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The economics of tariffs

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Abstract
A central insight from neoclassical economics is that international trade operates like an improvement in production technology. It generates mutual aggregate welfare gains for countries as a whole, but creates winners and losers within countries. Tariffs are a tax on this trading technology and distort the prices faced by domestic consumers and producers. Large countries can use tariffs to improve their terms of trade on world markets. But if all countries try to do so, they can end up with lower welfare than if they cooperated to liberalize trade. Tariffs can be used to redistribute income between the winners and losers from trade within countries. But there can be other more efficient ways to achieve redistribution. Policies to promote economic activity in critical industries can be rationalized based on externalities or national security. But these arguments typically rationalize targeted policies towards those industries and tariffs can be dominated by other policy interventions. Empirical findings from the recent waves of US tariffs suggest that most of the incidence of these tariffs has been borne by US importers, wholesalers, retailers and consumers rather than by foreign exporters. These tariffs have led to a large-scale reorganization of US supply chains away from China to third countries. Although this reorganization has substantially reduced China's share of US imports, the US remains indirectly exposed to China through the imports of these third countries.

Keywords: comparative advantage; tariffs; trade; and welfare
JEL codes: F13, F14, F15

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1 Introduction

For much of the period since the Second World War, tariffs appeared to be a largely settled issue in advanced economies. Successive rounds of multilateral liberalization under the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO), together with the expansion of preferential trade agreements, steadily reduced barriers to trade. By the mid-2010s, average import-weighted tariffs in the United States had fallen below 2 percent—levels that were exceptionally low by historical standards.

In recent years, this situation has changed dramatically. Beginning in 2018–2019, and intensifying in 2025–2026, the United States imposed successive waves of tariffs that raised protection to levels not seen since the Smoot–Hawley Tariff Act of the 1930s. Tariffs were applied broadly across products and trading partners and were subsequently adjusted through bilateral bargaining rather than through multilateral, rule-based processes. At the same time, geopolitical tensions have risen, concerns about resilience and national security have intensified, global production has become increasingly fragmented, and industrial policy has regained prominence. In this environment, tariffs have reemerged as an actively-deployed instrument of economic policy.

This renewed prominence of tariffs brings foundational economic questions back to the forefront. What are the aggregate welfare consequences of taxing imports, and who ultimately bears their burden? Under what conditions can tariffs raise national real income? How do they interact with global production structures and domestic distortions? What distributional effects do they generate within countries? And how should we understand their use in a world of strategic interaction among states and international institutions?

Against this background, this article synthesizes theoretical and empirical research on the economics of tariffs. Our aim is not to provide an exhaustive survey, but rather to distill key economic insights and clarify how they relate to contemporary trade policy debates. The exposition is intended to be accessible to advanced undergraduate and graduate students in economics, as well as interested non-economists, while remaining grounded in frontier research.

The analysis is organized around a central conceptual insight: international trade operates like a technology that allows economies to transform what they produce into what they consume through market-based exchange. Tariffs are a tax on this technology. This perspective provides a unified way of understanding both the costs and benefits of tariffs. By distorting the prices faced by consumers and producers, tariffs generate deadweight losses through inefficient consumption and production decisions. At the same time, economies that are large enough to influence world prices can use tariffs to improve their terms of trade, shifting part of the burden onto foreign exporters. The tension between domestic distortions and international price manipulation lies at the heart of the economics of tariffs and underpins both the classic optimum-tariff argument and the rationale for international

trade policy cooperation.

Another unifying theme concerns income distribution. Like other technological changes, trade generates winners and losers within countries—across industries, regions, firms, and households. Tariffs can redistribute income toward import-competing sectors or locations, but they do so indirectly and typically at the cost of reducing aggregate real income. These distributional consequences help explain the political appeal of tariffs and the persistence of protectionist pressures, even in circumstances under which tariffs lower aggregate real income.

Finally, many contemporary arguments for tariffs—whether framed in terms of manufacturing revival, supply-chain resilience, or national security—can be understood as modern variants of older economic ideas involving externalities or market failures. While such considerations can, in principle, justify intervention, tariffs are rarely the first-best policy instrument relative to more targeted interventions, particularly in economies deeply embedded in global value chains.

