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US Trade Wars with Emerging Countries in the 21st Century

Make America and Its Partners Lose Again

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US Trade Wars with Emerging Countries in the 21st Century: Make America and Its Partners Lose Again[1]

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Abstract

In a context of rising protectionist rhetoric, this paper looks at the potential impact of trade wars initiated by a change in US trade policies. We show that such trade wars can hurt emerging countries and damage the global trading system without bringing gains for the United States. We use a static multicountry, multisector Armington trade model to evaluate 6 modalities of 3 potential trade wars—for a total of 18 scenarios—between the United States and China, between the United States and Mexico, and between the United States and both China and Mexico. We also determine and analyze the optimal noncooperative unilateral tariff that the US government can implement against all of its trading partners. In each case, we evaluate various forms of trade retaliation by the trading partner(s): the same level of import duty as the one imposed by the United States, a duty that minimizes welfare loss, a duty that minimizes terms-of-trade deterioration, a duty that generates the same amount of collected revenue, and finally, a Nash equilibrium. We conclude that there is no scenario in which the US government augments its domestic welfare or gross domestic product. There may be sectoral gains in value-added in the United States, but they are small and to the detriment of other sectors. Although losses for China are relatively small, potential losses for the Mexican economy are significant. There are also potential free riders of these trade wars, particularly in Central America. Finally, the way in which trade retaliations are designed matters greatly.

JEL Classification: F11, F13, F15

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"*You know, I don't mind trade wars when we're losing $58 billion a year, you want to know the truth. We're losing so much. We're losing so much with Mexico and China, with China, we're losing $500 billion a year.*"

Donald Trump, *Breitbart News*, February 25, 2016

"*No one can win a trade war.*"
Xi Jinping, Davos, Switzerland, January 17, 2017

1 Introduction

The end of 2016 and the beginning of 2017 saw a dramatic change in the global trade picture. After the British referendum supporting the exit of the United Kingdom from the European Union, the US presidential election followed with the victory of Donald Trump, who made many protectionist statements during the campaign, particularly threatening China, Mexico, and Germany with import duties. He announced that he would "impose tariffs of 35 percent on Mexican imports and 45 percent on Chinese imports to protect American jobs from unfair foreign competition" (*Fox News* 2016). One of his first decisions was in fact to sign an executive order withdrawing the United States from the Trans-Pacific Partnership; however, this move was largely symbolic because the deal had not been ratified by the US Congress.

This paper evaluates potential trade wars between the United States and China and the United States and Mexico. With the help of a static multicountry, multisector general equilibrium model, we evaluate 18 scenarios of trade wars; these scenarios vary the function of the trading partners involved in a trade war with the United States (either China, Mexico, or both) and the form that retaliations could take.

Trade wars have been a highly debated topic in the economic literature recently; Section 2 of this paper reviews this literature. Overall, the literature concludes that (1) in global trade wars, all

countries lose in terms of welfare;[2] (2) a trade war between a large country and a small country[3] can result in gains for the large country but losses for the small one; and (3) a trade war cannot lead to gains for all countries involved, and cooperation may lead to a better solution for all countries. These conclusions have received both theoretical and empirical support.

The evaluation in this paper is based on a static multiregion, multisector computable general equilibrium (CGE) model based on the most recent data on tariffs, trade, and production, known as Modeling International Relationships under Applied General Equilibrium for the African Growth and Development Policy Modeling Consortium, or MIRAGRODEP (AGRODEP 2013). This methodology has the major advantage of being economically consistent through taking into account each country's limited productive resources, the interdependence between economic sectors and trading countries, and income effects. We carefully select the regions and sectors included in this modeling exercise in order to account for the trading partners and sectors that could be the most affected by these policy scenarios.

For this study, we select China and Mexico as target countries for the change in orientation of US trade policy.[4] During the US presidential campaign, Trump proposed various increases in import duties for both countries. We select an augmentation in import duty of 35 percentage points for imports coming from both China and Mexico. For Mexico, this is equal to the increase Trump often advanced during the campaign, which was commented upon by many experts (Jean 2017); for China, it is less. We use the same augmentation factor for both countries so as not to create an additional source of differentiating impact on the Chinese and the Mexican economies.

[2] In most studies, welfare is defined as an equivalent variation—that is to say, the monetary amount a representative agent would be indifferent about accepting in place of the implementation of the scenario.

[3] What is the criterion for defining a large or a small country in this literature? It depends on the elasticity of the demand for imports to the terms of trade. If a country is large enough, a modification of its demand for imports impacts world prices.

[4] We focus on these two developing countries in this paper. Nevertheless, the new US administration has also developed a protectionist rhetoric vis à vis two important partners in the G7: Germany and Canada.

In all cases, we apply the augmentation of the import duty to all products coming into the United States from these trading partners, with the exceptions of oil, energy, and mineral products, which US authorities often consider to be of strategic importance.[5]

To determine the degree of retaliation these two trade partners might impose, we adopt five scenarios:

1. China, Mexico, or both implement the same augmentation of import duty on products imported from the United States as the one adopted by the United States on its imports from these countries
2. China, Mexico, or both implement an import duty, *t*, on all imports from the United States such that the tariff revenue newly collected on these imports[6] is equal to the tariff revenue newly collected by US authorities on these countries' exports
3. China, Mexico, or both implement an import duty, *t*, on all imports from the United States such that the country's (countries') terms of trade with the United States are the same as they were in the baseline or as close as possible
4. There is an optimum tariff scenario wherein each country imposes the tariff that maximizes its representative agent's welfare, based on the initial tariff imposed by its trading partners
5. We establish a Nash equilibrium between the belligerents—that is, the best response in terms of welfare for each country based on the optimum tariff implemented by the belligerents

Our study reaches several conclusions, two of which are worth mentioning here. First, even for the United States, initiating a trade war is not the right policy for improving domestic welfare and gross domestic product (GDP). Even a unilateral augmentation of protection vis-à-vis trading partners such as China and Mexico at the magnitude Trump propounded as a candidate does not lead to an increase in domestic welfare and GDP for the United States. Second, trade wars could be significantly damaging for these trading partners, particularly Mexico, which is smaller than the United States in economic terms and whose exports are concentrated toward the United States.

[5] We understand that this policy breaks the basic principles of the World Trade Organization, but from various statements made by the new US president, it looks like these principles are not his priority.

[6] We take the value of imports in the baseline as the basis for this extra revenue.

The rest of the paper is laid out as follows. Section 2 reviews the literature. Section 3 provides a short assessment of current US trade relations with China and Mexico. The methodology of the study is presented in Section 4, and Section 5 presents the results. Section 6 concludes.

2 Review of Literature

The literature on trade wars is large. Let us start with the theoretical aspects. Johnson (1953) analyzed the case of trade wars based on the optimum tariff argument and was the first to clearly demonstrate that large countries can benefit from a trade war whereas small countries always lose. He demonstrated this point under a neoclassical framework with perfect competition, well-behaved utility functions, and *ad valorem* tariffs. In the "general case," large countries lose from trade wars. In what the literature has since called the "Johnson case," a large country's national welfare is better under the Nash tariff equilibrium than under free trade, but a small country's welfare is still reduced.

Since Johnson (1953), one strand of the literature has looked for various generalizations allowing for different policy instruments—specific tariffs in Horwell (1966), quotas in Rodriguez (1974) and Tower (1975), arbitrary numbers of countries and goods in Kuga (1973), and alternative formulations of governments' preferences in Bagwell and Staiger (1999)—without modifying Johnson's main conclusions. Grossman and Helpman (1995) introduced domestic political agendas into the analysis of international relations with terms-of-trade externalities, under the assumption that national leaders are concerned not only with maximizing welfare but also with collecting campaign contributions from special-interest groups. These authors studied the formation of the tariff equilibrium and the possibility of a cooperative policy equilibrium. This naturally opened up a second branch of the literature, which has tried to unveil conditions under which trade agreements would improve global welfare after a trade war (for example, Mayer 1981; Riezman 1982; and Dixit 1987). Along these lines, Bagwell and Staiger (2002) provided an economic analysis of and justification for the World Trade Organization's (WTO's) multilateral system.

This previous literature is based on terms-of-trade externalities: through trade restrictions, countries modify the terms of trade at the expense of their trading partners. However, this is not the only way in which trade retaliation and trade wars can be studied. Strategic trade policy is also

a channel through which the characteristics of trade policy equilibria can be examined. For example, Brander and Spencer (1985) studied an export subsidy war between two countries in an export market rivalry under Cournot competition. In this scenario, each country aims to allow national firms to collect more excess profits in a sector under imperfect competition. Spencer and Brander (1983) studied research and development subsidies, and Eaton and Grossman (1986) studied Bertrand competition and policy equilibrium between two countries that both tax their oligopolistic firms' exports. Maggi (1996) described a more complex framework in which governments first select a policy, firms then install their production capacities, and finally firms choose prices; in this scenario, the mode of competition, either Bertrand or Cournot, becomes endogenous. The model justifies a simple policy (capacity subsidies) that increases a country's income regardless of the mode of competition.

Moving to the empirical side of the literature, it is interesting to note important contributions from historical studies of trade wars. Conybeare defined trade wars as a "category of intense international conflict where states interact, bargain, and retaliate primarily over economic objectives directly related to the traded goods or service sectors of their economies, and where the means used are restrictions on the free flow of goods and services" (1987, 3). He made distinctions among three types of trade wars:

- Trade wars thought of as a prisoners' dilemma: In this scenario, cooperation is worthwhile only if it is bilateral; noncooperation is a dominating strategy, but if everyone implements that strategy, mutual disaster ensues (exemplified by the Chicken War between the United States and the European Economic Community during the 1960s).
- Trade wars between a large and a small country: In this scenario, the large country benefits from a trade war and the small one loses (known as the "Johnson case," as in the trade war between France and Italy in 1886–1898, the one between France and Switzerland in 1892–1895, and the one between Germany and Russia in 1893–1894).
- Trade wars among a large number of nations (such as the one sparked by the Smoot-Hawley Tariff Act of 1930)

The Smoot-Hawley Tariff Act itself has received a great deal of attention from economists. In June 1930, eight months after the Wall Street crash of October 1929, the US Congress raised tariffs on 20,000 imported goods. The average tariff on protected imports increased from 39 percent to 53

percent, and the share of protected imports in total imports increased from 34 percent to 48 percent. Many US trading partners retaliated against the United States in the following months, Canada as early as May 1930 (even before Congress enacted the US law), with other countries following. When global trade collapsed after 1930, the US economy was particularly affected: its share in world trade went from 16 percent to 11 percent between 1930 and 1935. US imports also fell by about 40 percent after June 1930, but part of this decline may be attributed to a decline in US national income as well as foreign retaliation and deflation, which increased the protectionist impact of Smoot-Hawley. By designing a simple general equilibrium model, Irwin (1998) concluded that this law led to an efficiency loss in the US gross national product of between 0.3 and 1.9 percent.

Although the primary objective of Bouët and Laborde (2010) was to provide a new evaluation of the Doha Development Agenda, their study also looked at the scenario of a multilateral trade war in which the tariffs applied by major economies between 2009 and 2014 increase to the currently bound tariff rates. These authors found that under this scenario, world trade decreases by 7.7 percent and world welfare drops by US$353 billion.

Hamilton and Whalley (1983) designed pure exchange models as well as models of production in a two-goods, two-countries trade model with conventional functional forms for preferences and production function. They found that Nash equilibrium tariffs are significantly higher than actual tariffs and that the adoption of Nash equilibrium tariffs implies substantial welfare losses for trading partners.

A case in which all trading partners lose from a trade war traditionally has been considered more probable in the literature (see Baumol and Blinder 1985); however, Kennan and Riezman (1988) showed that in an exchange economy, “Johnson cases” may often happen.

Ossa (2014) proposed a multicountry, multi-industry general equilibrium model of international trade in which governments impose import duties in order to (1) manipulate the terms of trade (the optimum tariff argument), (2) shift profits away from other countries (the strategic trade policy argument), and (3) protect politically influential industries (the political economy argument). Ossa’s model was calibrated on 33 industries and 7 regions. The author first studied the implementation of optimal tariffs (without retaliation) for each country, finding the average optimal tariff to be 62.4 percent and the mean welfare gain for a tariff-imposing economy to be

1.9 percent, with a mean welfare loss for other economies of 0.7 percent. Ossa then studied a Nash equilibrium wherein the average tariff was 63.4 percent and the average loss 2.9 percent, finding all economies worse off under this scenario, compared with free trade.

In a later paper, Ossa (2016) designed a new quantitative trade model, along the lines of the one used by Costinot and Rodriguez-Clare (2014), and estimated optimal tariffs (welfare-maximizing tariffs without retaliation) and Nash tariffs for 10 countries and 33 industries. The imposition of optimal tariffs, he found, leads to average welfare gains of 2.4 percent and average losses for partners of 0.6 percent. Nash tariffs lead to average losses of 3.5 percent and were found to be relatively high: around 50 percent in the case of the United States and 40 percent for Canada.

We draw three main conclusions from this review of the literature. First, global tariff wars may be very prejudicial to all countries and to the world economy in general. Second, in bilateral trade wars, two outcomes are possible. In the general case, the two countries are hurt compared with a scenario of free trade (or the initial point). In some cases, those that we could still call Johnson cases, the large country increases its welfare (or its GDP) and the small country loses. Third, even under Johnson cases, world welfare is decreased.

3 US Trade Relations with China and Mexico

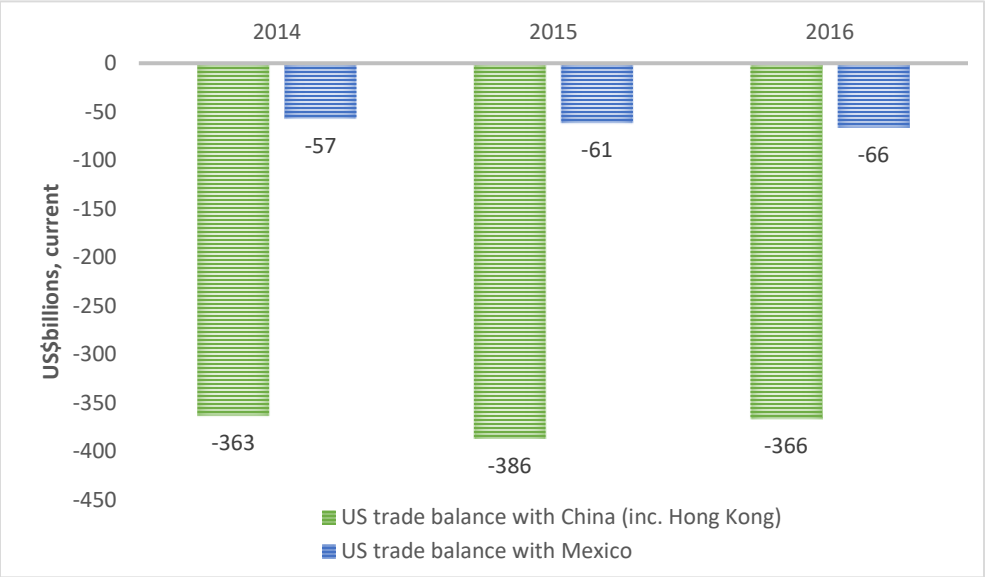
This section provides some data regarding trade between the United States and China and between the United States and Mexico in order to give some initial characterization of the object of our analysis.

