**
Textiles	-6,695,865	**16.03%**	-15,843,759	**15.35%**	-99,066	**0.44%**	15,744,693	**19.50%**	-366,575	**18.18%**
Transportation	-310,009	**0.74%**	-844,137	**0.82%**	-6,064,868	**26.98%**	-5,220,731	**-6.47%**	-36,887	**1.83%**
Vegetable Products	-653,896	**1.57%**	-2,143,995	**2.08%**	-8,993,603	**40.01%**	-6,849,608	**-8.48%**	-49,467	**2.45%**
Wood & Wood Products	-8,729,604	**20.90%**	-18,417,908	**17.84%**	-908,468	**4.04%**	17,509,439	**21.68%**	-247,329	**12.26%**
TOTAL	**-41,776,634**	**100%**	**-103,223,575**	**100%**	**-22,477,503**	**100%**	**80,746,072**	**100%**	**-2,016,747**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 4. The sensitivity analysis of the COVID-19 (-5%) scenario (in thousands of USD)

Lower bound with a substitution elasticity of 0.75

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-124,521	**0.60%**	-596,796	**0.73%**	-115,117	**0.54%**	481,679	**0.79%**	-30,241	**1.37%**
Chemicals & Allied Industries	-817,419	**3.97%**	-3,131,920	**3.82%**	96,123	**-0.45%**	3,228,043	**5.32%**	-88,809	**4.01%**
Foodstuffs	-189,600	**0.92%**	-580,160	**0.71%**	-1,995,614	**9.35%**	-1,415,454	**-2.33%**	-11,913	**0.54%**
Footwear / Headgear	-340,981	**1.66%**	-1,542,399	**1.88%**	-50,397	**0.24%**	1,492,002	**2.46%**	-65,833	**2.98%**
Machinery / Electrical	-9,339,859	**45.36%**	-34,032,337	**41.48%**	-2,061,421	**9.65%**	31,970,915	**52.69%**	-623,310	**28.17%**
Metals	-1,508,261	**7.33%**	-7,047,622	**8.59%**	-887,503	**4.16%**	6,160,119	**10.15%**	-175,055	**7.91%**
Mineral Products	-58,314	**0.28%**	-239,915	**0.29%**	-402,979	**1.89%**	-163,064	**-0.27%**	-5,832	**0.26%**
Miscellaneous	-2,738,764	**13.30%**	-10,523,107	**12.83%**	-870,691	**4.08%**	9,652,416	**15.91%**	-364,896	**16.49%**
Plastics / Rubbers	-1,094,282	**5.31%**	-5,583,538	**6.81%**	135,131	**-0.63%**	5,718,669	**9.42%**	-237,401	**10.73%**
Raw Hides, Skins, Leather, & Furs	-397,824	**1.93%**	-1,687,792	**2.06%**	-132,394	**0.62%**	1,555,399	**2.56%**	-108,517	**4.91%**
Stone / Glass	-461,959	**2.24%**	-2,471,732	**3.01%**	-212,335	**0.99%**	2,259,398	**3.72%**	-72,399	**3.27%**
Textiles	-1,185,708	**5.76%**	-5,463,205	**6.66%**	-199,554	**0.93%**	5,263,651	**8.67%**	-221,893	**10.03%**
Transportation	-1,855,181	**9.01%**	-5,678,800	**6.92%**	-5,301,545	**24.83%**	377,256	**0.62%**	-132,152	**5.97%**
Vegetable Products	-83,331	**0.40%**	-362,782	**0.44%**	-8,625,929	**40.39%**	-8,263,147	**-13.62%**	-6,175	**0.28%**
Wood & Wood Products	-392,661	**1.91%**	-3,093,500	**3.77%**	-730,414	**3.42%**	2,363,086	**3.89%**	-67,877	**3.07%**
TOTAL	**-20,588,665**	**100%**	**-82,035,606**	**100%**	**-21,354,638**	**100%**	**60,680,968**	**100%**	**-2,212,302**	**100%**

Source: compiled by the author, based on SMART model simulations.