This article complements a broad set of existing surveys and reviews on trade policy. The intellectual history of arguments over trade and protection is examined in Irwin (1997), while Irwin (2019) traces the evolution of U.S. trade policy. Classic surveys such as Corden (1984), Dixit (1985), Helpman and Krugman (1989), and Feenstra (1995) synthesize the normative and positive theory of trade policy in partial and general equilibrium. More recent reviews, including Costinot and Rodríguez-Clare (2014), Goldberg and Pavcnik (2016), and Caliendo and Parro (2022), incorporate modern quantitative trade frameworks and empirical evidence. Detailed assessments of the 2018–2019 U.S. tariffs are provided by Fajgelbaum and Khandelwal (2022), while Caliendo and Parro (2023) place U.S.–China trade tensions in a broader quantitative perspective. The resurgence of industrial policy is surveyed in Juhász and Steinwender (2024) and Juhász et al. (2024). Clausing and Obstfeld (2025) discuss the fiscal implications of tariffs and their role within modern tax systems.

The remainder of the paper is structured as follows. Section 2 provides some institutional and historical background on trade and tariffs. Section 3 examines the direct effects of a tariff in the industry in which it is introduced using conventional methods of demand and supply. We distinguish between statutory incidence (who is legally responsible to pay the tariff) and economic incidence (who bears the economic cost of the tariff). We compare the deadweight welfare losses from the distortion of domestic consumption and production decisions to the improvement in a country's terms of trade. We establish equivalences and non-equivalences between tariffs and other possible trade and domestic policies.

Section 4 turns to the aggregate effects of tariffs, including indirect effects in other industries, using conventional general equilibrium techniques. We introduce the central insight that international trade acts like an improvement in production technology that is mutually beneficial (win-win) for all nations. Instead of producing everything domestically, countries can specialize in what they are relatively good at producing, and use the technology of market-based exchange to obtain other

goods. A tariff is a tax on this technology of market-based exchange and is necessarily welfare reducing for a country that is too small to influence world prices. But a country that is large enough to influence world prices can use a tariff to improve its terms of trade at the expense of its trade partners and world welfare.

Section 5 shows that the mutual aggregate welfare gains from trade typically involve winners and losers within countries, as with any other technological improvement. Although the winners could in principle compensate the losers and still be better off (the famous Kaldor-Hicks compensation criterion), this compensation typically does not take place in practice. Tariffs can be rationalized as a policy to offset the distributional consequences of trade. But they are typically not the most efficient way of redistributing income. These distributional consequences of trade provide a political economy explanation for why countries adopt tariff protection. Organized interest groups lobby to raise the prices of domestic goods that provide them rents at the expense of the welfare of consumers and unorganized interest groups.

Section 6 turns to international trade agreements. The incentive for a large country to impose a tariff to improve its terms of trade (thereby worsening the terms of trade of its trade partners) introduces an externality between countries. If all countries succumb to this incentive, and engage in a trade war, the effects of countries' tariffs on the terms of trade can be offsetting. As a result, countries can end up with little improvement in the terms of trade, but welfare losses from the distortion of consumption and production decisions. If countries could collectively commit not to introduce tariffs, they could achieve a higher level of welfare than under the trade war (a Prisoners' Dilemma). The principles of reciprocity and non-discrimination of the WTO can be interpreted as providing a mechanism to help countries overcome this terms of trade externality and Prisoners' Dilemma.

Section 7 introduces quantitative trade models that have been used to evaluate the impact of tariffs and other trade policies. These quantitative trade models are sufficiently rich as to capture key features of the observed data and to be used for empirically-relevant counterfactuals. They provide sufficient statistics to evaluate the aggregate welfare gains from opening a closed economy to trade. They also can be used to evaluate the implications of trade wars and international trade agreements for countries' tariff choices and welfare levels.

Section 8 examines some of the most influential arguments for tariff protection, including domestic distortions, infant industries, external economies of scale, and national security. Section 9 reviews empirical evidence for the impact of the recent waves of U.S. tariffs and the extent to which these empirical findings align with the predictions of conventional economics. Section 10 concludes.