Data regarding the economic size of these three countries could be important in interpreting the results of a trade war. China and the United States can be considered large countries, with populations of 1,379 million and 324 million, respectively, in 2016, and GDPs in the same year of, respectively, US$11,392 and US$18,562 billion, in nominal terms. Comparatively, in 2016, Mexico's population was only 122 million and its GDP only US$1,064 billion. These data translate to a scale of 1 to 17.4 when comparing US and Mexican GDP and a scale of 1 to 10.7 when comparing US and Chinese GDP.

All three countries are members of the WTO; the United States and Mexico have been members since the birth of the institution (January 1, 1995), and China became a full member in 2001.

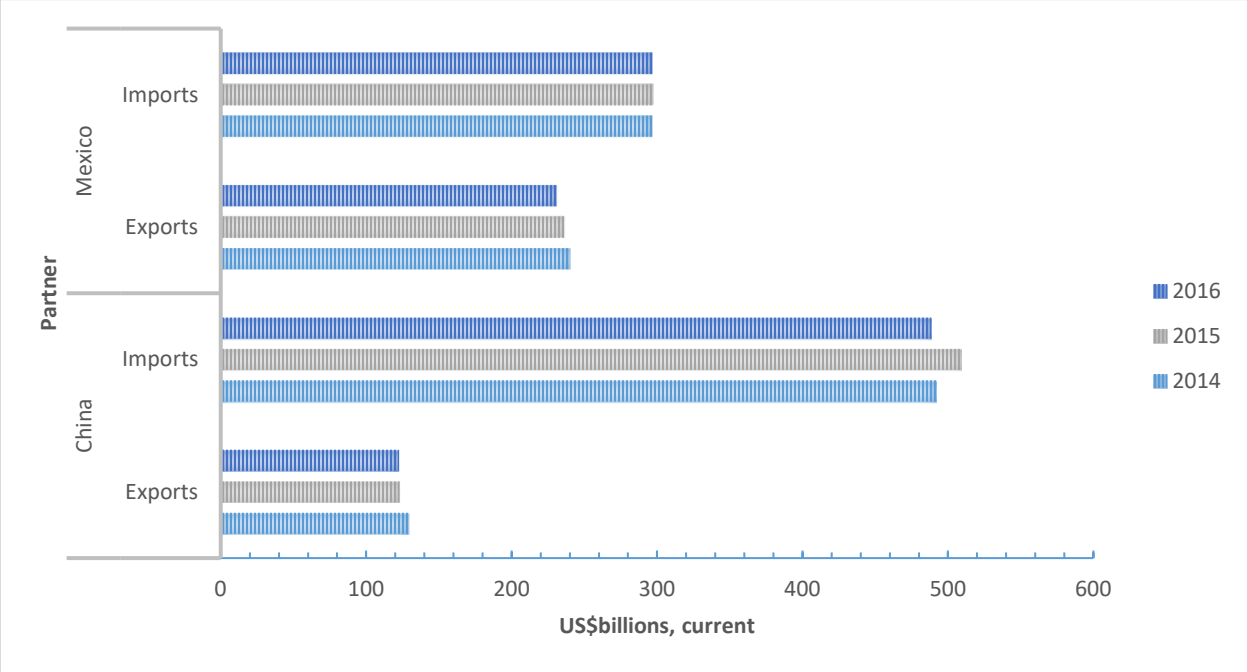
As stated by the recently elected US president, the main reason for launching a trade war is the importance of bilateral (with the United States) trade deficits. Figure 3.1 depicts these deficits, Figure 3.2 the value of trade flows. The US trade deficit with China is especially important.

Figure 3.1 Levels of US trade deficits, trade in goods, current US$billions



Source: Authors' computations based on the UN Comtrade database (United Nations 2017), with United States as reporting country.

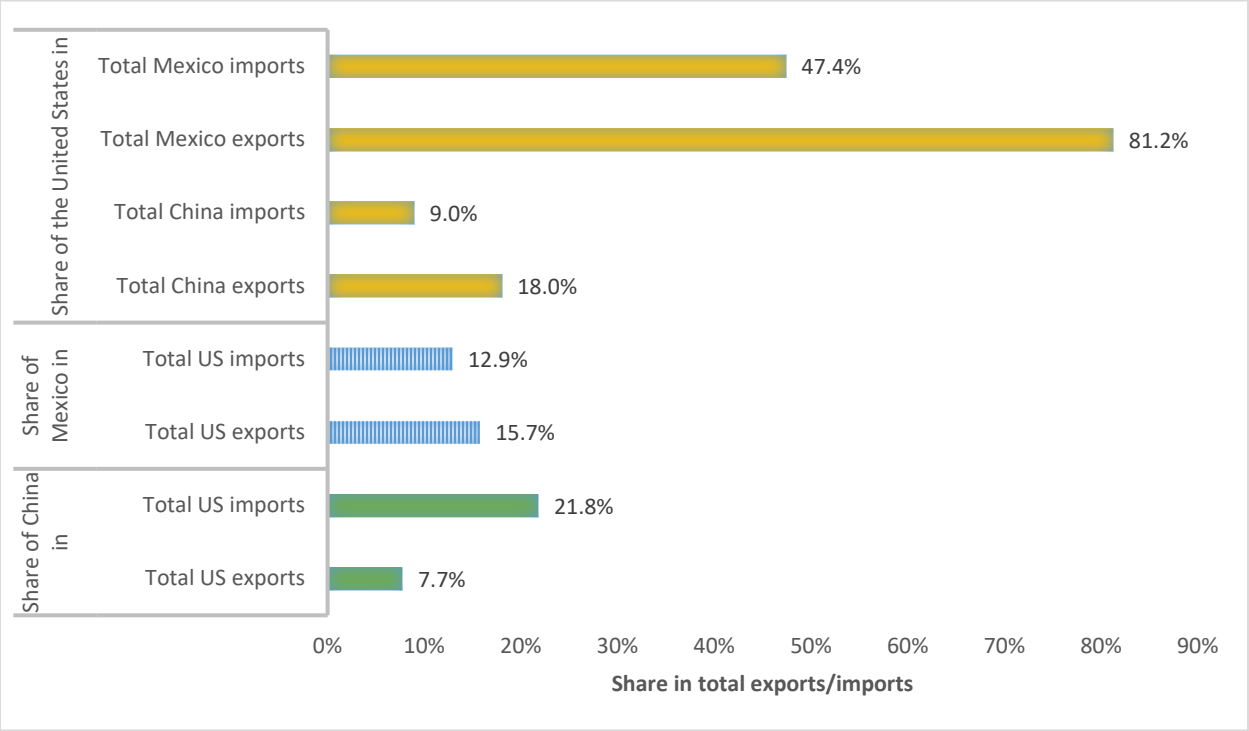
Figure 3.2 US exports and imports to and from China and Mexico, trade in goods, current US$billions



Source: Authors' computations based on the UN Comtrade database (United Nations 2017), with United States as reporting country.

The two trade relationships (US-China and US-Mexico) are significant, particularly for Mexico, for which the United States represents 81 percent of total exports of goods and 47 percent of total imports (Figure 3.3).

Figure 3.3 Bilateral trade shares (value) in total exports and imports of each country, 2015



Source: Authors' computations based on the UN Comtrade database (United Nations 2017).

The principal US exports to China in 2016 were transportation equipment (22 percent of total exports in value),[7] agricultural products (14.9 percent), and computers and electronic products (14.8 percent). The principal US imports from China in 2016 were computers and electronic products (34.8 percent), electrical equipment, appliances and components (8.8 percent), and other miscellaneous manufactured goods (8.5 percent). The sectoral structure of US exports to Mexico in 2016 was relatively similar to that of exports to China, with the exception that chemicals were important and agricultural products were significantly less important. The same conclusion applies to US imports from Mexico in 2016, although the transportation equipment sector is also important (33.8 percent of total imports).

Both trade relationships are highly illustrative of global value chains (GVCs), and their participation in GVCs are quite similar (Table 3.1). According to the Trade in Value-Added

[7] Data in this paragraph come from the International Trade Administration, US Department of Commerce (2017).

(TiVA) joint database of the Organisation for Economic Co-operation and Development (OECD) and the WTO, if the global participation index of both countries is close to the average index for developing economies, both countries are characterized by backward participation, or vertical specialization (OECD and WTO 2016). This situation corresponds to a relatively important foreign value-added export content: both countries import foreign inputs in order to produce intermediate or final goods and services to be exported. Comparatively, forward participation in GVCs is relatively small in both countries; forward participation is measured by domestic value-added sent to third economies for reexport purposes—that is, the domestic value-added of exported intermediates exported to a first economy that reexports to a third one after transformation.

Table 3.1 Global value chain participation index, 2011

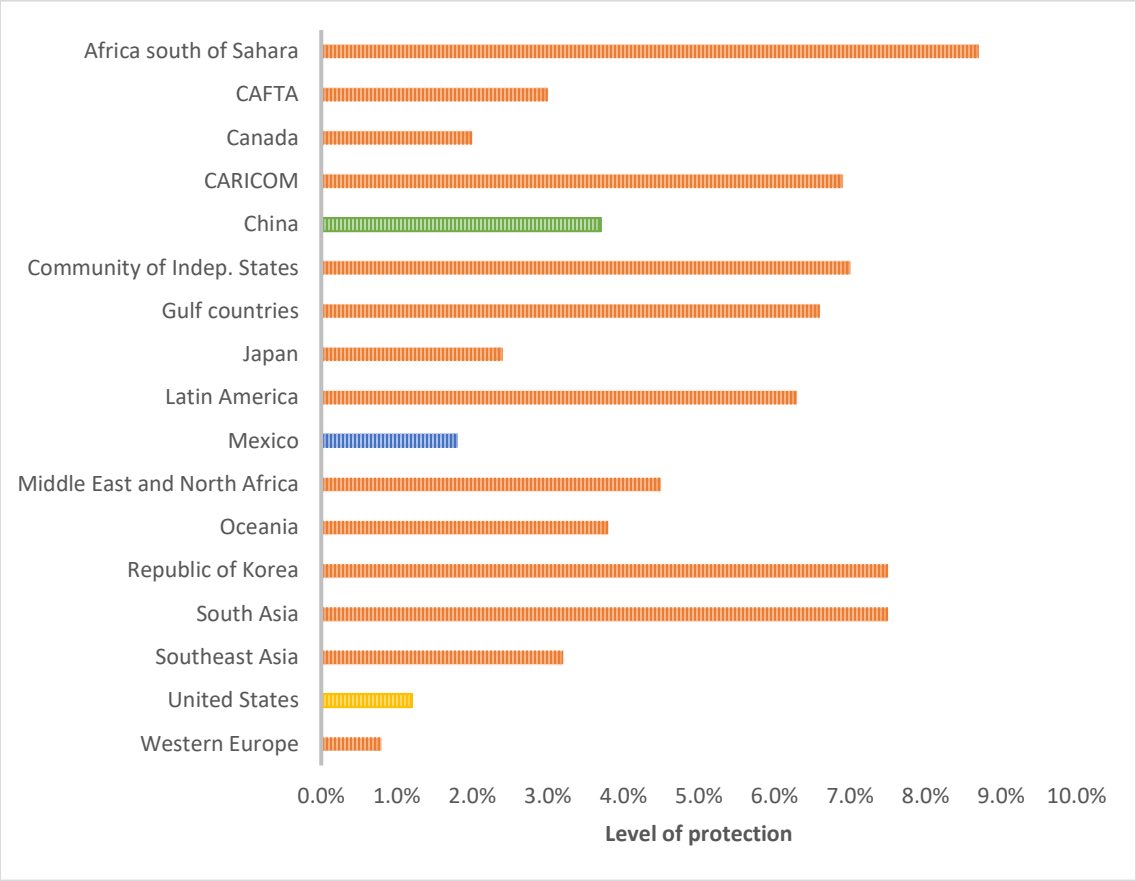
	Mexico	*China*	*Developing economies*	*Developed economies*
Total participation	46.8	47.7	48.6	48.0
Forward participation	15.1	15.6	23.1	24.2
Backward participation	31.7	32.1	25.5	23.8

Source: OECD and WTO (2016).

Let us now assess countries' level of protection. Figure 3.4 shows the average level of protection by country or region included in this study[8] for all goods and all partners. Because we weigh tariffs by bilateral trade, this indicator rather underestimates the average protection. However, it illustrates today's low level of average protection, particularly in the United States.

[8] The geographic disaggregation adopted here is explained in the next section and in the appendix. In particular, western Europe is the European Union plus the European Free Trade Association.

Figure 3.4 Level of global protection by country, trade-weighted average of import duties on goods, 2011



Source: Authors' calculations based on the GTAP 9 database (GTAP 2017).

Note: CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community.

Table 3.2 indicates bilateral levels of protection. For example, the average protection imposed by Canada on imports of goods coming from China is 4 percent, whereas the same average for goods from Japan is 3 percent. We note that US protection on Chinese goods is 3 percent on average, whereas it is 0 percent for Mexico due to the North American Free Trade Agreement (NAFTA). China imposes an average import duty of 5 percent on goods coming from the United States and Mexico, if we do not account for duty drawback. The Mexican average tariff on Chinese exports is 6 percent and on US goods 0 percent.

Table 3.2 Bilateral tariff structure, trade weighted, percentage points

Importer: / Exporter:	*Canada*	***China***	*Japan*	*Rep. of Korea*	***Mexico***	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	n.a.	**3**	9	6	**0**	**0**	2	3	12	6	4	3	2	12	5	6	9
China	**4**	n.a.	**3**	**6**	**6**	**3**	**4**	**4**	**9**	**11**	**7**	**6**	**4**	**9**	**11**	**8**	**13**
Japan	3	**6**	n.a.	5	**3**	**1**	10	5	12	10	2	6	3	13	7	6	12
Rep. of Korea	10	**5**	2	n.a.	**8**	**1**	9	3	8	11	6	20	1	11	10	9	11
Mexico	**0**	**5**	**7**	**4**	n.a.	**0**	**4**	**4**	**4**	**3**	**2**	**4**	**0**	**14**	**4**	**7**	**5**
United States	**1**	**5**	**6**	**28**	**0**	n.a.	**1**	**3**	**8**	**6**	**2**	**9**	**2**	**8**	**4**	**4**	**8**
Oceania	5	**2**	3	5	**7**	**1**	2	3	6	9	20	7	7	9	5	7	7
Southeast Asia	2	**3**	1	3	**7**	**3**	2	3	17	10	4	5	2	8	6	10	11
South Asia	4	**2**	1	14	**13**	**4**	4	5	9	8	5	3	3	9	6	4	10
Latin America	2	**2**	2	14	**4**	**1**	1	4	3	1	4	5	4	10	6	10	10
CAFTA	1	**1**	1	3	**3**	**1**	1	1	7	5	3	5	2	11	1	19	6
CARICOM	3	**10**	8	9	**9**	**0**	3	3	8	4	3	4	2	15	6	6	14
Western Europe	4	**8**	4	7	**0**	**1**	5	4	10	9	4	9	0	8	6	4	7
CIS	0	**1**	1	4	**3**	**1**	0	1	6	3	1	5	0	0	6	4	8
Gulf countries	0	**1**	0	3	**2**	**0**	0	1	3	1	1	1	0	6	4	1	3
MENA	2	**1**	1	3	**5**	**1**	3	2	2	6	1	4	0	9	7	4	8
Africa south of Sahara	1	**1**	1	21	**3**	**0**	3	1	3	2	5	1	0	3	6	3	6

Source: Authors' calculations from the GTAP 9 (GTAP 2017) and MIRAGRODEP (AGRODEP 2013) databases.