Higher bound with a substitution elasticity of 2.25

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-394,258	**0.62%**	-866,532	**0.69%**	-188,185	**0.80%**	678,347	**0.67%**	-25,665	**1.42%**
Chemicals & Allied Industries	-2,504,757	**3.94%**	-4,819,258	**3.86%**	1,875,880	**-7.95%**	6,695,138	**6.60%**	-74,677	**4.14%**
Foodstuffs	-568,470	**0.89%**	-959,029	**0.77%**	-1,973,899	**8.36%**	-1,014,870	**-1.00%**	-9,664	**0.54%**
Footwear / Headgear	-1,048,826	**1.65%**	-2,250,244	**1.80%**	-66,271	**0.28%**	2,183,973	**2.15%**	-66,023	**3.66%**
Machinery / Electrical	-28,611,815	**45.04%**	-53,304,293	**42.65%**	-3,532,983	**14.97%**	49,771,310	**49.10%**	-469,998	**26.05%**
Metals	-4,708,332	**7.41%**	-10,247,693	**8.20%**	-1,343,761	**5.69%**	8,903,932	**8.78%**	-141,817	**7.86%**
Mineral Products	-180,200	**0.28%**	-361,802	**0.29%**	-623,176	**2.64%**	-261,374	**-0.26%**	-4,982	**0.28%**
Miscellaneous	-8,781,967	**13.82%**	-16,566,310	**13.26%**	-1,497,207	**6.34%**	15,069,103	**14.86%**	-280,358	**15.54%**
Plastics / Rubbers	-3,433,809	**5.40%**	-7,923,065	**6.34%**	1,307,116	**-5.54%**	9,230,181	**9.10%**	-185,059	**10.26%**
Raw Hides, Skins, Leather, & Furs	-1,296,663	**2.04%**	-2,586,631	**2.07%**	-7,659	**0.03%**	2,578,972	**2.54%**	-97,074	**5.38%**
Stone / Glass	-1,420,518	**2.24%**	-3,430,290	**2.74%**	-276,132	**1.17%**	3,154,158	**3.11%**	-64,750	**3.59%**
Textiles	-3,540,698	**5.57%**	-7,818,196	**6.26%**	1,348	**-0.01%**	7,819,543	**7.71%**	-217,765	**12.07%**
Transportation	-5,684,039	**8.95%**	-9,507,659	**7.61%**	-6,828,292	**28.93%**	2,679,366	**2.64%**	-102,577	**5.69%**
Vegetable Products	-254,761	**0.40%**	-534,211	**0.43%**	-9,361,282	**39.66%**	-8,827,071	**-8.71%**	-5,595	**0.31%**
Wood & Wood Products	-1,102,353	**1.74%**	-3,803,192	**3.04%**	-1,086,609	**4.60%**	2,716,583	**2.68%**	-57,938	**3.21%**
TOTAL	**-63,531,465**	**100%**	**-124,978,406**	**100%**	**-23,601,112**	**100%**	**101,377,294**	**100%**	**-1,803,942**	**100%**

Source: compiled by the author, based on SMART model simulations.