2 Historical Background

Countries have adopted a number of different policies towards international trade over time. Perhaps the most common is a tariff, which corresponds to a tax on imports. Tariffs can take two main forms: *ad valorem* (a percentage amount, such as a 20 percent tariff) or *specific* (a monetary amount such as $10 per unit of a good imported). In perfectly competitive markets, these two forms of tariffs are equivalent, in the sense that one can always find an *ad valorem* tariff that has exactly the same effects on prices, quantities and welfare as any given *specific* tariff.[1]

The statutory incidence of a tariff falls on imported goods. But a tariff typically also affects the price of competing domestic goods, and its impact can be replicated by a combination of a domestic consumption tax and production subsidy (see Section 3). The opposite of a tariff for imported goods is an import subsidy. Whereas a tariff raises revenue, an import subsidy must be financed through other taxes. The analogue of a tariff for exported goods is an export tax. The equivalent of an import subsidy for exported goods is an export subsidy. Although import and export taxes are levied on different sets of goods (imports versus exports), their effects on the relative prices of goods are closely related (see Section 4).

Tariffs operate through prices. But countries also have used a variety of non-tariff barriers, such as an import quota, which corresponds to a physical limit on the quantity of a good imported (as in the Multi-Fibre Agreement from 1974-94). Whereas import quotas are imposed by importers, exporters can choose to restrict the quantity of goods supplied to an importer through Voluntary Export Restraints (VERs), as for Japanese auto exports to the United States in the 1980s. Less transparent forms of non-tariff barriers include product standards and technical regulations that benefit domestic firms relative to their foreign counterparts.

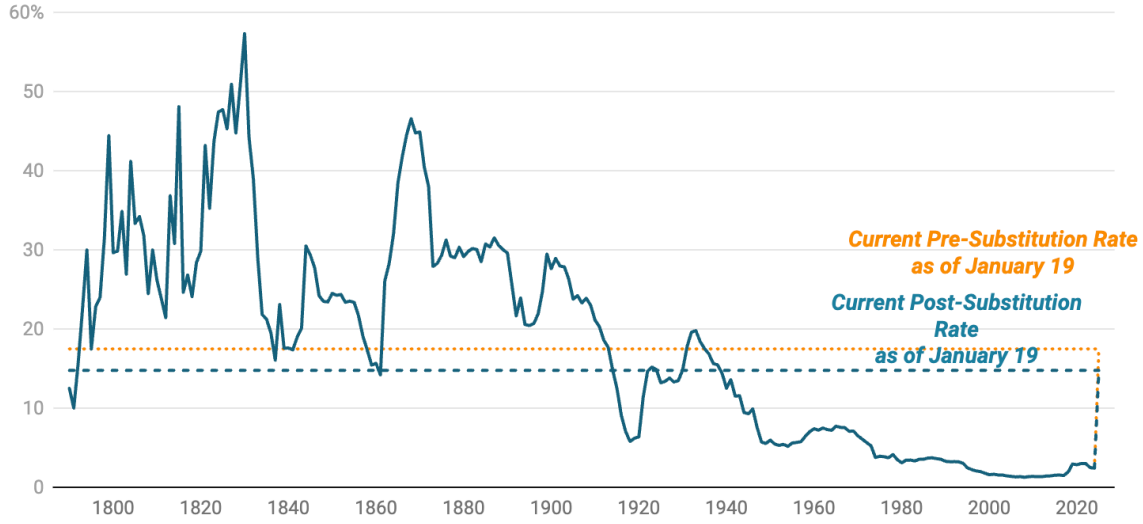
Figure 1 provides evidence on the globalization of the world economy since the early 19th century, measured by merchandise exports as a share of world GDP. Three points are noteworthy. First, the period since the Second World War was characterized by globalization, with exports growing substantially more rapidly than GDP. This globalization was particularly rapid from 1986-2008, which is referred to as a period of "hyperglobalization" in Antràs (2020). Second, there have been previous periods of globalization, such as the second half of the 19th century, during which exports grew more rapidly than GDP. Third, globalization is not inevitable or pre-ordained, with these two time periods separated by the interwar years, during which exports grew substantially less rapidly than GDP. Relative to these previous episodes of globalization, a distinctive feature of globalization today is the emergence of global value chains (GVCs), in which stages of production are fragmented across national borders (e.g., Apple's iPhone).