Note: CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

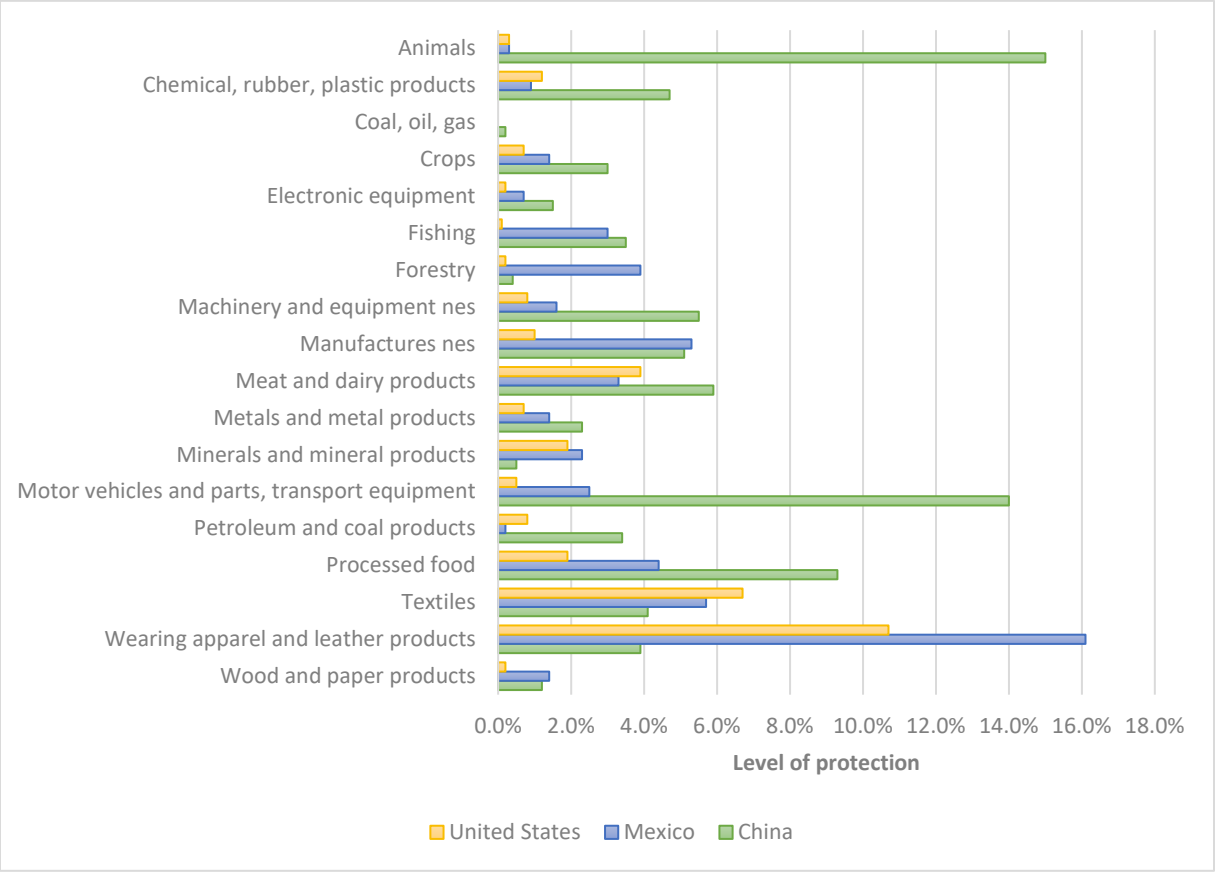
It is interesting to note that the United States is not particularly mistreated in terms of access to China; Japan, the Caribbean Community (CARICOM), and western Europe are more penalized by China due to their specialization structure. US access to Mexico is free, thanks to NAFTA, whereas countries like China, the Republic of Korea, and those of the South Asia region are clearly disadvantaged in terms of access to Mexico.[9] It is also worth noting that the average tariff the United States faces when it exports to China is 5 percent; when China exports to the United States,

[9] It is important to explain that these average bilateral tariffs are not only affected by regional agreements; there is also a product-composition effect.

it faces an average import duty of 3 percent. There is no bilateral reciprocity, but trade relations have never been based on this principle since World War II.

Figure 3.5 shows the level of protection in China, Mexico, and the United States by sector. This is the sectoral disaggregation used in our model. US protection is low in all sectors except wearing apparel and leather products. Average protection by sector varies much more in China (with a peak in motor vehicles and parts, transportation equipment, and animals) and Mexico (with a peak in wearing apparel and leather products).

Figure 3.5 Level of protection in China, Mexico, and the United States by sector



Source: Authors' calculations from the GTAP 9 (GTAP 2017) and MIRAGRODEP (AGRODEP 2013) databases.
Note: *nes* = not elsewhere specified.

4 Methodology

This section presents the methodology adopted to conduct the evaluation: first the general features of MIRAGRODEP, the CGE model adopted for this evaluation, then the data, and finally, the scenario design and implementation.

General Features of MIRAGRODEP

MIRAGRODEP is a CGE model based on the MIRAGE (Modelling International Relationships under Applied General Equilibrium) model.[10] In its standard version, MIRAGRODEP is a recursive, dynamic multiregion, multisector model. For the current study, we use a static version of the model to optimize computational time and avoid specific theoretical issues regarding the implementation of a noncooperative dynamic Nash game. In MIRAGRODEP, the government is explicitly modeled as different from private agents. Government income consists of taxes collected on production, on factors of production, on exports, on imports, on consumption, and on households' income. MIRAGRODEP has already been utilized to study issues related to international trade and trade policy (Bouët, Deason, and Laborde 2014; Bouët, Laborde, and Traoré 2017).

From the supply side in each sector, the production function is a Leontief function of value-added and intermediate inputs; for its production, one output unit needs x percent of an aggregate of productive factors (labor, both unskilled and skilled; capital; and land and natural resources) and $(1 - x)$ percent of intermediate inputs. The intermediate inputs function is an aggregate constant elasticity of substitution (CES) function of all goods, which means that substitutability exists between two intermediate goods, depending on the relative prices of these goods. This substitutability is constant and at the same level for any pair of intermediate goods. Similarly, in the generic version of the model, value-added is a CES function of unskilled labor, land, natural resources, and a bundle of skilled labor and capital. This nesting allows for the introduction of less substitutability between capital and skilled labor than between these two and other factors. In this

[10] MIRAGE is a multisector, multiregion CGE model devoted to trade policy analysis, developed at the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), Paris, between 2001 and 2004. See Bchir et al. (2002) and Decreux and Valin (2007) for details.

version, we assume that all sectors operate under perfect competition, there are no fixed costs, and price equals marginal cost.

The utilization rate of productive factors is assumed to be constant. The only factor with a fixed supply over time is natural resources. Capital supply is fixed in this static version of the model. Labor supply growth rates are fixed exogenously following the evolution of the active population. Land supply is endogenous, depending on the real remuneration of land.

Skilled labor is the only factor that is perfectly mobile. Installed capital and natural resources are sector specific. New capital is allocated among sectors according to an investment function. We consider two alternative assumptions regarding capital mobility in our static model: no sectoral mobility (short-term adjustment) and perfect sectoral mobility (long-term adjustment). Unskilled labor is imperfectly mobile between agricultural and nonagricultural sectors, according to a constant elasticity of transformation function. Land is also imperfectly mobile between agricultural sectors. Capital in a given region, whatever its origin (domestic or foreign), is assumed to be obtained by assembling intermediate inputs according to a specific combination. The capital good is the same regardless of the sector.

The demand side is modeled in each region through a representative agent whose propensity to save is constant. The rest of the national income is used to purchase final consumption. Preferences between goods are represented by a linear expenditure system–CES function, which implies that consumption has a nonunitary income elasticity. The sector subutility function used in MIRAGRODEP is a nesting of four CES-Armington functions that defines the origin of the goods. The Armington assumption (Armington 1969) allows us to capture product differentiation, including varying levels of substitution of products by origin and destination, and it is a robust way to represent bilateral and intersectoral trade flows. In this study, Armington elasticities are drawn from the GTAP 9.1 database (GTAP 2017) but vary across regions depending on the product mix of each sector.

The model includes three important assumptions: the external account closure, the government account closure, and the private account closure. The private account closure assumption concerns the savings-investment closure. The MIRAGRODEP model is neoclassical, meaning that the marginal propensity to save is constant such that variation in income leads to variation in savings, which brings variation in investment. The external account closure concerns the assumption on the

current account. In MIRAGRODEP, the real exchange rate is adjusted in such a way that the current account balance is stable as a percentage of global GDP. The government or public account closure assumption concerns how the public balance is affected when taxes are changed by a reform. In this study, we assume that each government maintains the public balance constant and that after a shock that reduces customs duties, a lump-sum tax (either negative or positive) is established in order to maintain real public expenses per capita constant, with the public budget balance constant as a percentage of GDP. With this assumption, the level of public services in each country is constant, and there is no variation of public budget balance and thus no associated crowding-out effect on private investment. A lump-sum tax is efficient in the sense that it does not interfere with market mechanisms. Moreover, it is useful for measuring one imperfection associated with the reform: the magnitude of the lump-sum tax measures the cost imposed, or the gain, on each individual to maintain constant real public expenses per capita, and consequently constant provision of public goods.

In this specific paper, the fiscal closure of the model also has direct implications regarding discussions around the US public deficit. Indeed, we do not consider here that the extra tariff revenue in the United States is used to reduce the deficit or to increase public expenditures. The closure used in our model could be considered as moderately conservative because the higher tariff, which has an effect similar to that of a higher tax on consumption,[11] is counterbalanced by a monetary transfer, or a check, to households. In practice, the transfer can be made through an income tax cut or an income tax rebate, with potential regressive implications because the consumer tax—that is, the tariff—and the tax cut or rebate do not have the same targeted population. Alternative closures will have different interpretations in contexts other than the present one: either an expansion of public expenditures (fixed public sold) or a reduction of the public deficit through an increase in the average taxation level.

[11] In our various simulations, the US net tax revenue impact of trade conflict is always positive, meaning that the additional tariff revenues (first-order effects) are never fully offset by a reduction in other tax sources (second-order effects) driven by a worse-off economy.

Data

The social accounting matrix and the trade data in MIRAGRODEP are based on GTAP 9.1 (Aguiar, Narayanan, and McDougall 2016). The GTAP 9.1 database (GTAP 2017) is a fully documented global database that contains complete bilateral trade, transport, and protection data in 140 regions for all 57 GTAP commodities for 2011.

This evaluation is based on a geographic and sectoral disaggregation that includes 17 regions and 24 sectors. Lists of these regions and sectors, with GTAP correspondences, are presented in the appendix (Tables A.1 and A.2). Among the 24 sectors, there are 4 agricultural and food sectors and 4 primary nonagricultural sectors.

Even though we use a static version of the model for the simulations, we run a pre-experiment simulation in the baseline to update the dataset from 2011 to 2015 in order to target the GDP evolution of all regions in the model and have a more up-to-date description of the world. Bilateral trade structure and levels are not targeted but evolve from their 2011 values based on relative productivity changes implied by GDP dynamics and exogenous current account evolution.

Scenarios

We study various scenarios of trade wars initiated by noncooperative action implemented by the US government. We design these scenarios along three dimensions; each scenario is labeled by combining the three dimensions (*a_b_c*).

The first dimension, with three modalities, defines which country(ies) are targeted by the additional tariff implemented by the United States. We model a US trade policy change consisting of an additional tariff of 35 percentage points applied to all goods except energy goods coming from either *China* or *Mexico* or both (the latter referred to as *China-Mexico*).

The second dimension is the type of retaliation implemented by the US trading partner(s). Five options are considered. In each case, the additional tariff is applied on each sector uniformly, except for energy goods.

1. The economy(ies) targeted by the US government's tariff increase implement trade reprisals in the form of the same variation in tariffs on goods coming from the United States (scenario called *35PctRetaliation*)

2. The partners implement a change in tariff on imports coming from the United States, generating a variation in customs revenues equal to the gain in tariff revenue obtained by the United States (scenario called *RevenueRetaliation*)[12]
3. The partners implement a change in tariff on imports coming from the United States in order to stabilize welfare loss (scenario called *WelfareRetaliation*)[13]
4. The partners implement a change in tariff on imports coming from the United States in order to minimize terms-of-trade losses (scenario called *ToTRetaliation*)[14]
5. The partners do not retaliate (scenario called *Unilateral*), but countries involved in the trade war implement tariffs corresponding to a Nash equilibrium among themselves (scenario called *Nash*)[15]

In all cases except the first, the tariffs implemented by the responding parties are endogenously computed in the model.

The third dimension considers either short-term adjustment (no sectoral capital mobility; this is called *ST*) or long-term adjustment (full capital mobility; this is called *LT*).

For a simple and transparent approach, we consider a homogenous change in tariffs across sectors, with the exception of energy products. Still, we perform a sensitivity analysis allowing for sector-specific tariffs in the scenarios with optimal retaliation on terms of trade, welfare, and the Nash game. These sector-specific optimal tariffs vary from sector to sector, but all of the key macroeconomic conclusions presented in the next section remain qualitatively the same. These results are not presented here but may be requested from the authors.

[12] Variations in customs revenues are calculated based only on trade that takes place between the United States and the trading partner in the baseline.

[13] The US trading partner's tariff on imports coming from the United States is modified in order to restore the country's welfare to its initial level.

[14] The US trading partner's tariff on imports coming from the United States is increased in order to restore the initial terms of trade.

[15] The process to design the Nash equilibrium is the following: We evaluate the optimal (welfare-maximizing) tariff for one country, given the other countries' tariffs, and then do the same for other countries, iteratively repeating the same process until variation in the tariff applied tends to be 0. During this process, the same tariff is applied to all sectors except energy for each country.

5 Results

We first present results concerning a trade war between the United States and Mexico, followed by results when the belligerents are the United States and China. Finally, we offer results of the evaluation combining both shocks.

A US Trade War with Only Mexico

Tariffs

We first consider a potential trade war between the United States and Mexico. Table 5.1 indicates the variation in tariffs applied at the border by each country on imports coming from the trading partner. The United States imposes a 35-percentage-point increase in tariffs on all goods coming from Mexico except energy; the exception is the *Nash* scenario with full capital mobility (*LT*), under which the United States increases tariffs by only 13.4 percentage points. With no capital mobility (*ST*), the *Nash* case, because it is associated with a less elastic supply for both partners, leads to a higher optimal tariff.