Best case with a substitution elasticity of 3

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-550,996	**0.64%**	-1,023,270	**0.69%**	-224,728	**0.91%**	798,543	**0.65%**	-22,707	**1.41%**
Chemicals & Allied Industries	-3,345,593	**3.90%**	-5,660,094	**3.84%**	2,765,290	**-11.18%**	8,425,384	**6.88%**	-68,529	**4.26%**
Foodstuffs	-756,218	**0.88%**	-1,146,777	**0.78%**	-1,963,126	**7.94%**	-816,349	**-0.67%**	-9,068	**0.56%**
Footwear / Headgear	-1,416,749	**1.65%**	-2,618,167	**1.78%**	-74,212	**0.30%**	2,543,955	**2.08%**	-66,101	**4.11%**
Machinery / Electrical	-38,563,837	**44.95%**	-63,256,314	**42.96%**	-4,268,820	**17.26%**	58,987,494	**48.14%**	-387,280	**24.06%**
Metals	-6,413,001	**7.47%**	-11,952,362	**8.12%**	-1,571,924	**6.36%**	10,380,438	**8.47%**	-123,516	**7.67%**
Mineral Products	-245,116	**0.29%**	-426,718	**0.29%**	-733,245	**2.97%**	-306,527	**-0.25%**	-4,512	**0.28%**
Miscellaneous	-12,014,332	**14.00%**	-19,798,675	**13.45%**	-1,810,525	**7.32%**	17,988,150	**14.68%**	-240,325	**14.93%**
Plastics / Rubbers	-4,564,551	**5.32%**	-9,053,807	**6.15%**	1,893,093	**-7.66%**	10,946,900	**8.93%**	-171,968	**10.68%**
Raw Hides, Skins, Leather, & Furs	-1,795,073	**2.09%**	-3,085,041	**2.10%**	54,706	**-0.22%**	3,139,747	**2.56%**	-90,438	**5.62%**
Stone / Glass	-1,942,322	**2.26%**	-3,952,094	**2.68%**	-308,031	**1.25%**	3,644,064	**2.97%**	-61,160	**3.80%**
Textiles	-4,774,167	**5.56%**	-9,051,665	**6.15%**	101,685	**-0.41%**	9,153,350	**7.47%**	-215,137	**13.37%**
Transportation	-7,653,998	**8.92%**	-11,477,618	**7.79%**	-7,591,819	**30.70%**	3,885,799	**3.17%**	-89,508	**5.56%**
Vegetable Products	-343,232	**0.40%**	-622,682	**0.42%**	-9,728,965	**39.35%**	-9,106,283	**-7.43%**	-5,271	**0.33%**
Wood & Wood Products	-1,420,261	**1.66%**	-4,121,101	**2.80%**	-1,264,836	**5.12%**	2,856,265	**2.33%**	-54,085	**3.36%**
TOTAL	**-85,799,445**	**100%**	**-147,246,386**	**100%**	**-24,725,456**	**100%**	**122,520,930**	**100%**	**-1,609,604**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 5. The model output for the COVID-19 (-10%) scenario (in thousands of USD)

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-242,010	**0.61%**	-689,428	**0.71%**	-106,924	**0.51%**	582,504	**0.76%**	-26,603	**1.39%**
Chemicals & Allied Industries	-1,571,764	**3.97%**	-3,764,450	**3.85%**	-1,287,544	**6.12%**	2,476,906	**3.23%**	-76,844	**4.02%**
Foodstuffs	-355,438	**0.90%**	-725,441	**0.74%**	-2,063,234	**9.81%**	-1,337,793	**-1.74%**	-10,394	**0.54%**
Footwear / Headgear	-654,085	**1.65%**	-1,792,271	**1.83%**	-66,164	**0.31%**	1,726,107	**2.25%**	-62,462	**3.27%**
Machinery / Electrical	-17,912,380	**45.26%**	-41,305,253	**42.24%**	-497,879	**2.37%**	40,807,374	**53.17%**	-517,661	**27.09%**
Metals	-2,913,037	**7.36%**	-8,160,852	**8.35%**	-597,629	**2.84%**	7,563,224	**9.85%**	-150,451	**7.87%**
Mineral Products	-112,223	**0.28%**	-284,266	**0.29%**	-530,245	**2.52%**	-245,978	**-0.32%**	-5,131	**0.27%**
Miscellaneous	-5,341,821	**13.50%**	-12,716,462	**13.00%**	234,100	**-1.11%**	12,950,562	**16.87%**	-309,369	**16.19%**
Plastics / Rubbers	-2,097,744	**5.30%**	-6,350,723	**6.49%**	-694,537	**3.30%**	5,656,186	**7.37%**	-207,381	**10.85%**
Raw Hides, Skins, Leather, & Furs	-786,014	**1.99%**	-2,008,089	**2.05%**	-247,999	**1.18%**	1,760,090	**2.29%**	-97,652	**5.11%**
Stone / Glass	-883,997	**2.23%**	-2,787,993	**2.85%**	-210,388	**1.00%**	2,577,605	**3.36%**	-65,361	**3.42%**
Textiles	-2,228,630	**5.63%**	-6,280,996	**6.42%**	-489,738	**2.33%**	5,791,258	**7.55%**	-208,197	**10.90%**
Transportation	-3,585,345	**9.06%**	-7,207,722	**7.37%**	-4,931,226	**23.44%**	2,276,496	**2.97%**	-108,724	**5.69%**
Vegetable Products	-159,712	**0.40%**	-424,455	**0.43%**	-8,585,310	**40.80%**	-8,160,855	**-10.63%**	-5,582	**0.29%**
Wood & Wood Products	-733,663	**1.85%**	-3,292,353	**3.37%**	-966,618	**4.59%**	2,325,735	**3.03%**	-58,789	**3.08%**
TOTAL	**-39,577,863**	**100%**	**-97,790,755**	**100%**	**-21,041,334**	**100%**	**76,749,422**	**100%**	**-1,910,603**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 6. The sensitivity analysis of the COVID-19 (-10%) scenario (in thousands of USD)