[1] *Ad valorem* and *specific* tariffs can have different market implications under imperfect competition (e.g., Krishna 1987) or under asymmetric information (Madsen et al. 2025).

Figure 1: World Exports as a Share of World GDP 1827-2014

Note: Value of merchandise exports as a share of world GDP. Source: Fouquin and Hugot (2016).

Figure 2: U.S. Average Effective Tariff Rate Since 1790



Note: Average effective tariff rate measured as customs duty revenue as a percentage of the value of merchandise imports; pre-substitution rate measured before changes in import shares; post-substitution rate measured after changes in import shares (as of January 19, 2026); Yale Budget Lab; Source: Historical Statistics of the United States; Ea424-434; Monthly Treasury Statement; Bureau of Economic Analysis.

Figure 2 shows average effective tariffs over time for the United States since 1790. Average effective tariffs are measured as customs duty divided by the value of goods imports. A number of features are again apparent. First, average tariffs were relatively high in the early decades of the republic, in

part with the aim of protecting nascent manufacturing industries. Second, average tariffs fell from 1870-1920 during the late-19th century globalization. Third, average tariffs rose during the interwar retreat from globalization. Fourth, average tariffs again fell during the period of globalization in the aftermath of the Second World War. Fifth, the increase in average tariffs in recent years is substantial relative to both recent decades and the interwar period. Although far from conclusive, the close relationship between periods of globalization and tariff reductions is at least suggestive of an important role for trade policy in shaping the integration of the world economy.

Figure 3: U.S. Tariff Revenue as a Percent of Total Government Revenue 1795-2019

Note: U.S. tariff revenue as a share of total government revenue; Source: Chad P. Bown and Douglas A. Irwin's (2019) "Tariff revenue and Trump tweets — 5 things you need to know," Washington Post MonkeyCage, July 16, 2019.

Figure 3 displays U.S. tariff revenue as a share of total government revenue from 1795-2019. In the early decades of the republic, tariff revenue accounted for a substantial share of government revenue, in part because government capacity was limited and tariffs are relatively easy to administer. At least since the Second World War, tariff revenue has accounted for a negligible share of government revenue, as the improvement in government capacity allowed revenue to be raised through other taxes such as income tax. This time-series pattern for the United States is in line with cross-country evidence today. Tariffs account for a substantial share of government revenue today in low-income countries with limited government capacity, and contribute a negligible share of government revenue in high-income countries with substantial government capacity.

3 Direct Effects of Tariffs

We begin by examining the direct effects of tariffs in the industry where they are introduced. We use a partial equilibrium analysis based on demand and supply to introduce the deadweight welfare losses from the distortion of producer and consumer decisions and the terms of trade effects from

the introduction of a tariff.

3.1 Price and Quantity Effects of a Tariff

We consider a neoclassical environment with perfect competition, constant returns to scale and no market failures. We focus on a single sector (e.g., wheat). There are two countries: home and the rest of the world (foreign), where foreign variables are denoted by an asterisk. We assume that each country is large, in the sense that its trade volume is sufficiently large so as to influence the world market price for the good.

Figure 4 shows the home market for wheat. D is the domestic demand curve. S is the domestic supply curve. The closed economy (autarky) equilibrium price is p_A, at which domestic demand is equal to domestic supply. When the closed economy is opened to free trade, we suppose that home is an importer of wheat in the free trade equilibrium, while foreign is an exporter of wheat. The domestic price (p_F) is equal to the world market price (p_F^*) under free trade: $p_F = p_F^*$. Home's equilibrium quantity of imports is equal to the difference between domestic demand and supply at the free trade equilibrium price: $M_F = D_F - S_F$.

Suppose that home introduces a specific tariff of $t > 0$, while the rest of the world maintains policies of free trade. Home's tariff introduces a wedge between the domestic price (p_T) and the world market price under the tariff (p_T^*):

$$p_T = p_T^* + t. \tag{1}$$

The direct effect of the tariff is to raise the price of imported wheat. But domestic and foreign wheat are perfect substitutes, which implies that the domestic price of wheat must also rise, in order to leave consumers indifferent between consuming domestic and foreign wheat, in any equilibrium with positive wheat imports. Therefore, although only imported wheat is taxed, the price of domestic wheat also rises in equilibrium from p_F to p_T.