Table 5.1 Changes in tariff implemented by scenario, US-Mexico scenarios, percentage points

Scenario	Short-term closure		Long-term closure	
	Mexico	*United States*	*Mexico*	*United States*
US unilateral tariff	n.a.	35.0	n.a.	35.0
35 percent tariff retaliation	35.0	35.0	35.0	35.0
Tariff revenue retaliation	36.0	35.0	36.1	35.0
Terms-of-trade retaliation	50.0	35.0	33.1	35.0
Optimal welfare retaliation	9.3	35.0	9.1	35.0
Nash equilibrium	9.6	14.4	9.5	13.4

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: n.a. = not applicable.

The degree of Mexico's retaliation depends on the country's objective. If the country implements trade reprisals in order to reestablish the initial terms of trade, its tariff augmentation on US imports has to be substantial (+50 percent with short-term closure and more inelastic US supply, and +33 percent with long-term closure). A 35-percentage-point increase in tariffs on all US imports coming from Mexico is a major terms-of-trade loss for the latter because, as explained earlier (see Figure 3.3), the United States receives more than 80 percent of Mexican exports. To catch up with

the United States on terms of trade, the Mexican government has to impose a substantially increased tariff on US goods, especially because the United States is the source of only 47 percent of all Mexican imports (again see Figure 3.3). This increase in import duties is also much larger than any other retaliation based on a welfare target because, due to internal distortions, the terms-of-trade target will not capture the moderating effects of the welfare costs.

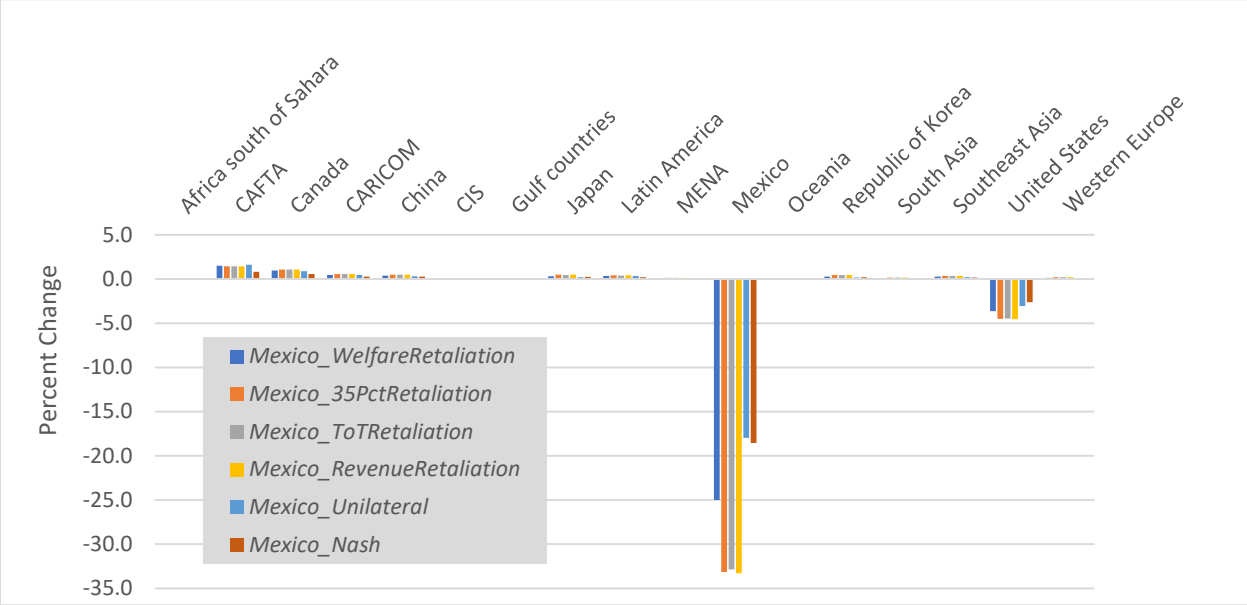
If Mexico initiates retaliation in the spirit of WTO law—that is, equivalent in terms of duty collected—it has to augment its tariff on imports from the United States by an extent slightly larger than the US tariff augmentation, which is normal because of the bilateral US trade deficit with Mexico.

Nash tariffs are substantially lower; for the United States, a 35-percentage-point tariff augmentation is not optimal. The Mexican Nash tariff augmentation is close to the tariff augmentation needed to maximize welfare, which means a flat reaction function.

Trade Impacts

Figure 5.1 indicates the rate of variation of total exports, in volume, by country and scenario. The unilateral US imposition of taxes on Mexican products (scenario *Unilateral*) decreases total Mexican exports by 18 percent in volume. The retaliatory imposition of taxes by Mexico on US products has a direct restrictive impact on Mexican imports, leading to a real appreciation of Mexican currency; under this scenario, Mexico's exports will decrease even more in order to keep the current account constant in proportion of GDP (external closure). A similar effect appears for the United States but at a lower magnitude. In the US case, the US tariff and real US dollar appreciation leads to a decline of US exports by approximately 3 percent; Mexican retaliation can increase this loss to up to 4.5 percent (*35PctRetaliation* scenario).

Figure 5.1 Rate of variation in total exports, in volume, by region and scenario, US-Mexico scenarios, percentage points



Source: Authors' calculation.

Note: Results are displayed as percentage change between the scenario and the baseline (reference). For the sake of clarity, we display only scenarios with long-term closure. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa.

Table 5.2 shows the variation in bilateral exports, in volume, in the *Unilateral* scenario. If Mexico's exports to the United States are cut by 57.0 percent, they are augmented to all other partners by 40.6 to 71.7 percent due to a strong real depreciation of Mexican currency. For example, Mexico's exports to Canada increase by 67.0 percent. Still, this is only a partial compensation for the loss of exports to the United States; as shown earlier, total Mexican exports are substantially reduced (by about -18 percent), whereas CAFTA region (Central American) exports to the United States are augmented by 6.3 percent. US exports are also significantly impacted by the US tariff due to a combination of real exchange rate appreciation and increased competition from cheap Mexican exports on third markets. Bilateral exports to Mexico are cut by 21.8 percent.

Table 5.2 Rate of variation in bilateral exports, in volume, by region, scenario Mexico_Unilateral, percentage points

Importer: / Exporter:	*Canada*	*China*	*Japan*	*Rep. of Korea*	***Mexico***	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	-0.3	-0.4	-0.3	-0.3	**-23.5**	**2.7**	-0.7	-0.4	-0.4	-1.8	-2.9	-2.3	-0.8	-1.1	-0.9	-0.5	-0.8
China	-1.0	0.0	0.0	-0.1	**-23.7**	**5.2**	-0.4	0.1	-0.2	-2.2	-2.5	-2.2	-0.4	-0.5	-0.5	-0.3	-0.4
Japan	-0.5	-0.1	n.a.	-0.2	**-22.6**	**6.1**	-0.4	0.0	-0.3	-2.3	-1.8	-1.9	-0.5	-0.7	-0.5	-0.5	-0.4
Rep. of Korea	-0.4	0.2	0.2	n.a.	**-22.7**	**6.0**	-0.2	0.4	0.0	-2.4	-1.9	-1.8	-0.3	-0.5	-0.3	-0.2	-0.2
Mexico	**67.0**	**53.6**	**71.7**	**58.6**	n.a.	**-57.0**	**61.3**	**63.8**	**40.6**	**62.1**	**59.3**	**65.5**	**63.8**	**64.8**	**55.1**	**56.7**	**64.2**
United States	**-1.2**	**-1.2**	**-0.8**	**-1.1**	**-21.8**	n.a.	**-1.4**	**-1.2**	**-1.0**	**-2.4**	**-2.8**	**-2.3**	**-1.1**	**-1.4**	**-1.5**	**-0.9**	**-1.2**
Oceania	0.5	0.1	-0.1	-0.2	**-23.4**	**2.4**	0.1	0.3	-0.2	-1.0	-0.9	-0.7	-0.1	-0.3	-0.2	-0.1	-0.1
Southeast Asia	-0.8	0.1	-0.1	-0.1	**-23.3**	**4.9**	-0.3	0.1	-0.2	-1.9	-1.8	-1.9	-0.4	-0.5	-0.5	-0.3	-0.4
South Asia	0.2	0.0	0.1	0.0	**-23.1**	**2.0**	-0.1	0.2	0.0	-1.1	-2.4	-0.9	-0.1	-0.3	-0.2	-0.1	-0.1
Latin America	1.4	0.7	0.6	0.6	**-21.8**	**1.8**	0.9	1.0	0.8	-0.4	-1.5	-1.6	0.7	0.7	0.3	0.6	0.7
CAFTA	-0.5	0.6	-0.3	0.3	**-21.7**	**6.3**	-0.1	1.4	0.1	-1.1	-2.6	-1.1	-0.5	-0.7	-0.8	-0.4	-0.1
CARICOM	1.1	0.9	0.9	0.9	**-19.8**	**2.3**	0.6	1.1	0.7	-0.2	-1.3	-0.3	0.5	0.2	0.2	0.6	0.5
Western Europe	0.4	0.3	0.4	0.3	**-21.4**	**3.3**	0.1	0.4	0.1	-1.2	-1.8	-1.1	0.0	-0.2	-0.1	0.0	0.0
CIS	0.2	0.4	0.4	0.2	**-23.4**	**0.2**	0.4	0.6	0.4	-0.8	-2.2	-2.9	-0.2	0.1	0.1	0.2	0.2
Gulf countries	-0.1	0.3	0.2	0.1	**-16.6**	**-1.4**	0.3	0.3	0.1	-0.4	-0.3	-1.9	-0.3	0.1	0.2	0.1	0.0
MENA	0.1	0.3	0.3	0.1	**-21.1**	**0.9**	0.1	0.4	0.0	-1.1	1.1	-1.7	0.0	-0.1	-0.1	0.1	0.0
Africa south of Sahara	0.1	0.4	0.5	0.2	**-16.0**	**-0.6**	0.5	0.7	0.4	-0.5	-0.7	-3.6	0.1	0.1	0.0	0.2	0.2

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

Table 5.3 indicates the variation in bilateral exports, in volume, in the *RevenueRetaliation* scenario, under which Mexican reprisals are severe (see Table 5.1), and Table 5.4 shows the variation in bilateral exports, in volume, in the *Nash* scenario, under which Mexican reprisals are more moderate (again, see Table 5.1) and the final, noncooperative US tariffs are lower (13.4 percent instead of 35.0 percent). In the first case, both the destruction and the deflection of trade flows are

significantly larger, exemplifying how much trade wars can differ in their impact on trade depending on the magnitude of initial "aggression" and reprisals. In any case, the retaliation manages to balance the damage from a mercantilist point of view: the *RevenueRetaliation* case leads to a very large decline in bilateral trade between the United States and Mexico (a 64.0 percent decline in Mexican exports to the United States and a 69.0 percent decline in US exports to Mexico); the *Nash* outcome is still strongly negative for both exporters, with a slightly smaller reduction for the United States due to stronger bilateral power (Mexican exports to the United States fall by 37.0 percent and US exports to Mexico fall by 35.0 percent).

Table 5.3 Rate of variation in bilateral exports, in volume, by region, scenario Mexico_RevenueRetaliation, percentage point

Importer: / Exporter:	*Canada*	*China*	*Japan*	*Rep. of Korea*	***Mexico***	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	-0.3	-0.3	-0.3	-0.2	**26.8**	**1.5**	-0.7	-0.3	-0.6	-1.1	-1.5	-1.2	-0.5	-0.9	-1.0	-0.5	-0.8
China	-1.1	-0.1	-0.1	-0.1	**25.7**	**3.2**	-0.7	-0.1	-0.5	-1.4	-1.5	-1.4	-0.6	-0.7	-0.8	-0.7	-0.7
Japan	-0.8	-0.2	n.a.	-0.3	**33.9**	**4.1**	-0.7	-0.3	-0.7	-1.5	-1.2	-1.2	-0.7	-1.0	-1.0	-0.8	-0.8
Rep. of Korea	-0.8	0.0	-0.1	n.a.	**31.9**	**3.8**	-0.6	-0.1	-0.5	-1.5	-1.4	-1.2	-0.6	-0.9	-0.9	-0.7	-0.7
Mexico	**27.8**	**27.3**	**32.7**	**30.5**	n.a.	**-64.0**	**26.6**	**33.2**	**22.5**	**26.4**	**26.3**	**31.5**	**30.0**	**29.5**	**30.2**	**26.4**	**31.7**
United States	**1.3**	**2.0**	**2.0**	**1.9**	**-69.0**	n.a.	**1.5**	**1.8**	**1.7**	**0.9**	**0.6**	**0.9**	**1.7**	**1.5**	**1.2**	**1.4**	**1.4**
Oceania	0.0	0.2	0.0	-0.1	**13.9**	**0.6**	0.0	0.2	-0.2	-0.5	-0.1	-0.3	-0.1	-0.3	-0.3	-0.2	-0.2
Southeast Asia	-0.8	0.2	0.0	0.0	**20.4**	**3.1**	-0.4	0	-0.3	-1.1	-0.9	-1.1	-0.4	-0.6	-0.7	-0.5	-0.5
South Asia	0.0	0.3	0.3	0.2	**26.3**	**0.4**	-0.1	0.2	0.1	-0.5	-1.0	-0.5	0.0	-0.2	-0.2	-0.1	-0.1
Latin America	0.2	0.4	0.3	0.3	**25.2**	**0.3**	0.2	0.4	0.4	-0.3	-0.8	-1.2	0.2	0.1	-0.2	0.0	0.0
CAFTA	-1.2	0.1	-0.9	-0.2	**19.4**	**3.9**	-0.8	0.6	-0.6	-1.3	-1.9	-1.3	-1.0	-1.2	-1.3	-1.0	-1.0
CARICOM	0.0	0.5	0.3	0.4	**21.8**	**0.3**	-0.1	0.4	0.1	-0.3	-0.8	-0.4	0.0	-0.3	-0.4	0.0	-0.1
Western Europe	-0.1	0.4	0.3	0.3	**30.2**	**1.5**	-0.2	0.3	0.0	-0.6	-0.7	-0.5	0.0	-0.3	-0.4	-0.2	-0.2
CIS	-0.2	0.5	0.4	0.2	**19.5**	**-0.7**	0.3	0.6	0.4	-0.2	-0.6	-1.7	-0.1	0.1	0.0	0.1	0.1
Gulf countries	-0.3	0.4	0.2	0.1	**-8.8**	**-1.8**	0.3	0.3	0.1	-0.1	0.4	-1.0	-0.1	0.1	0.2	0.1	0.0
MENA	-0.1	0.4	0.4	0.2	**8.8**	**-0.2**	0.1	0.5	0.1	-0.4	1.1	-0.8	0.1	0.0	-0.1	0.1	0.0
Africa south of Sahara	-0.2	0.5	0.6	0.4	**7.0**	**-1.1**	0.5	0.6	0.4	-0.2	0.0	-1.9	0.2	0.1	-0.1	0.1	0.1

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

Table 5.4 Rate of variation in bilateral exports, in volume, by region, scenario Mexico_Nash, percentage points