Lower bound with a substitution elasticity of 0.75

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-117,967	**0.60%**	-565,385	**0.73%**	-90,689	**0.45%**	474,696	**0.82%**	-28,650	**1.37%**
Chemicals & Allied Industries	-774,397	**3.97%**	-2,967,082	**3.82%**	-1,019,971	**5.07%**	1,947,111	**3.38%**	-84,135	**4.01%**
Foodstuffs	-179,622	**0.92%**	-549,625	**0.71%**	-1,982,088	**9.86%**	-1,432,462	**-2.49%**	-11,286	**0.54%**
Footwear / Headgear	-323,035	**1.66%**	-1,461,220	**1.88%**	-53,195	**0.26%**	1,408,025	**2.44%**	-62,368	**2.98%**
Machinery / Electrical	-8,848,287	**45.36%**	-32,241,161	**41.48%**	-876,848	**4.36%**	31,364,313	**54.44%**	-590,504	**28.17%**
Metals	-1,428,879	**7.33%**	-6,676,694	**8.59%**	-611,167	**3.04%**	6,065,528	**10.53%**	-165,841	**7.91%**
Mineral Products	-55,244	**0.28%**	-227,288	**0.29%**	-403,840	**2.01%**	-176,552	**-0.31%**	-5,525	**0.26%**
Miscellaneous	-2,594,619	**13.30%**	-9,969,260	**12.83%**	-146,919	**0.73%**	9,822,341	**17.05%**	-345,691	**16.49%**
Plastics / Rubbers	-1,036,688	**5.31%**	-5,289,667	**6.81%**	-560,844	**2.79%**	4,728,823	**8.21%**	-224,906	**10.73%**
Raw Hides, Skins, Leather, & Furs	-376,886	**1.93%**	-1,598,961	**2.06%**	-216,253	**1.08%**	1,382,708	**2.40%**	-102,805	**4.91%**
Stone / Glass	-437,646	**2.24%**	-2,341,641	**3.01%**	-190,663	**0.95%**	2,150,978	**3.73%**	-68,589	**3.27%**
Textiles	-1,123,302	**5.76%**	-5,175,668	**6.66%**	-387,012	**1.93%**	4,788,656	**8.31%**	-210,214	**10.03%**
Transportation	-1,757,540	**9.01%**	-5,379,916	**6.92%**	-4,615,258	**22.96%**	764,659	**1.33%**	-125,197	**5.97%**
Vegetable Products	-78,945	**0.40%**	-343,688	**0.44%**	-8,204,464	**40.81%**	-7,860,776	**-13.64%**	-5,850	**0.28%**
Wood & Wood Products	-371,995	**1.91%**	-2,930,684	**3.77%**	-744,958	**3.71%**	2,185,727	**3.79%**	-64,305	**3.07%**
TOTAL	**-19,505,051**	**100%**	**-77,717,943**	**100%**	**-20,104,169**	**100%**	**57,613,774**	**100%**	**-2,095,865**	**100%**

Source: compiled by the author, based on SMART model simulations.