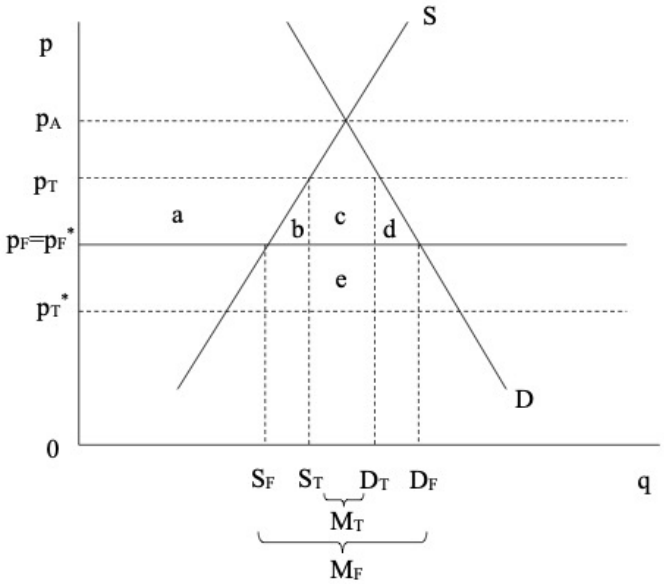
As the domestic price of wheat rises, domestic demand for wheat declines (from D_F to D_T), and domestic supply of wheat increases (from S_F to S_T), with the result that there is a decline in home's imports of wheat to $M_T = D_T - S_T$. Since home is large relative to the world market for wheat, this decline in import demand leads to a fall in the world market price of wheat from p_F^* to p_T^*.[2]

Therefore, although the statutory incidence of the tariff is on imports, its equilibrium incidence is shared between home consumers (higher home price) and foreign producers (lower world market price). The size of the fall of the world market price depends on the elasticity of the foreign export supply curve. In the special case in which home is small relative to world markets, it faces a perfectly

[2]We make the standard assumption that the world market price falls by less than the tariff, such that the domestic price rises ($p_T > p_F$), which is the empirically-relevant case of no Metzler Paradox (Metzler 1949).

elastic foreign export supply curve, such that its imports have no effect on the world market price ($p_T^* = p_F^*$). In this special case, the entire incidence of the tariff falls on domestic consumers.

Figure 4: Impact of a Tariff in the Domestic Market in Partial Equilibrium



Note: Impact of the introduction of a tariff by home on its imported good; p_A is the closed economy (autarky) market price; $p_F = p_F^*$ is the common domestic and world market price under free trade; p_T is the domestic market price under the tariff; p_T^* is the world market price under the tariff.

Multiple claims have been made about the effects of tariffs, such as increasing domestic employment without increasing domestic prices, reducing imports, and raising tax revenue. The demand-supply analysis in Figure 4 already indicates some trade-offs between achieving alternative objectives. In order to stimulate domestic production (from S_F to S_T), tariffs must raise domestic prices (from p_F to p_T), such that domestic producers move up their supply curve. Although tariffs do simultaneously reduce imports (from M_F to M_T) and raise tax revenue (by $M_T\left(p_T - p_T^*\right)$), the reduction in imports decreases the tax base and hence the revenue raised, thereby indicating a trade-off between the objectives of restricting imports and raising revenue.