Importer: / Exporter:	*Canada*	*China*	*Japan*	*Rep. of Korea*	***Mexico***	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	-0.2	-0.1	-0.1	-0.1	**5.6**	**1.0**	-0.4	-0.2	-0.3	-0.7	-1.0	-0.8	-0.3	-0.5	-0.5	-0.3	-0.4
China	-0.6	0.0	0.0	0.0	**6.7**	**2.2**	-0.3	0.0	-0.3	-0.9	-1.0	-0.9	-0.3	-0.4	-0.4	-0.3	-0.4
Japan	-0.4	-0.1	n.a.	-0.1	**9.2**	**2.7**	-0.3	-0.1	-0.3	-1.0	-0.7	-0.8	-0.4	-0.5	-0.5	-0.4	-0.4
Rep. of Korea	-0.3	0.0	0.0	n.a.	**9.0**	**2.5**	-0.3	0.1	-0.2	-1.0	-0.8	-0.8	-0.3	-0.4	-0.4	-0.3	-0.3
Mexico	**20.1**	**18.3**	**22.5**	**20.1**	n.a.	**-37.0**	**18.8**	**21.8**	**14.8**	**19.1**	**18.8**	**21.5**	**20.6**	**20.6**	**19.7**	**18.4**	**21.2**
United States	**0.3**	**0.6**	**0.7**	**0.6**	**-35.0**	n.a.	**0.4**	**0.5**	**0.5**	**0.0**	**-0.2**	**0.0**	**0.5**	**0.3**	**0.2**	**0.4**	**0.3**
Oceania	0.1	0.1	0.0	-0.1	**0.7**	**0.6**	0.0	0.1	-0.1	-0.4	-0.2	-0.3	-0.1	-0.2	-0.2	-0.1	-0.1
Southeast Asia	-0.4	0.1	0.0	0.0	**4.6**	**2.1**	-0.2	0.0	-0.2	-0.8	-0.6	-0.8	-0.2	-0.3	-0.4	-0.3	-0.3
South Asia	0.0	0.1	0.1	0.1	**5.7**	**0.5**	0.0	0.1	0.0	-0.4	-0.7	-0.3	0.0	-0.1	-0.1	-0.1	-0.1
Latin America	0.3	0.3	0.3	0.2	**5.2**	**0.3**	0.2	0.3	0.3	-0.2	-0.5	-0.7	0.2	0.2	0.0	0.1	0.1
CAFTA	-0.5	0.2	-0.3	0.0	**2.9**	**2.6**	-0.3	0.5	-0.2	-0.6	-1.1	-0.6	-0.4	-0.5	-0.6	-0.4	-0.4
CARICOM	0.2	0.4	0.3	0.3	**4.4**	**0.5**	0.1	0.4	0.2	-0.1	-0.5	-0.2	0.1	-0.1	-0.1	0.1	0.1
Western Europe	0.0	0.2	0.2	0.2	**7.4**	**1.1**	0.0	0.2	0.0	-0.4	-0.5	-0.4	0.0	-0.1	-0.2	0.0	-0.1
CIS	0.0	0.3	0.2	0.1	**2.6**	**-0.3**	0.2	0.3	0.2	-0.2	-0.6	-1.1	-0.1	0.0	0.0	0.1	0.1
Gulf countries	-0.2	0.2	0.1	0.0	**-6.5**	**-1.0**	0.2	0.2	0.1	-0.1	0.1	-0.7	-0.1	0.1	0.1	0.0	0.0
MENA	0.0	0.2	0.2	0.1	**-0.6**	**0.1**	0.1	0.3	0.0	-0.3	0.8	-0.6	0.1	0.0	0.0	0.1	0.0
Africa south of Sahara	-0.1	0.3	0.3	0.2	**-0.6**	**-0.6**	0.3	0.4	0.2	-0.1	-0.1	-1.3	0.1	0.0	0.0	0.1	0.1

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

Macroeconomic Outcomes

Table 5.5 presents the impact of all scenarios on countries' welfare, measured as Hicks equivalent variations.[16] These impacts are very close to the impacts on countries' GDP. Table 5.5 highlights the magnitude of potential losses that a trade war with Mexico's major trading partner can inflict on this middle-income country. Mexican welfare losses range from -3.2 to -1.1 in the short term and from -1.9 to -0.5 in the long term, when capital mobility helps to mitigate the shock. In

[16] We omit results for countries whose welfare is unaffected in all scenarios.

addition, for the *ToTRetaliation*, *WelfareRetaliation*, and *Nash* cases, the tariff changes are smaller in the long term. These results are quite comparable to the average losses estimated by Ossa (2016) in the case of a global trade war. In fact, due to the importance of the United States as a major trading partner and the severity of the augmentation of US import duties on Mexican goods, this shock is close to a return to autarky. Variations in the volume of GDP are not presented here, but those results are close to the variations in welfare.

Table 5.5 Rate of variation in household welfare (equivalent variation), US-Mexico scenarios, percentage points

	Mexico_Unilateral_ST	*Mexico_Unilateral_LT*	*Mexico_35PctRetaliation_ST*	*Mexico_35PctRetaliation_LT*	*Mexico_RevenueRetaliation_ST*	*Mexico_RevenueRetaliation_LT*	*Mexico_ToTRetaliation_ST*	*Mexico_ToTRetaliation_LT*	*Mexico_WelfareRetaliation_ST*	*Mexico_WelfareRetaliation_LT*	*Mexico_Nash_ST*	*Mexico_Nash_LT*
United States	**0.0**	**0.0**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**-0.1**	**0.0**	**0.0**	**0.0**	**0.0**
Mexico	**-2.1**	**-1.3**	**-2.6**	**-1.8**	**-2.7**	**-1.9**	**-3.2**	**-1.8**	**-1.8**	**-1.0**	**-1.1**	**-0.5**
CAFTA	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.1	0.1
Canada	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1
CARICOM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
China	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Gulf countries	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Rep. of Korea	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference) and given only for regions with nontrivial variations. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community.

The most interesting fact may be that Mexico's retaliation may be counterproductive for the country if not properly implemented. Indeed, welfare losses and real GDP losses are more important in scenarios with Mexican retaliatory tariffs greater than 10 percent (see Table 5.1). Moreover, in all cases, US welfare is only slightly affected (when Mexico does not retaliate—scenario *Unilateral*—or implements a small augmentation of import duties on US products—scenarios *WelfareRetaliation* and *Nash*) or suffers only minimal damage (when Mexico

implements large augmentations of import duties on US products—scenarios *35PctRetaliation*, *RevenueRetaliation*, and *ToTRetaliation*).

The limited magnitude of this shock on US activity is not surprising. The *Unilateral* scenario, in which US imports from Mexico are cut by 57.0 percent but US imports from other sources are increased such that total US imports are reduced by only 2.8 percent, leads to large trade deviation effects and limited import substitution for the United States. Because the Mexican economy relies on US inputs (value chains between the United States and Mexico), reducing US imports has a direct negative impact on US exports to Mexico. In any case, the net impact on US GDP is positive but limited, if not negative.

This exercise points to two important policy conclusions. First, as exemplified by the history of trade relations, small countries do not have the capacity to retaliate against large countries' protectionism in order to avoid losses to their own citizens and inflict losses on their large trading partners. Second, the design of trade retaliation must be conducted rationally, with the objective of maximizing domestic welfare; the implementation of retaliation based on other principles (collected duties, terms of trade, same magnitude of tariff surcharge) may be particularly self-damaging.

Let us add that there are potential free riders from this trade war, with the CAFTA region obtaining a significant welfare gain (+0.3 percent in two scenarios).

Value-Added and Real Wages

A clear motivation of this US protectionist law is to promote domestic production and employment, with a potential negative effect on sectoral value-added in Mexico. This is why Table 5.6 shows the share in the baseline (in the column "Share of Value-Added") and the rate of variation of valued-added, in volume, in three scenarios.

Table 5.6 Share and rate of variation in value-added, in volume and by sector, US-Mexico scenarios, percentage points

	Share of value-added		*Mexico_ Unilateral_ LT*		*Mexico_ Revenue Retaliation_ LT*		*Mexico_ Nash_LT*	
	Mex.	US	Mex.	US	Mex.	US	Mex.	US
Other animal products	0.6	0.2	3.7	-0.5	6.4	-0.9	3.8	-0.6
Chemical, rubber, plastic products	2.4	3.1	13.5	-0.5	24.1	-1.4	11.2	-0.7
Coal, oil, gas	1.6	1.8	20.6	-0.7	14.0	0.3	8.9	0.0
Crops	2.2	1.0	-3.6	0.5	1.4	0.1	0.1	0.0
Electronic equipment	2.4	0.5	-27.0	0.8	-38.0	1.2	-23.0	0.4
Fishing	0.1	0.0	-0.5	0.4	1.9	0.4	1.0	0.2
Forestry	0.3	0.1	3.2	0.3	12.7	0.5	5.9	0.2
Machinery and equipment *nes*	2.4	3.9	-26.0	0.1	-30.0	-0.5	-20.0	-0.2
Manufactured products *nes*	0.5	0.4	4.1	-0.5	4.4	0.5	2.9	0.0
Meat and dairy products	1.0	0.6	8.6	-0.6	14.7	-1.1	8.2	-0.7
Metals and metal products	2.5	2.1	-0.7	0.0	0.3	-0.4	-0.3	-0.4
Minerals and mineral products	2.3	0.7	6.7	-0.4	4.5	0.0	3.1	-0.1
Petroleum and coal products	0.7	0.1	5.4	0.0	5.7	0.0	3.4	0.0
Processed food	3.9	1.4	-1.1	0.1	-0.3	-0.1	0.5	-0.1
Textiles	0.3	0.5	-3.4	-0.1	0.4	-0.7	-1.5	-0.4
Transportation equipment	3.3	1.8	-16.0	0.2	-22.0	-0.1	-12.0	-0.1
Wearing apparel and leather prod.	0.7	0.3	-5.9	0.4	-9.5	1.0	-5.2	0.4
Wood and paper products	0.9	2.4	-0.2	0.1	10.3	0.0	4.4	0.0

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). *nes* = not elsewhere specified.

In Mexico, important sectors in which value-added is significantly hurt in all scenarios are motor vehicles and parts, transportation equipment, electronic equipment, and machinery and equipment. In the United States, value-added in all sectors and under all scenarios is not affected by more than 1 percent in absolute value, except in the case of the *RevenueRetaliation* scenario, which leads to substantial reprisals by Mexico (see Table 5.1); in this scenario, value-added contracts by 1.4 percent and 1.1 percent, respectively, for chemical, rubber, and plastic products and for meat and dairy products, whereas it expands by 1.2 percent in the electronic equipment sector.

Recall that in our model, the US tariff augmentation, as well as the Mexican tariff augmentation in the case of reprisals, is homogenous and identical across sectors (except for the energy sector),

even in the *WelfareRetaliation* and *Nash* scenarios. If the augmentation of import duties were applied differently from one sector to another, there could be even more heterogeneity in the evolution of value-added and activity across sectors.

Table 5.7 indicates the impact of the six scenarios in their long-term versions (*LT*) on real remuneration of productive factors in the United States and in Mexico, respectively. US workers, both skilled and unskilled and working in either the primary or the manufacturing sector, are hurt by these reforms as capital owners. Only landowners may be positively affected by this change in US trade policy, particularly in the *Unilateral* scenario, which supports crop cultivation within the United States. In any case, these variations in real remuneration are relatively small.

Table 5.7 Rate of variation in real remuneration of factors, US-Mexico scenarios, percentage points

	Mexico_Unilateral_LT	***Mexico_35PctRetaliation_LT***	***Mexico_RevenueRetaliation_LT***	***Mexico_ToTRetaliation_LT***	***Mexico_WelfareRetaliation_LT***	***Mexico_Nash_LT***
Changes in the US real rate of return for						
Skilled workers	-0.1	-0.2	-0.2	-0.2	-0.1	-0.1
Unskilled workers—primary sectors	-0.5	-0.1	-0.1	-0.1	-0.3	-0.1
Unskilled workers—nonprimary sectors	-0.1	-0.3	-0.3	-0.3	-0.2	-0.1
Capital	-0.1	-0.2	-0.2	-0.2	-0.1	-0.1
Land	0.3	-0.1	-0.1	0.0	0.2	0.0
Changes in the Mexico real rate of return for						
Skilled workers	-0.3	-1.7	-1.7	-1.6	-0.6	0.1
Unskilled workers—primary sectors	-1.8	-0.4	-0.3	-0.5	-1.5	-0.2
Unskilled workers—nonprimary sectors	-4.1	-5.5	-5.5	-5.5	-4.6	0.2
Capital	-2.5	-4.0	-4.0	-4.0	-3.1	0.1
Land	-5.9	-0.3	-0.2	-0.6	-4.3	-0.5

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference).

This is not the case for productive factors in Mexico, for which a trade war with the United States is a significant event (Table 5.7). All Mexican productive factors would lose from such a scenario, particularly unskilled workers in the manufacturing sector, especially if the increase in US import duties is large (all scenarios except the *Nash* scenario). Land in Mexico may also significantly suffer under the *Unilateral* scenario (-5.9 percent). Even if we do not model international labor movements, it is obvious that the large shock on the Mexican poor workforce (-4.1 percent in real wages with the US unilateral tariff) will also increase incentives for illegal migration, resulting in an additional issue to consider.

A US Trade War with Only China

Let us consider now a US trade war with China.

Tariffs

We still consider six scenarios; Table 5.8 indicates the tariffs implemented by both trading partners in each of these scenarios.

Table 5.8 Changes in tariff implemented, by scenario, US-China scenarios, percentage points

	Short-term closure		Long-term closure	
	China	*United States*	*China*	*United States*
US unilateral tariff	n.a.	35.0	n.a.	35.0
35 percent tariff retaliation	35.0	35.0	35.0	35.0
Tariff revenue retaliation	59.9	35.0	59.7	35.0
Terms-of-trade retaliation	42.9	35.0	38.5	35.0
Optimal welfare retaliation	4.1	35.0	3.7	35.0
Nash equilibrium	3.6	7.0	3.1	7.0

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: n.a. = not applicable.

The US imposition of a 35-percentage-point increase in import duties on Chinese products represent a severe loss of terms of trade for China, which has to impose a relatively high augmentation of import duties on US products to reestablish its initial terms of trade. Chinese reprisals are even more severe if the country's objective is to collect the same amount of duties the United States has collected, due to the trade flow from the United States to China, which is much

smaller (by about 35 percent) than the trade flow from China to the United States. Tariffs implemented to maximize welfare are much smaller, showing again that the US government does not maximize its domestic welfare by imposing a 35-percentage-point augmentation of import duties on Chinese products.