Higher bound with a substitution elasticity of 2.25

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-373,507	**0.62%**	-820,925	**0.69%**	-123,159	**0.56%**	697,766	**0.72%**	-24,315	**1.42%**
Chemicals & Allied Industries	-2,372,927	**3.94%**	-4,565,613	**3.86%**	-1,555,138	**7.08%**	3,010,475	**3.12%**	-70,746	**4.14%**
Foodstuffs	-538,551	**0.89%**	-908,554	**0.77%**	-2,144,384	**9.76%**	-1,235,830	**-1.28%**	-9,155	**0.54%**
Footwear / Headgear	-993,624	**1.65%**	-2,131,810	**1.80%**	-79,137	**0.36%**	2,052,673	**2.13%**	-62,548	**3.66%**
Machinery / Electrical	-27,105,930	**45.04%**	-50,498,803	**42.65%**	-119,018	**0.54%**	50,379,785	**52.25%**	-445,261	**26.05%**
Metals	-4,460,525	**7.41%**	-9,708,340	**8.20%**	-584,091	**2.66%**	9,124,249	**9.46%**	-134,353	**7.86%**
Mineral Products	-170,716	**0.28%**	-342,759	**0.29%**	-656,652	**2.99%**	-313,892	**-0.33%**	-4,719	**0.28%**
Miscellaneous	-8,319,759	**13.82%**	-15,694,400	**13.26%**	614,908	**-2.80%**	16,309,308	**16.91%**	-265,602	**15.54%**
Plastics / Rubbers	-3,253,082	**5.40%**	-7,506,062	**6.34%**	-828,227	**3.77%**	6,677,835	**6.93%**	-175,319	**10.26%**
Raw Hides, Skins, Leather, & Furs	-1,228,418	**2.04%**	-2,450,493	**2.07%**	-279,749	**1.27%**	2,170,744	**2.25%**	-91,965	**5.38%**
Stone / Glass	-1,345,754	**2.24%**	-3,249,749	**2.74%**	-230,113	**1.05%**	3,019,636	**3.13%**	-61,342	**3.59%**
Textiles	-3,354,345	**5.57%**	-7,406,712	**6.26%**	-592,505	**2.70%**	6,814,207	**7.07%**	-206,303	**12.07%**
Transportation	-5,384,879	**8.95%**	-9,007,256	**7.61%**	-5,247,367	**23.87%**	3,759,888	**3.90%**	-97,178	**5.69%**
Vegetable Products	-241,352	**0.40%**	-506,095	**0.43%**	-8,966,152	**40.79%**	-8,460,057	**-8.77%**	-5,300	**0.31%**
Wood & Wood Products	-1,044,334	**1.74%**	-3,603,024	**3.04%**	-1,188,347	**5.41%**	2,414,677	**2.50%**	-54,889	**3.21%**
TOTAL	**-60,187,703**	**100%**	**-118,400,595**	**100%**	**-21,979,132**	**100%**	**96,421,463**	**100%**	**-1,708,998**	**100%**

Source: compiled by the author, based on SMART model simulations.

Best case with a substitution elasticity of 3

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-521,996	**0.64%**	-969,414	**0.69%**	-139,396	**0.61%**	830,018	**0.71%**	-21,512	**1.41%**
Chemicals & Allied Industries	-3,169,509	**3.90%**	-5,362,194	**3.84%**	-1,822,760	**7.95%**	3,539,434	**3.04%**	-64,922	**4.26%**
Foodstuffs	-716,417	**0.88%**	-1,086,421	**0.78%**	-2,225,539	**9.71%**	-1,139,118	**-0.98%**	-8,591	**0.56%**
Footwear / Headgear	-1,342,183	**1.65%**	-2,480,369	**1.78%**	-92,114	**0.40%**	2,388,254	**2.05%**	-62,622	**4.11%**
Machinery / Electrical	-36,534,160	**44.95%**	-59,927,034	**42.96%**	259,734	**-1.13%**	60,186,768	**51.63%**	-366,897	**24.06%**
Metals	-6,075,475	**7.47%**	-11,323,290	**8.12%**	-570,549	**2.49%**	10,752,741	**9.22%**	-117,015	**7.67%**
Mineral Products	-232,215	**0.29%**	-404,259	**0.29%**	-783,061	**3.42%**	-378,802	**-0.32%**	-4,275	**0.28%**
Miscellaneous	-11,382,000	**14.00%**	-18,756,640	**13.45%**	995,505	**-4.34%**	19,752,146	**16.94%**	-227,677	**14.93%**
Plastics / Rubbers	-4,324,311	**5.32%**	-8,577,291	**6.15%**	-961,911	**4.20%**	7,615,379	**6.53%**	-162,917	**10.68%**
Raw Hides, Skins, Leather, & Furs	-1,700,595	**2.09%**	-2,922,670	**2.10%**	-311,503	**1.36%**	2,611,168	**2.24%**	-85,678	**5.62%**
Stone / Glass	-1,840,094	**2.26%**	-3,744,090	**2.68%**	-249,841	**1.09%**	3,494,249	**3.00%**	-57,941	**3.80%**
Textiles	-4,522,895	**5.56%**	-8,575,262	**6.15%**	-695,314	**3.03%**	7,879,948	**6.76%**	-203,814	**13.37%**
Transportation	-7,251,156	**8.92%**	-10,873,533	**7.79%**	-5,563,683	**24.28%**	5,309,850	**4.55%**	-84,797	**5.56%**
Vegetable Products	-325,167	**0.40%**	-589,909	**0.42%**	-9,346,990	**40.79%**	-8,757,081	**-7.51%**	-4,993	**0.33%**
Wood & Wood Products	-1,345,511	**1.66%**	-3,904,201	**2.80%**	-1,410,147	**6.15%**	2,494,054	**2.14%**	-51,238	**3.36%**
TOTAL	**-81,283,685**	**100%**	**-139,496,576**	**100%**	**-22,917,569**	**100%**	**116,579,007**	**100%**	**-1,524,888**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 7. The model output for the COVID-19 (-15%) scenario (in thousands of USD)