3.2 Welfare Effects of a Tariff

In this partial equilibrium setting, national welfare ($\mathcal{W}(t)$) can be represented as the sum of consumer surplus ($CS\left(p\left(t\right)\right)$), producer surplus ($PS\left(p\left(t\right)\right)$) and government revenue ($R\left(t\right)$):

$$\mathcal{W}(t) = CS\left(p\left(t\right)\right) + PS\left(p\left(t\right)\right) + R\left(t\right), \tag{2}$$

$$R\left(t\right) = tM\left(p\left(t\right)\right). \tag{3}$$

From Figure 4, the tariff reduces consumer surplus by areas $a + b + c + d$; increases producer surplus by area a; and increases government revenue by area $c+e$; which equals the value of the tariff

times the quantity of imports under the tariff (tM_T). Therefore, the net effect of the tariff on welfare is $e-(b+d)$, which is ambiguous, depending on whether the improvement in the terms of trade (e) exceeds the deadweight welfare loss from the distortion of consumer and producer decisions ($b+d$). Area e corresponds to a welfare improvement, because under the tariff the home country obtains the good from the world market at a lower price than under free trade ($p_T^* < p_F$), allowing the country to obtain a greater quantity of imports for any given quantity of exports (an improvement in the terms of trade). This terms of trade improvement shows up as part of government revenue, because the wedge between domestic and world prices corresponds to tax revenue. Areas b and d are Harberger triangles for the deadweight welfare losses for producers and consumers (Harberger 1964). For a small tariff, the welfare impact of the tariff is:

$$\frac{d\mathcal{W}(t)}{dt} = -M(p)\frac{dp^*}{dt} + t\frac{dM(p)}{dp}\frac{dp}{dt}, \tag{4}$$

as shown in Online Appendix C.1. The first term is the terms of trade improvement on infra-marginal imports, and is positive, since $\frac{dp^*}{dt} < 0$. The second term is the deadweight welfare loss from distorting producer and consumer decisions, and is negative, since $\frac{dM(p)}{dp} < 0$ and $\frac{dp}{dt} > 0$.

3.3 Optimum Tariff for a Large Country

Starting from free trade ($t = 0$), the welfare gain from the terms of trade improvement (area e and the first-term in equation (4)) is first-order, because it captures the reduction in the cost of sourcing infra-marginal units on world markets. In contrast, the deadweight welfare losses (areas $b + d$ and the second term in equation (4)) are second-order, because the free trade equilibrium is efficient. In this free trade equilibrium, producers equate price to marginal cost, and consumers equate price to marginal utility. Therefore, the envelope theorem applies, and the deadweight welfare losses from the distortion of producer and consumer decisions are second-order small.

This property has two important implications. First, starting from free trade ($t = 0$) and taking the behavior of the rest of the world as given, a country that is large enough to affect the world market price has a unilateral incentive to introduce a small tariff, because the first-order welfare gain from the terms of trade improvement exceeds the second-order welfare loss from the distortion of producer and consumer decisions. Second, as the tariff increases from zero, the second-order welfare losses from the distortion of producer and consumer decisions become large relative to the first-order welfare gain from the terms of trade improvement, such that a large tariff can be welfare reducing.

The optimum tariff for a large country can be obtained by setting equation (4) equal to zero, which yields the classic optimum tariff formula (Johnson 1953):

$$t_V = \frac{1}{\epsilon_S^*}, \qquad \epsilon_S^* \equiv \frac{dM}{dp^*(M)}\frac{p^*}{M}, \tag{5}$$

as shown in Online Appendix C.2; where t_V is an *ad valorem* tariff (such that $p = (1 + t_V)\, p^*$); and ϵ_S^* is the elasticity of foreign export supply with respect to the world price of the good (which equals the elasticity of home's imports with respect to that world price).

A country that is large enough to affect the world market price faces a positive and finite export supply elasticity ($0 < \epsilon_S^* < \infty$), which implies that its optimum tariff is strictly positive, assuming no retaliation by the rest of the world. Therefore, the crucial object in determining the size of the optimum tariff is the foreign export-supply elasticity. Using the Feenstra (1994) methodology for estimating demand and supply elasticities, Broda et al. (2008) estimate export supply elasticities for 15 countries that were able to choose tariffs unilaterally, because they were not members of the World Trade Organization (WTO). Estimated inverse export supply elasticities are lower for homogenous products that are traded on organized exchanges ($1/\epsilon_S^* = 0.5$) than for differentiated products ($1/\epsilon_S^* = 2.4$). Countries are found to set tariffs about 9 percentage points higher in goods with medium or high market power than in those with lower market power, consistent with countries' tariff choices being influenced by their ability to manipulate the terms of trade.