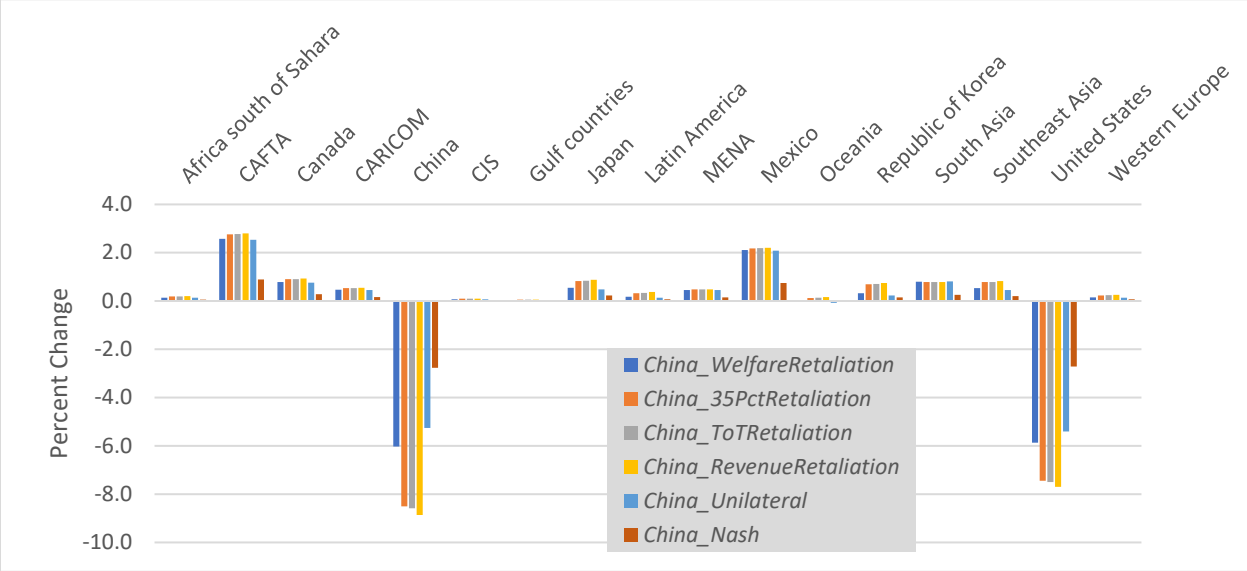
Comparing Nash tariffs with others implemented in the hypothetical trade war between the United States and China, it is interesting to note that the Nash US tariff augmentation against China is about two times smaller than the one imposed against Mexico: 7.0 percent instead of 13.4 percent (compare with Tables 5.1 and 5.7). One explanation for this discrepancy lies in the initial US tariff on Mexican products (0.0 percent); in comparison, the initial US tariff on Chinese products is close to 3.0 percent (trade-weighted import duties, services excluded). Another, complementary, explanation may be that US imports from China are more elastic than US imports from Mexico, such that the optimal US tariff on Chinese imports is smaller. As before, shifting from short-term to long-term closure reduces optimal retaliatory tariffs.

Trade Impacts

In relation to the impact on total exports by both countries, a US-China trade war implies trade destruction shared relatively equally between the United States and China.[17] Due to the size of the two economies involved and their involvement in regional trade on both sides of the Pacific, side effects on third parties are much larger than in the US-Mexico scenarios. Trade deflection implied by the trade war between the two belligerents is more pronounced in the US-China trade war, with total exports from CAFTA and Mexico being augmented by more than 2 percent in many scenarios.

[17] In the hypothetical US-Mexico trade war, trade destruction is concentrated on Mexico's total exports: as much as -33 percent in some scenarios (see Figure 5.1).

Figure 5.2 Rate of variation in total exports, in volume, by region and scenario, US-China scenarios, percentage points



Source: Authors' calculation.

Note: Results are displayed as percentage change between the scenario and the baseline (reference). For the sake of clarity, we display only scenarios with long-term closure. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa.

Table 5.9 presents the impact of the *China_Unilateral_LT* scenario on bilateral exports (in volume). The direct effect of this policy is to cut the bilateral flow from China to the United States by 75 percent. This policy also leads to new sources for US imports (Southeast Asia, Japan, the Republic of Korea, and others) and new destinations for Chinese exports (Mexico, CAFTA, Canada, and others). It has a domino effect on all bilateral trade relations; for example, increased exports from Southeast Asia to the United States have a negative impact on exports from Southeast Asia to China and Japan.

Table 5.9 Rate of variation in bilateral exports, in volume, by region, scenario China_Unilateral_LT, percentage points

Importer: / Exporter:	*Canada*	***China***	*Japan*	*Rep. of Korea*	*Mexico*	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	-0.1	**-8.9**	-3.4	-3.5	1.7	**4.2**	-4.4	-3.4	-2.3	-3.0	2.1	-2.8	-3.4	-4.2	-3.3	-2.6	-3.6
China	**15.1**	**1.9**	**8.8**	**9.3**	**20.1**	**-75.1**	**9.0**	**10.0**	**10.1**	**10.9**	**19.0**	**12.7**	**10.6**	**9.1**	**9.5**	**10.8**	**9.3**
Japan	5.4	**-6.6**	n.a.	-0.3	6.8	**14.8**	0.2	0.4	0.7	1.1	10.7	1.7	0.8	0.2	0.6	1.0	0.1
Rep. of Korea	5.2	**-6.6**	-0.5	n.a.	7.7	**19.7**	-0.2	0.4	0.3	0.8	8.1	1.1	0.5	-0.2	0.0	0.8	-0.1
Mexico	-4.0	**-12.2**	-9.0	-7.9	n.a.	**6.9**	-8.3	-7.7	-6.4	-8.0	-1.9	-7.2	-8.3	-8.5	-7.0	-6.9	-8.3
United States	**-1.8**	**-12.5**	**-5.9**	**-6.6**	**-0.8**	**n.a.**	**-6.8**	**-7.4**	**-5.3**	**-5.2**	**0.0**	**-3.4**	**-5.2**	**-6.0**	**-5.7**	**-4.3**	**-5.3**
Oceania	4.2	**-4.0**	0.7	0.6	7.3	**8.4**	0.3	0.8	1.3	1.6	7.1	2.8	1.3	0.9	1.1	1.5	0.8
Southeast Asia	3.5	**-7.3**	-1.1	-0.9	7.1	**24.3**	-0.9	-0.3	0.1	-0.1	6.9	1.7	-0.4	-1.0	-0.7	0.2	-0.6
South Asia	1.3	**-6.9**	-2.0	-1.7	5.0	**15.4**	-2.4	-1.1	-0.6	-0.6	5.0	1.0	-1.3	-1.9	-1.3	-0.5	-1.5
Latin America	3.5	**-5.1**	-0.5	-0.7	5.1	**5.5**	-1.0	-0.4	-0.4	0.1	4.5	1.0	-0.1	-0.7	-0.1	0.4	-0.3
CAFTA	-3.5	**-14.5**	-6.8	-7.3	-1.2	**14.6**	-8.3	-9.1	-6.1	-6.9	-1.5	-4.7	-5.4	-6.3	-5.2	-5.2	-8.0
CARICOM	1.7	**-7.5**	-2.2	-2.3	3.2	**7.2**	-2.3	-1.9	-1.2	-1.1	3.0	0.4	-1.5	-1.8	-1.7	-1.1	-1.7
Western Europe	3.2	**-7.1**	-1.0	-1.0	5.2	**9.4**	-0.9	-0.4	-0.2	0.1	5.2	1.2	-0.1	-0.9	-0.6	0.1	-0.7
CIS	3.6	**-3.8**	-0.4	-0.7	6.0	**4.5**	-0.5	-0.4	0.4	0.8	5.0	3.1	0.5	0.0	-0.1	0.7	0.1
Gulf countries	3.5	**-3.2**	-0.2	-0.5	4.2	**4.3**	-0.3	-0.5	0.4	0.7	4.5	2.6	0.7	0.0	-0.1	0.7	0.2
MENA	2.7	**-4.8**	-1.1	-1.2	4.6	**11.4**	-1.3	-0.9	-0.4	-0.2	13.5	1.4	-0.6	-1.4	-1.1	-0.1	-1.1
Africa south of Sahara	3.6	**-4.0**	-0.6	-0.7	4.0	**4.8**	-0.8	-0.8	0.0	0.6	4.2	2.9	0.2	-0.2	-0.2	0.7	-0.3

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

Table 5.10 presents the impact of the *China_RevenueRetaliation_LT* scenario on bilateral exports (in volume), showing its significant effect on another major trade flow, the one from the United States to China (-82 percent; let us remember the substantial augmentation of Chinese import duties on US products in this case, close to +60 percent). This scenario implies new trade diversion effects, including an augmentation of US exports to Canada, Mexico, and CAFTA countries.

Table 5.10 Rate of variation in bilateral exports, in volume, by region, scenario China_RevenueRetaliaion_LT, percentage points

Importer: / Exporter:	*Canada*	***China***	*Japan*	*Rep. of Korea*	*Mexico*	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	-0.5	**-0.3**	-1.6	-1.6	0.5	**2.5**	-2.1	-1.1	-0.7	-1.4	1.5	-1.3	-1.7	-2.2	-1.8	-1.2	-2.0
China	**7.7**	**3.2**	**5.3**	**5.9**	**12.0**	**-77.0**	**5.1**	**6.3**	**5.9**	**6.0**	**11.0**	**6.7**	**6.0**	**4.9**	**5.3**	**5.9**	**4.9**
Japan	1.2	-0.4	n.a.	-0.3	2.6	8.8	-0.5	0.1	-0.1	-0.2	6.5	0.1	-0.3	-0.7	-0.6	-0.3	-0.7
Rep. of Korea	1.0	**-0.9**	-0.6	n.a.	3.5	**13.0**	-0.8	0.2	-0.4	-0.5	4.4	-0.5	-0.7	-1.1	-1.1	-0.5	-1.0
Mexico	-3.9	**-5.5**	-5.5	-4.8	n.a.	**5.7**	-5.5	-4.6	-3.5	-5.4	-1.5	-5.0	-5.4	-5.8	-4.9	-4.7	-5.7
United States	**0.9**	**-82**	**0.0**	**-0.4**	**1.9**	**n.a.**	**-0.9**	**-0.7**	**0.3**	**-0.3**	**3.1**	**0.7**	**-0.2**	**-0.5**	**-0.6**	**0.4**	**0.0**
Oceania	1.1	**-0.6**	0.1	0.1	2.6	**3.4**	-0.1	0.5	0.5	0.4	3.8	0.6	0.2	-0.1	-0.1	0.1	-0.2
Southeast Asia	0.5	**-2.0**	-1.1	-0.8	3.7	**18.0**	-1.2	-0.3	-0.4	-0.9	3.6	-0.2	-1.1	-1.5	-1.4	-0.8	-1.2
South Asia	-0.1	**-1.9**	-1.2	-0.9	2.1	**11.0**	-1.7	-0.5	-0.3	-0.7	2.7	0.0	-1.1	-1.6	-1.2	-0.6	-1.3
Latin America	0.5	**1.4**	-0.5	-0.6	1.8	**1.9**	-0.7	-0.1	0.0	-0.2	2.3	0.1	-0.4	-0.8	-0.6	-0.4	-0.7
CAFTA	-3.9	**-8**	-4.6	-4.8	-2.0	**13.0**	-5.4	-5.2	-3.9	-4.8	-1.8	-4.1	-3.5	-4.2	-3.6	-3.6	-6.0
CARICOM	0.2	**-1.8**	-1.0	-0.9	1.4	**4.7**	-1.2	-0.5	-0.4	-0.6	1.9	0.1	-0.9	-1.1	-1.2	-0.6	-0.8
Western Europe	1.0	**0.0**	-0.3	-0.2	2.3	**5.4**	-0.5	0.3	0.1	0.0	3.3	0.4	-0.1	-0.6	-0.5	0.0	-0.5
CIS	1.2	**-0.8**	0.1	0.0	3.0	**1.5**	0.1	0.4	0.6	0.5	2.9	1.3	0.1	0.0	-0.1	0.3	-0.1
Gulf countries	1.1	**-1.0**	0.1	-0.1	2.2	**0.9**	0.1	0.2	0.4	0.3	3.2	1.0	0.1	0.0	0.0	0.3	0.0
MENA	0.6	**-1.9**	-0.4	-0.4	2.4	**7.8**	-0.6	0.1	0.0	-0.1	11.0	0.4	-0.4	-0.8	-0.7	-0.1	-0.7
Africa south of Sahara	1.0	**-0.9**	0.1	-0.1	1.1	**1.6**	0.0	0.3	0.4	0.3	2.5	1.5	0.1	-0.1	-0.2	0.3	-0.2

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

Table 5.11 displays the rate of variation of bilateral exports under the *China_Nash_LT* scenario. Tariff augmentations are more modest than in the US-Mexico scenarios (see Table 5.7) and consequently trade destruction (and also trade diversion) is significantly smaller (-29 percent for the China-US trade flow and -18 percent for the US-China trade flow).

Table 5.11 Rate of variation in bilateral exports, in volume, by region, scenario China_Nash_LT, percentage points

Importer: / Exporter:	*Canada*	***China***	*Japan*	*Rep. of Korea*	*Mexico*	***United States***	*Oceania*	*Southeast Asia*	*South Asia*	*Latin America*	*CAFTA*	*CARICOM*	*Western Europe*	*CIS*	*Gulf countries*	*MENA*	*Africa south of Sahara*
Canada	-0.1	**-2.0**	-0.9	-1.0	0.5	**1.2**	-1.2	-0.9	-0.6	-0.9	0.6	-0.8	-1.0	-1.2	-1.0	-0.7	-1.1
China	**4.2**	**0.9**	**2.6**	**2.8**	**5.7**	**-28.8**	**2.6**	**3.0**	**2.9**	**3.1**	**5.3**	**3.6**	**3.0**	**2.6**	**2.7**	**3.1**	**2.6**
Japan	1.3	**-1.4**	n.a.	-0.1	1.9	**4.3**	0.0	0.1	0.1	0.2	3.1	0.4	0.1	-0.1	0	0.1	-0.1
Rep. of Korea	1.3	**-1.5**	-0.2	n.a.	2.2	**5.8**	-0.2	0.1	0.0	0.1	2.3	0.2	0.0	-0.2	-0.1	0.1	-0.2
Mexico	-1.4	**-3.5**	-2.8	-2.4	n.a.	**2.3**	-2.6	-2.4	-1.9	-2.5	-0.6	-2.3	-2.6	-2.7	-2.2	-2.2	-2.7
United States	**-0.3**	**-18.2**	**-1.4**	**-1.6**	**0.1**	**n.a.**	**-1.7**	**-1.9**	**-1.2**	**-1.3**	**0.3**	**-0.7**	**-1.3**	**-1.5**	**-1.4**	**-1.0**	**-1.2**
Oceania	1.1	**-1.0**	0.2	0.2	1.9	**2.2**	0.1	0.2	0.3	0.4	2.0	0.7	0.3	0.2	0.2	0.3	0.2
Southeast Asia	0.9	**-1.8**	-0.3	-0.3	2.1	**7.2**	-0.3	-0.1	-0.1	-0.1	2.0	0.4	-0.2	-0.4	-0.3	-0.1	-0.3
South Asia	0.3	**-1.8**	-0.5	-0.4	1.5	**4.5**	-0.7	-0.3	-0.2	-0.2	1.5	0.2	-0.4	-0.6	-0.4	-0.2	-0.4
Latin America	0.9	**-1.0**	-0.1	-0.2	1.4	**1.4**	-0.3	-0.1	-0.1	0.0	1.3	0.3	-0.1	-0.2	-0.1	0.0	-0.1
CAFTA	-1.2	**-4.3**	-2.1	-2.2	-0.5	**4.7**	-2.5	-2.7	-1.9	-2.1	-0.5	-1.5	-1.6	-1.9	-1.6	-1.6	-2.5
CARICOM	0.4	**-1.9**	-0.6	-0.6	0.9	**2.1**	-0.6	-0.5	-0.3	-0.3	0.9	0.1	-0.4	-0.5	-0.5	-0.3	-0.5
Western Europe	0.8	**-1.5**	-0.2	-0.2	1.5	**2.7**	-0.3	-0.1	-0.1	0.0	1.5	0.3	0.0	-0.3	-0.2	0.0	-0.2
CIS	1.0	**-0.9**	-0.1	-0.2	1.7	**1.2**	-0.1	0.0	0.1	0.2	1.4	0.8	0.1	0.0	0.0	0.2	0.0
Gulf countries	0.9	**-0.8**	0.0	-0.1	1.2	**1.1**	-0.1	-0.1	0.1	0.2	1.4	0.7	0.2	0.0	0.0	0.2	0.0
MENA	0.7	**-1.3**	-0.3	-0.3	1.4	**3.3**	-0.3	-0.2	-0.1	0.0	4.4	0.4	-0.1	-0.4	-0.3	0.0	-0.3
Africa south of Sahara	0.9	**-1.0**	-0.1	-0.2	1.0	**1.2**	-0.2	-0.1	0.0	0.2	1.2	0.8	0.1	0.0	-0.1	0.2	-0.1

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa; n.a. = not applicable.