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-142,419	**0.38%**	-397,465	**0.43%**	-135,685	**0.67%**	261,780	**0.37%**	-6,741	**0.38%**
Chemicals & Allied Industries	-3,800,466	**10.23%**	-10,448,684	**11.40%**	882,353	**-4.39%**	11,331,036	**15.84%**	-346,312	**19.53%**
Foodstuffs	-218,747	**0.59%**	-564,761	**0.62%**	-1,775,812	**8.83%**	-1,211,051	**-1.69%**	-9,180	**0.52%**
Footwear / Headgear	-37,015	**0.10%**	-107,020	**0.12%**	-52,192	**0.26%**	54,827	**0.08%**	-2,867	**0.16%**
Machinery / Electrical	-16,831,752	**45.32%**	-38,613,698	**42.13%**	-2,502,741	**12.44%**	36,110,957	**50.48%**	-460,317	**25.96%**
Metals	-2,758,286	**7.43%**	-7,676,799	**8.38%**	-998,186	**4.96%**	6,678,613	**9.34%**	-134,461	**7.58%**
Mineral Products	-125,540	**0.34%**	-361,105	**0.39%**	-459,078	**2.28%**	-97,973	**-0.14%**	-11,580	**0.65%**
Miscellaneous	-5,020,939	**13.52%**	-11,899,560	**12.98%**	-1,059,306	**5.27%**	10,840,255	**15.15%**	-285,612	**16.11%**
Plastics / Rubbers	-512,103	**1.38%**	-2,535,918	**2.77%**	645,223	**-3.21%**	3,181,140	**4.45%**	-49,033	**2.77%**
Raw Hides, Skins, Leather, & Furs	-190,669	**0.51%**	-598,836	**0.65%**	-62,655	**0.31%**	536,181	**0.75%**	-7,077	**0.40%**
Stone / Glass	-544,980	**1.47%**	-1,770,590	**1.93%**	-218,524	**1.09%**	1,552,067	**2.17%**	-35,923	**2.03%**
Textiles	-3,078,006	**8.29%**	-8,683,236	**9.47%**	-88,638	**0.44%**	8,594,598	**12.01%**	-302,396	**17.05%**
Transportation	-3,416,306	**9.20%**	-6,836,119	**7.46%**	-5,426,402	**26.98%**	1,409,717	**1.97%**	-92,327	**5.21%**
Vegetable Products	-363,095	**0.98%**	-726,528	**0.79%**	-8,046,909	**40.01%**	-7,320,381	**-10.23%**	-11,939	**0.67%**
Wood & Wood Products	-98,187	**0.26%**	-429,401	**0.47%**	-812,841	**4.04%**	-383,440	**-0.54%**	-17,537	**0.99%**
TOTAL	**-37,138,511**	**100%**	**-91,649,721**	**100%**	**-20,111,393**	**100%**	**71,538,327**	**100%**	**-1,773,301**	**100%**

Source: compiled by the author, based on SMART model simulations.

Annex 8. The sensitivity analysis of the COVID-19 (-15%) scenario (in thousands of USD)

Lower bound with a substitution elasticity of 0.75

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-111,589	**0.61%**	-533,749	**0.73%**	-103,000	**0.54%**	430,750	**0.80%**	-26,905	**1.38%**
Chemicals & Allied Industries	-721,267	**3.94%**	-2,792,137	**3.83%**	86,003	**-0.45%**	2,878,139	**5.36%**	-82,364	**4.23%**
Foodstuffs	-167,222	**0.91%**	-516,670	**0.71%**	-1,785,550	**9.35%**	-1,268,880	**-2.36%**	-13,079	**0.67%**
Footwear / Headgear	-289,150	**1.58%**	-1,364,103	**1.87%**	-45,092	**0.24%**	1,319,011	**2.46%**	-60,116	**3.09%**
Machinery / Electrical	-8,313,279	**45.42%**	-3,0095,226	**41.33%**	-1,844,430	**9.65%**	28,250,796	**52.60%**	-528,561	**27.14%**
Metals	-1,352,744	**7.39%**	-6,271,257	**8.61%**	-794,081	**4.16%**	5,477,176	**10.20%**	-148,977	**7.65%**
Mineral Products	-52,168	**0.29%**	-214,654	**0.29%**	-360,560	**1.89%**	-145,907	**-0.27%**	-5,220	**0.27%**
Miscellaneous	-2,438,376	**13.32%**	-9,316,997	**12.80%**	-779,039	**4.08%**	8,537,957	**15.90%**	-319,859	**16.42%**
Plastics / Rubbers	-968,288	**5.29%**	-4,984,991	**6.85%**	120,909	**-0.63%**	5,105,900	**9.51%**	-213,059	**10.94%**
Raw Hides, Skins, Leather, & Furs	-350,881	**1.92%**	-1,505,063	**2.07%**	-118,458	**0.62%**	1,386,605	**2.58%**	-100,318	**5.15%**
Stone / Glass	-412,283	**2.25%**	-2,182,166	**3.00%**	-189,984	**0.99%**	1,992,183	**3.71%**	-62,100	**3.19%**
Textiles	-1,026,173	**5.61%**	-4,853,408	**6.67%**	-178,549	**0.93%**	4,674,859	**8.70%**	-212,702	**10.92%**
Transportation	-1,675,813	**9.16%**	-5,095,626	**7.00%**	-4,743,459	**24.83%**	352,167	**0.66%**	-107,633	**5.53%**
Vegetable Products	-73,444	**0.40%**	-321,300	**0.44%**	-7,717,937	**40.39%**	-7,396,637	**-13.77%**	-5,697	**0.29%**
Wood & Wood Products	-350,029	**1.91%**	-2,766,570	**3.80%**	-653,528	**3.42%**	2,113,041	**3.93%**	-60,982	**3.13%**
TOTAL	**-18,302,706**	**100%**	**-72,813,916**	**100%**	**-19,106,754**	**100%**	**53,707,161**	**100%**	**-1,947,572**	**100%**

Source: compiled by the author, based on SMART model simulations.

Higher bound with a substitution elasticity of 2.25

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-353,351	**0.63%**	-775,512	**0.70%**	-168,376	**0.80%**	607,136	**0.68%**	-22,817	**1.44%**
Chemicals & Allied Industries	-2,208,954	**3.91%**	-4,279,824	**3.86%**	1,678,419	**-7.95%**	5,958,243	**6.63%**	-69,544	**4.39%**
Foodstuffs	-501,319	**0.89%**	-850,767	**0.77%**	-1,766,123	**8.36%**	-915,356	**-1.02%**	-11,042	**0.70%**
Footwear / Headgear	-888,144	**1.57%**	-1,963,097	**1.77%**	-59,295	**0.28%**	1,903,802	**2.12%**	-60,261	**3.81%**
Machinery / Electrical	-25,467,642	**45.09%**	-47,249,588	**42.57%**	-3,161,087	**14.97%**	44,088,501	**49.06%**	-392,507	**24.79%**
Metals	-4,224,861	**7.48%**	-9,143,374	**8.24%**	-1,202,311	**5.69%**	7,941,063	**8.84%**	-119,247	**7.53%**
Mineral Products	-161,226	**0.29%**	-323,712	**0.29%**	-557,578	**2.64%**	-233,867	**-0.26%**	-4,458	**0.28%**
Miscellaneous	-7,821,585	**13.85%**	-14,700,206	**13.24%**	-1,339,608	**6.34%**	13,360,598	**14.87%**	-244,323	**15.43%**
Plastics / Rubbers	-3,038,050	**5.38%**	-7,054,753	**6.36%**	1,169,528	**-5.54%**	8,224,281	**9.15%**	-166,173	**10.49%**
Raw Hides, Skins, Leather, & Furs	-1,143,105	**2.02%**	-2,297,287	**2.07%**	-6,854	**0.03%**	2,290,434	**2.55%**	-90,089	**5.69%**
Stone / Glass	-1,267,978	**2.25%**	-3,037,862	**2.74%**	-247,064	**1.17%**	2,790,798	**3.11%**	-55,272	**3.49%**
Textiles	-3,058,313	**5.42%**	-6,885,548	**6.20%**	1,206	**-0.01%**	6,886,754	**7.66%**	-208,909	**13.19%**
Transportation	-5,133,506	**9.09%**	-8,553,319	**7.71%**	-6,109,438	**28.93%**	2,443,881	**2.72%**	-81,532	**5.15%**
Vegetable Products	-224,670	**0.40%**	-472,526	**0.43%**	-8,375,884	**39.66%**	-7,903,359	**-8.79%**	-5,178	**0.33%**
Wood & Wood Products	-984,510	**1.74%**	-3,401,051	**3.06%**	-972,229	**4.60%**	2,428,822	**2.70%**	-52,012	**3.28%**
TOTAL	**-56,477,215**	**100%**	**-110,988,425**	**100%**	**-21,116,693**	**100%**	**89,871,732**	**100%**	**-1,583,363**	**100%**