Macroeconomic Impacts

Table 5.12 indicates the impact of all scenarios on welfare. We include only countries for which equivalent variation is affected in at least one scenario.

Table 5.12 Rate of variation in household welfare (equivalent variation), US-China scenarios, percentage points

	China_Unilateral_ST	*China_Unilateral_LT*	*China_35PctRetaliation_ST*	*China_35PctRetaliation_LT*	*China_RevenueRetaliation_ST*	*China_RevenueRetaliation_LT*	*China_ToTRetaliation_ST*	*China_ToTRetaliation_LT*	*China_WelfareRetaliation_ST*	*China_WelfareRetaliation_LT*	*China_Nash_ST*	*China_Nash_LT*
United States	**-0.2**	**-0.1**	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**-0.3**	**-0.2**	**-0.2**	**0.0**	**0.0**
China	**-0.7**	**-0.7**	**-0.8**	**-0.9**	**-1.0**	**-1.0**	**-0.9**	**-0.9**	**-0.6**	**-0.6**	**-0.2**	**-0.2**
CAFTA	0.5	0.4	0.4	0.3	0.4	0.3	0.4	0.3	0.4	0.4	0.1	0.1
Canada	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
CARICOM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Japan	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Mexico	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.1	0.1
South Asia	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Southeast Asia	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0
Rep. of Korea	0.0	0.0	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.0	0.0
MENA	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Africa south of Sahara	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference) and only for regions with nontrivial variations. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; MENA = Middle East and North Africa.

Both belligerent countries lose from this trade war, with larger losses on the Chinese side. It is important to notice that the Chinese losses are less pronounced than the Mexican losses in the US-Mexico trade war (see previous section), but US losses are slightly more pronounced in the US-China trade war. Two countries/regions benefit from this trade war scenario: CAFTA (again) and Mexico.

Sectoral Value-Added

Table 5.13 presents the impact of these three scenarios (*China_Unilateral_LT*, *China_RevenueRetaliation_LT*, and *China_Nash_LT*) on value-added in China and in the United States by sector and in volume. It also gives the share of each sector in total value-added in the baseline.

Table 5.13 Share and rate of variation in value-added, in volume and by sector, US-China scenarios, percentage points

	Share of value-added		*China_ Unilateral_LT*		*China_ Revenue Retaliation_LT*		*China_Nash_ LT*	
	China	US	China	US	China	US	China	US
Other animal products	2.84	0.23	-0.3	-0.2	-0.5	-1.4	-0.1	-0.3
Chemical, rubber, plastic products	4.32	3.05	0.2	-0.1	0.9	-0.9	0.2	-0.3
Coal, oil, gas	2.51	1.78	2.0	-1.0	1.2	0.7	0.6	-0.1
Crops	5.29	0.96	0.3	-1.0	2.1	-6.6	0.3	-1.1
Electronic equipment	2.26	0.54	-6.3	4.6	-7.8	4.7	-2.8	1.3
Fishing	1.09	0.04	0.0	0.0	0.0	-1.0	0.0	-0.1
Forestry	0.66	0.08	-0.4	0.4	0.9	-4.6	0.1	-0.7
Machinery and equipment *nes*	5.53	3.87	0.4	-1.0	0.6	-1.3	0.1	-0.6
Manufactured products *nes*	1.79	0.36	-4.0	5.6	-4.6	7.2	-1.5	2.0
Meat and dairy products	0.30	0.55	0.3	-0.4	0.7	-0.8	0.3	-0.3
Metals and metal products	4.79	2.08	0.7	-0.2	0.9	-0.4	0.2	-0.3
Minerals and mineral products	4.29	0.66	1.1	-0.4	0.6	0.4	0.3	-0.1
Petroleum and coal products	0.35	0.10	-0.1	0.5	0.2	0.3	0.0	0.2
Processed food	2.17	1.38	-0.3	-0.1	-0.9	-0.3	-0.1	-0.1
Textiles	1.30	0.46	-0.9	5.2	-2.9	6.1	-0.5	1.8
Transportation equipment	2.45	1.76	1.0	-1.8	1.8	-2.3	0.5	-0.8
Wearing app. and leather prod.	1.32	0.29	-2.4	6.3	-3.9	7.5	-1.0	2.2
Wood and paper products	1.56	2.43	-1.8	1.5	-1.2	0.7	-0.5	0.3

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Services are excluded. *nes* = not elsewhere specified.

Many sectors in China are affected by the 35-percentage-point augmentation of import duties by the United States, in particular the electronic equipment sector, which represents 2.3 percent of total value-added and is reduced in volume by 6.3 percent (see also the sectors of wearing apparel and leather products, wood and paper products, and nondurable manufactured goods not elsewhere

specified). This policy implies an increase of economic activity in these sectors in the United States, but these are small sectors in the US economy, with limited comparative advantage.

With severe Chinese retaliation (scenario *RevenueRetaliation*), economic activity in the United States is negatively affected in the crops and forestry sectors. Recall that agricultural products form an essential component of US exports to China. With modest retaliation (the *Nash* scenario), the diminution of activity in the US crops sector is significantly less marked than under the other scenarios.

Table 5.14 presents the impact of all six scenarios of a trade war between the United States and China, with long-term adjustment, on real remuneration of productive factors in the United States and China, respectively.

Table 5.14 Rate of variation of real remuneration of factors, US-China scenarios, percentage points

	China_Unilateral_LT	*China_35PctRetaliation_LT*	*China_RevenueRetaliation_LT*	*China_ToTRetaliation_LT*	*China_WelfareRetaliation_LT*	*China_Nash_LT*
Changes in the US real rate of return for						
Skilled workers	-0.2	-0.3	-0.4	-0.3	-0.3	-0.1
Unskilled workers—primary sectors	-0.9	-1.0	-1.0	-1.0	-0.9	-0.4
Unskilled workers—nonprimary sectors	-0.2	-0.3	-0.3	-0.3	-0.2	-0.1
Capital	-0.2	-0.4	-0.4	-0.4	-0.3	-0.1
Land	-1.2	-5.5	-6.5	-5.7	-1.9	-1.1
Changes in the China real rate of return for						
Skilled workers	-0.5	-0.9	-1.0	-0.9	-0.5	-0.2
Unskilled workers—primary sectors	0.1	0.5	0.7	0.5	0.2	0.1
Unskilled workers—nonprimary sectors	-0.7	-1.1	-1.2	-1.1	-0.8	-0.3
Capital	-0.4	-0.7	-0.8	-0.8	-0.5	-0.2
Land	0.3	1.9	2.4	2.0	0.5	0.4

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as a percentage change between the scenario and the baseline (reference).

Let us first explain what happens in terms of price level. When a government imposes protections at the border, this inflationist shock leads to a loss of domestic purchasing power at constant nominal remuneration of productive factors. This increase in domestic prices can directly affect consumers by impacting the price of final consumption goods. A price increase that impacts the price of intermediate goods affects the competitiveness of domestic sectors all along a value chain, which can be negative for economic activity. When a sector's economic activity is negatively affected by protectionist policies, the demand for productive factors in that sector is also negatively affected.

However, some sectors could also be positively affected by this shock, such as the wearing apparel and leather products sector, which benefits from increased production, in turn increasing the demand for productive factors used intensively in the sector. Thus, the overall impact of this shock on real remuneration is the result of these two channels.

When an economy is affected by protectionism abroad, as China is in the *Unilateral* scenario, this poses a negative shock on that economy's domestic production. For example, in the *Unilateral* scenario, production prices in China go down (with a positive result for real remuneration) and there is less demand for productive factors, in particular those intensively utilized in export sectors (with a negative result for nominal remuneration). Under a scenario with Chinese retaliation, some economic sectors could benefit in terms of economic activity (due to an increase in demand for productive factors); however, prices in China also increase due to the protectionist shock. For example, the consumption price index falls by 2.55 percent in the *China_Unilateral_LT* scenario, whereas it falls by only 0.42 percent in the *China_RevenueRetaliation_LT* scenario.

Table 5.14 clearly shows that in all scenarios, real remuneration of all productive factors is hurt in the United States. Thus, no US owners of productive factors benefit from this policy, even unskilled workers in the US manufacturing sector. Unskilled workers in these sectors benefit relatively more from the increased protection than their counterparts in agriculture, but the net effect in real terms is still negative. Thus, when China implements retaliation, US landowners are significantly damaged.

In China, unskilled workers in the manufacturing sector and capital owners are negatively affected by US unilateral protectionism; this effect is of course related to the diminution of economic

activity in the sectors of electronic equipment, wearing apparel and leather products, wood and paper products, and manufactures not elsewhere specified (see above).

A US Trade War with Both Mexico and China

Finally, we provide some results concerning scenarios of a trade war involving the United States on one side and both China and Mexico on the other side. In all of these cases, we consider that the US government increases protection at the border on imports coming from China and Mexico. In cases with retaliation, we consider that China and Mexico augment protection on imports coming from the United States, but we do not consider augmentation of Mexican tariffs on Chinese products or of Chinese tariffs on Mexican goods.

Tariffs

Table 5.15 indicates variations in tariffs in each case. Concerning the *RevenueRetaliation* scenarios, tariffs raised by both China and Mexico are quite similar to those raised in a bilateral trade war; this is normal because, as explained earlier, the collected duties are calculated on a baseline trade flow.

Table 5.15 Changes in tariffs implemented by scenario, United States versus both China and Mexico scenarios, percentage points

	Short-term closure			Long-term closure		
	China	*Mexico*	*US*	*China*	*Mexico*	*US*
US unilateral tariff	n.a.	n.a.	35.0	n.a.	n.a.	35.0
35 percent tariff retaliation	35.0	35.0	35.0	35.0	35.0	35.0
Tariff revenue retaliation	59.9	36.3	35.0	59.7	36.1	35.0
Terms-of-trade retaliation	50.0	50.0	35.0	48.1	43.9	35.0
Optimal welfare retaliation	9.3	9.3	35.0	6.3	9.1	35.0
Nash equilibrium	3.7	9.6	10.3	3.2	9.6	9.9

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: n.a. = not applicable.

In the *ToTRetaliation* scenario, the tariffs raised by China and Mexico in the trilateral trade war are higher than the tariffs implemented in each bilateral trade war (compare with Tables 5.1 and 5.7). The deterioration of terms of trade for China (respectively, Mexico) in its bilateral trade war with United States is identical to the one seen in the trilateral trade war: -1.8 percent (respectively,

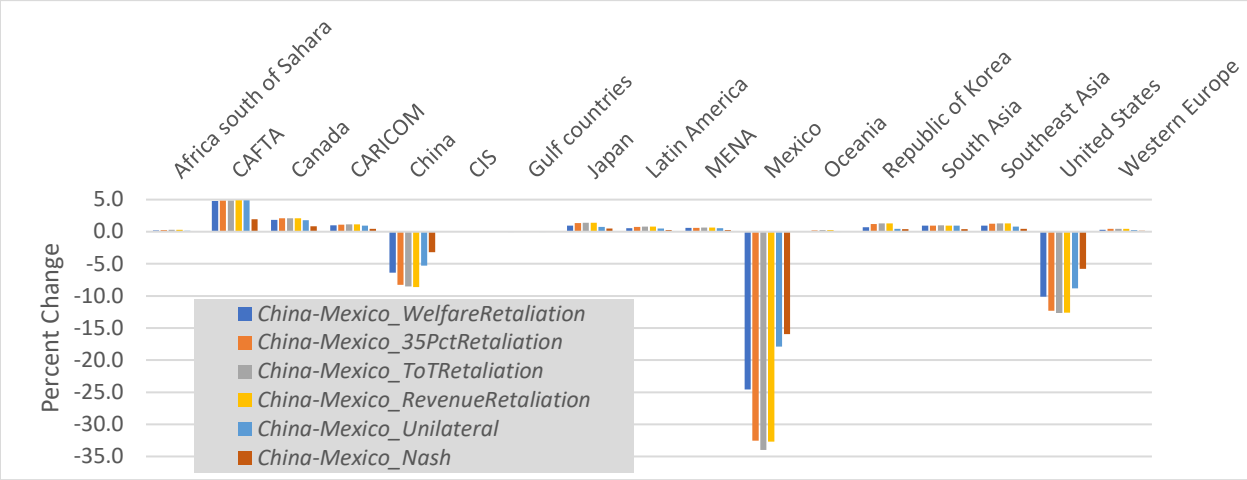
-6.9 percent).[18] However, when China (respectively, Mexico) implements a tariff to recover the initial level of terms of trade, each percentage-point increase in its tariff improves its terms of trade by more when Mexico (respectively, China) does not raise protection against the United States.

In the *WelfareRetaliation* scenarios, the tariff implemented by China and Mexico in either bilateral wars or dual-bilateral wars is similar. Concerning the *Nash* scenario, it is worth noting that if China's and Mexico's tariff augmentations are similar, in either a bilateral war or a trilateral war, the tariff raised at equilibrium by the US government (9.9 percent) is between the one applied in the bilateral war with Mexico (13.4 percent) and the one implemented in the bilateral war with China (7.0 percent).

Trade Impacts

Figure 5.3 indicates the rate of variation of total exports, in volume and by country/region, implied by all scenarios of trade wars between China and Mexico on one side and the United States on the other side.

Figure 5.3 Rate of variation in total exports, in volume, by region and scenario, United States versus both China and Mexico scenarios, percentage points



Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). For the sake of clarity, only scenarios with long-term closure are displayed. CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; MENA = Middle East and North Africa.