Source: compiled by the author, based on SMART model simulations.

Best case with a substitution elasticity of 3

Product categories	Trade diversion from China		US imports from China		US exports to China		Trade balance with China		Welfare	
Animal & Animal Products	-493,838	**0.65%**	-915,999	**0.70%**	-201,072	**0.91%**	714,927	**0.66%**	-20,172	**1.43%**
Chemicals & Allied Industries	-2,949,146	**3.86%**	-5,020,016	**3.83%**	2,474,206	**-11.18%**	7,494,221	**6.89%**	-64,005	**4.54%**
Foodstuffs	-667,363	**0.87%**	-1,016,811	**0.78%**	-1,756,485	**7.94%**	-739,674	**-0.68%**	-10,494	**0.75%**
Footwear / Headgear	-1,198,823	**1.57%**	-2,273,776	**1.74%**	-66,401	**0.30%**	2,207,376	**2.03%**	-60,317	**4.28%**
Machinery / Electrical	-34,500,563	**45.14%**	-56,282,509	**42.98%**	-3,819,469	**17.26%**	52,463,041	**48.21%**	-317,134	**22.52%**
Metals	-5,754,922	**7.53%**	-10,673,435	**8.15%**	-1,406,458	**6.36%**	9,266,976	**8.52%**	-102,852	**7.30%**
Mineral Products	-219,306	**0.29%**	-381,792	**0.29%**	-656,061	**2.97%**	-274,269	**-0.25%**	-4,039	**0.29%**
Miscellaneous	-10,699,823	**14.00%**	-17,578,444	**13.43%**	-1,619,945	**7.32%**	15,958,499	**14.67%**	-208,561	**14.81%**
Plastics / Rubbers	-4,038,474	**5.28%**	-8,055,177	**6.15%**	1,693,824	**-7.66%**	9,749,001	**8.96%**	-154,509	**10.97%**
Raw Hides, Skins, Leather, & Furs	-1,575,794	**2.06%**	-2,729,976	**2.08%**	48,947	**-0.22%**	2,778,923	**2.55%**	-84,207	**5.98%**
Stone / Glass	-1,733,400	**2.27%**	-3,503,284	**2.68%**	-275,606	**1.25%**	3,227,678	**2.97%**	-52,063	**3.70%**
Textiles	-4,118,707	**5.39%**	-7,945,942	**6.07%**	90,982	**-0.41%**	8,036,923	**7.39%**	-206,606	**14.67%**
Transportation	-6,905,692	**9.04%**	-10,325,506	**7.89%**	-6,792,565	**30.70%**	3,532,941	**3.25%**	-69,973	**4.97%**
Vegetable Products	-302,805	**0.40%**	-550,661	**0.42%**	-8,704,863	**39.35%**	-8,154,203	**-7.49%**	-4,888	**0.35%**
Wood & Wood Products	-1,268,249	**1.66%**	-3,684,790	**2.81%**	-1,131,695	**5.12%**	2,553,095	**2.35%**	-48,564	**3.45%**
TOTAL	**-76,426,906**	**100%**	**-130,938,116**	**100%**	**-22,122,660**	**100%**	**108,815,456**	**100%**	**-1,408,385**	**100%**

Source: compiled by the author, based on SMART model simulations.