[18] These statistics are not presented in any table.

The variation of exports in volume for a country/region in a *China-Mexico* scenario is not exactly equal to the sum of the shock implied by a war with China and that implied by a war with Mexico, but it is close. For example, in a scenario with perfect mobility of capital and in which US trading partners retaliate in order to maximize welfare (*WelfareRetaliation_LT*), China implements a 3.7 percent augmentation of its tariffs under a trade war between China and the United States; this augmentation is 6.3 percent if the trade war takes place between China and Mexico on one side and the United States on the other. It is important to note that the reduction in export volume can be very substantial for the United States: between approximately 6 and 13 percent.

Macroeconomic Impacts

Table 5.16 presents the impact on welfare, by country, of all 12 scenarios of a trade war between the United States on one side and China and Mexico on the other side. The impact is quite similar to the sum of the impact of the bilateral wars considered earlier (compare with Tables 5.2 and 5.9), except in the case of a US-Mexico trade war with retaliation based on terms of trade. CAFTA welfare gains become quite significant. As mentioned earlier, when trade retaliation targets a stabilization of terms of trade, one side effect is an increase in the effect of protection on the terms of trade of the other belligerent.

Table 5.16 Rate of variation in welfare (equivalent variation), United States versus both China and Mexico scenarios, percentage points

	China-Mexico_Unilateral_ST	*China-Mexico_Unilateral_LT*	*China-Mexico_35PctRetaliation_ST*	*China-Mexico_35PctRetaliation_LT*	*China-Mexico_RevenueRetaliation_ST*	*China-Mexico_RevenueRetaliation_LT*	*China-Mexico_ToTRetaliation_ST*	*China-Mexico_ToTRetaliation_LT*	*China-Mexico_WelfareRetaliation_ST*	*China-Mexico_WelfareRetaliation_LT*	*China-Mexico_Nash_ST*	*China-Mexico_Nash_LT*
United States	**-0.1**	**-0.1**	**-0.4**	**-0.4**	**-0.4**	**-0.4**	**-0.5**	**-0.4**	**-0.3**	**-0.2**	**0.0**	**0.0**
China	**-0.7**	**-0.6**	**-0.8**	**-0.8**	**-1.0**	**-1.0**	**-0.9**	**-0.9**	**-0.6**	**-0.6**	**-0.3**	**-0.3**
Mexico	**-2.1**	**-1.3**	**-2.5**	**-1.8**	**-2.6**	**-1.8**	**-3.2**	**-2.2**	**-1.8**	**-1.0**	**-0.7**	**-0.3**
Canada	0.2	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.1	0.1
Japan	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Rep. of Korea	0.1	0.1	0.3	0.3	0.4	0.3	0.4	0.3	0.2	0.2	0.1	0.1
Southeast Asia	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1
South Asia	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Latin America	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
CAFTA	0.9	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.8	0.7	0.3	0.3
CARICOM	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Western Europe	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Gulf countries	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
MENA	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; MENA = Middle East and North Africa.

6 Policy Discussion and Concluding Remarks

The objective of this research is to evaluate the economic and trade impact of potential trade wars initiated by the US government. The evaluation is based on a static multicountry, multisector general equilibrium model, MIRAGRODEP. We study various scenarios, depending on which country or countries the United States is at war with, whether the partner(s) exert retaliation, and what type of retaliation is implemented.

Table 6.1 presents a synthesis of the results for three scenarios: the *Unilateral* scenario, in which only the United States imposes an increase of bilateral tariffs of 35 percentage points; the *RevenueRetaliation* scenario, in which US trading partners exert reprisals in order to augment the collection of tariff revenues by the same amount as the US increase in tariff collection; and the *Nash* scenario, in which each trading partner imposes its welfare-maximizing tariff on the basis of the welfare-maximizing tariff of its trading partner(s). In all cases, we present the long-term scenario, in which there is perfect mobility of capital.

Table 6.1 Synthesis of the results, selected indicators and scenarios

	Unilateral scenario			*RevenueRetaliation* scenario			*Nash* scenario		
	US vs. Mexico	US vs. China	US vs. China & Mexico	US vs. Mexico	US vs. China	US vs. China & Mexico	US vs. Mexico	US vs. China	US vs. China & Mexico
Additional US tariffs on Mexico	35.0	n.a.	35.0	35.0	n.a.	35.0	13.4	n.a.	9.9
Additional US tariffs on China	n.a.	35.0	35.0	n.a.	35.0	35.0	n.a.	7.0	9.9
Additional Mexican tariffs on US	0.0	n.a.	0.0	3.61	n.a.	3.61	n.a.	9.5	9.6
Additional Chinese tariffs on US	n.a.	0.0	0.0	n.a.	5.97	5.97	n.a.	3.1	3.2
US real income (welfare)	-0.1	-0.1	-0.1	-0.1	-0.3	-0.4	0.0	0.0	0.0
US total exports	-3.0	-5.4	-8.8	-4.5	-7.7	-12.6	-2.6	-2.7	-5.8
US real imports from Mexico	-57.0	6.9	-54.5	-63.5	5.7	-62.2	-34.7	2.3	-29.0
US real imports from China	5.2	-75.1	-74.0	3.2	-76.8	-76.3	2.2	-28.8	-36.6
US real unskilled wages in primary sectors	-0.5	-0.9	-1.4	-0.1	-1.0	-1.2	-0.1	-0.4	-0.6
US real unskilled wages in nonprimary sectors	-0.1	-0.2	-0.3	-0.3	-0.3	-0.6	-0.1	-0.1	-0.2

Source: MIRAGRODEP model simulations (AGRODEP 2013).

Note: Results are displayed as percentage change between the scenario and the baseline (reference). Long-term closure is assumed. n.a. = not applicable.

Our first policy conclusion is that there is no scenario under which the United States benefits from either protectionism applied on these two trading partners or a trade war with them. The scenarios depicted in Table 6.1 are interesting because they offer contrasting pictures of a trade war: unilateral protectionism; a large and bilateral increase of US protectionism; US protectionism with severe retaliation; and relatively moderate bilateral augmentation of protectionism. In all scenarios, the impact on US welfare is either 0 or negative; findings are the same for the impact on US GDP. It is true that some US sectors may benefit from these scenarios in terms of value-added (textiles, wearing apparel and leather products, electronic equipment, and so on), but these gains are to the detriment of other sectors (chemical, rubber, and plastic products; crops; meat and dairy products; motor vehicles and parts; and transportation equipment) as well as to the detriment of workers, both skilled or unskilled and in both agricultural and nonagricultural activities. All of these

scenarios have a negative impact on the real remuneration of both unskilled workers and skilled workers in the United States, particularly unskilled workers in primary sectors (this impact is driven by the adverse outcome for US agriculture). Similarly, capital is negatively affected in all cases.[19]

A second policy conclusion comes from the following observation: if we compare a trade war in which the United States imposes a 35-percentage-point increase in protection and the trading partner imposes a similar increase in import duties, both on a bilateral basis, with the *Nash* scenario, in which both countries increase protection by a lesser extent, we see that countries' losses are significantly smaller in the second case. For example, in the *China-Mexico_35PctRetaliation_LT* scenario, welfare losses are 0.8, 1.8, and 0.4 for China, Mexico, and the United States, respectively, whereas in the *China-Mexico_Nash_LT* scenario, they are 0.3, 0.3, and 0.0, respectively. Comparisons of *Nash* scenarios and *RevenueRetaliation* or *ToTRetaliation* scenarios, in the cases of either bilateral or trilateral trade wars, bring similar conclusions. To put this differently, a 35-percentage-point increase in protection and similar retaliation clearly constitute an overreaction in terms of noncooperative trade policy.

A third policy conclusion concerns US trading partners. Although China is significantly affected by trade wars (in terms of welfare, between -0.2 percent and -1.0 percent under a US-China trade war and between -0.3 percent and -1.0 percent under a trade war between the United States and both China and Mexico), the welfare losses are potentially huge for Mexico (between -0.5 percent and -3.2 percent under a US-Mexico trade war and between -0.3 percent and -3.2 percent under a trade war between the United States and both China and Mexico). Furthermore, value-added may drastically decrease in some sectors: for example, the Mexican motor vehicles and parts sector and transportation equipment sector together represent 3.3 percent of total Mexican value-added. In the scenario of unilateral adoption of more protection by the United States, the value-added in these sectors decreases by approximately 16 percent. If Mexico adopts trade retaliation in terms of either an identical augmentation of protection, equivalence of collected duties, or restoration of terms of trade, the sectoral value-added diminishes by about 22 percent.

[19] Table 5.7 presents only long-term scenarios. Short-term scenarios also indicate negative impacts on capital and on skilled and unskilled labor but, for clarity purposes, are not shown.

It is important to highlight the potentially high losses for Mexico, whose economic size is significantly smaller than that of the United States and for which the United States is a major destination of exports (see Figure 3.3). Along the same lines, we also conclude that the design of trade retaliation matters. In a bilateral trade war between Mexico and the United States, trade retaliation based on terms of trade, duty collected, or achieving the same level of increase in protection leads systematically to a greater welfare loss for Mexico,[20] whereas retaliation based on welfare reduces this loss for Mexico. A look at the case of a bilateral trade war between China and the United States brings similar conclusions.

A fourth policy conclusion underlines an economic mechanism in the model that softens the negative impact on China and Mexico. Because the current account is supposed to be constant in percentage of GDP, an adjustment of real exchange rates through domestic prices is required. In the case of Mexico, for example, with the loss of exports to its northern neighbor, a depreciation of the real exchange rate brings more exports, particularly to other trading partners, and fewer imports until the reestablishment of the initial current account as a percentage of GDP. Of course, this effect moderates the loss of activity implied by the loss of exports to the United States. In addition, in the short term, this mechanism may not occur or may occur only partially. In that case, the negative impact of increased US protectionism could lead to more negative results for its trading partners in terms of welfare and GDP.

A fifth policy conclusion concerns the emergence of free riders, that is, countries/regions that benefit from a bilateral or trilateral trade war between the United States and its trading partners. This is the case for the CAFTA region, which obtains welfare gains ranging from 0.3 percent to 0.8 percent under a US trade war with Mexico, China, or both. This impact is, of course, associated with increased exports from CAFTA to the United States to replace either Mexican or Chinese goods.

Let us add that global welfare systematically decreases as a result of these trade wars, with a maximum loss of 0.1 percent when there is a trade war between China and Mexico on one side

[20] That is, compared with the case in which the United States unilaterally imposes increased protection.

and the United States on the other side with trade retaliation under the *RevenueRetaliation* scenario.

Does this study exaggerate the potential magnitude of a trade war? It is true that the recently elected president of the United States has been making fewer protectionist threats against China and Mexico since he took office than he did during the presidential campaign. It is also true that even if these threats are executed, we are not certain the partners will react. Indeed, even though the economic losses driven by US unilateral protectionism are not negligible for China (-0.7 percent of its real income) and are large for Mexico (-2.1 percent in the short run) and therefore should trigger some reaction, these trading partners may expect a single-term presidency or want to avoid escalation and long-term disruption by maintaining a climate of good will and policy stability on their side to reassure private investors. Therefore these US partners may consider a wider range of instruments to cope with increased US protectionism.

Beyond the goods markets, China has potentially large retaliatory capacities through either capital and currency markets (for example, through the amount of US dollars and US Treasury bonds retained by the Chinese central bank) or export restrictions (for example, through leveraging its high market share in the global production of rare earths). These are clearly strong mechanisms with which the Chinese government can exert pressure on the US government. However, the negative outcomes for unskilled workers and deterioration of labor markets in Mexico following an increase in the US tariff will also trigger additional incentives for legal and illegal migration, leading to additional challenges in US-Mexico relations and additional costs for the United States due to these noncooperative outcomes.

As a concluding remark, it is important to restate that trade wars are potentially harmful for the world economy. Protectionism is not the right way to reduce current account deficits from the private and public sectors, inasmuch as these deficits are mainly the consequence of insufficient net savings. It is also important to remember the role of the multilateral trade system that provides mediation for the litigation of trade disputes. If the US government believes some of its trading partners are implementing unfair trade practices at the expense of US producers, the WTO is the right arena in which to complain and obtain a removal of or change in these practices.

Appendix

Table A.1 Geographic disaggregation

Region label	GTAP region code(s)
Oceania	AUS, NZL, XOC
China	CHN, HKG
Japan	JPN
Rep. of Korea	KOR
Southeast Asia	TWN, XEA, KHM, IDN, LAO, MYS, PHL, SGP, THA, VNM, XSE
South Asia	BGD, IND, PAK, LKA, NPL, XSA
Canada	CAN, XNA
United States (US)	USA
Mexico	MEX
Latin America	ARG, BOL, BRA, CHL, COL, ECU, PRY, PER, URY, VEN, XSM, PAN, HND, XCA
CAFTA	CRI, GTM, NIC, SLV
CARICOM	DOM, JAM, PRI, TTO, XCB
Western Europe	AUT, BEL, CYP, CZE, DNK, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, LVA, LTU, LUX, MLT, NLD, POL, PRT, SVK, SVN, ESP, SWE, GBR, CHE, NOR, XEF, BGR, HRV, ROU, XTW
CIS	ALB, BLR, RUS, UKR, XEE, XER, KAZ, KGZ, MNG, XSU, ARM, AZE, GEO
Gulf countries	IRN, ARE, BHR, KWT, OMN, QAT, SAU, XNF
MENA	TUR, ISR, JOR, XWS, EGY, MAR, TUN
Africa south of the Sahara	NGA, SEN, BEN, BFA, CIV, GHA, GIN, TGO, XWF, CMR, XCF, XAC, ETH, KEN, MDG, MWI, MUS, MOZ, RWA, TZA, UGA, ZMB, ZWE, XEC, BWA, ZAF, NAM, XSC

Source: authors

Note: CAFTA = Central America Free Trade Agreement; CARICOM = Caribbean Community; CIS = Commonwealth of Independent States; GTAP = Global Trade Analysis Project ; MENA = Middle East and North Africa.

Table A.2 Sectoral disaggregation

Sector label	GTAP sector code(s)
Crops	PDR, WHT, GRO, V_F, OSD, C_B, PFB, OCR
Animals	CTL, OAP, RMK, WOL
Forestry	FRS
Fishing	FSH
Coal, oil, gas	COA, OIL, GAS
Minerals and mineral products	OMN, NMM
Meat and dairy products	CMT, OMT, MIL
Processed food	VOL, PCR, SGR, OFD, B_T
Textiles	TEX
Wearing apparel, leather products	WAP, LEA
Paper and lumber products	LUM, PPP
Fossil fuels	P_C
Chemical, rubber, and plastic products	CRP
Metals and metal products	I_S, NFM, FMP
Transportation equipment	MVH, OTN
Electronic equipment	ELE
Capital goods	OME
Other manufactured goods	OMF
Utilities	ELY, GDT, WTR
Construction	CNS
Trade	TRD
Road transportation	OTP
Transportation services	WTP, ATP
Services	CMN, OFI, ISR, OBS, ROS, OSG, DWE

Source: authors

Note: GTAP = Global Trade Analysis Project.

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