However, this optimum tariff argument for a large country assumes no retaliation by the rest of the world. If home and foreign both introduce a tariff, each country may end up with little improvement in its terms of trade, at the cost of distorting domestic production and consumption decisions, as discussed further in Section F below. In this case, both countries may end up with lower welfare than under free trade. From the point of view of the world as a whole, the terms of trade is a pure transfer between the home and foreign countries. The tariff reduces world welfare, because consumers and producers in each country equate marginal utility and marginal cost to domestic prices, which differ from world prices under the tariff.

3.4 Small Country Special Case

In the special case of a small country that is unable to influence the world price of a good ($\frac{dp^*}{dt} = 0$), there is zero first-order effect of the tariff on welfare in equation (4). Therefore, the tariff only has second-order effects on welfare through the deadweight welfare losses from the distortion of domestic producer and consumer decisions:

$$\frac{d\mathcal{W}(t)}{dt} = t\frac{dM(p)}{dp}\frac{dp}{dt} < 0, \tag{6}$$

since $\frac{dM(p)}{dp} < 0$ and $\frac{dp}{dt} > 0$. Therefore, a tariff necessarily reduces welfare for a small country. Taking a second-order Taylor-series expansion around the free trade equilibrium, the deadweight welfare losses correspond to the area of the Harberger triangles ($b + d$) in Figure 4:

$$\Delta\mathcal{W}(t) \approx \frac{1}{2}\frac{dM(p^*)}{dp}t^2 \approx \frac{1}{2}t(\Delta M) < 0, \tag{7}$$

as shown in Online Appendix C.1. In terms of equation (5), a small country that is unable to influence the world price of a good faces a perfectly elastic export supply curve ($\epsilon_S^* = \infty$), and hence has a zero optimum tariff.

Although the tariff is distortionary and welfare reducing for a small country, one could argue that most forms of taxation (e.g., income, consumption, property taxes) are distortionary, because lump sum taxes that are levied per head regardless of individual characteristics are typically viewed as politically infeasible. Following Ramsey (1927), public finance economists typically think of choosing the optimal portfolio of taxes, taking into account the magnitude of these distortions, depending for example on elasticities of demand and supply for each good and factor of production. Therefore, one can ask whether the optimal portfolio of taxes should typically include positive tariffs, even for a small country for which these tariffs are purely distortionary.

There are three reasons why economists typically view tariffs as especially costly from a welfare perspective. First, while consumption taxes distort consumption and production taxes distort production, tariffs simultaneously distort both of these margins. Second, for a large country such as the United States, imports account for a relatively small share of income and expenditure at around 10 percent, which implies a much smaller tax base than for income or expenditure taxes. This smaller tax base implies that a larger tax rate must be chosen in order to raise a given amount of revenue. Since the distortionary effects of taxation increase with the square of the tax rate (as shown for tariffs in equation (7) above), this implies that tariffs are more distortionary than these other taxes for the same amount of revenue raised. Third, since the statutory incidence of tariffs falls directly on imports, they can be more prone to retaliation by foreign countries than domestic taxes, where foreign retaliation reduces home welfare.

3.5 Policy Equivalences

From this demand-supply analysis under perfectly competitive markets in Figure 4, there are a number of equivalences between tariffs and other taxes or trade policies, in the sense that these other policies have exactly the same effects on prices, quantities and welfare as tariffs.

First, a tariff is equivalent to the combination of a consumption tax and a production subsidy. A consumption tax (t_C) can be used to shift the domestic demand curve in Figure 4, such that it intersects the prevailing world price under the tariff at the same domestic quantity demanded as under the tariff (D_T), with the same (consumer) price inclusive of the tax as under the tariff ($p_T = p_T^* + t_C$) . A production subsidy (x_S) can be used to shift the domestic supply curve in Figure 4, such that it intersects the prevailing world price under the tariff at the same domestic quantity supplied as under the tariff (S_T), with the same (producer) price inclusive of the subsidy as under the tariff ($p_T = p_T^* + x_S$). This property again makes clear that tariffs simultaneously distort both consumption and production decisions. It also highlights that domestic taxes and subsidies can be used to achieve the

same effects as tariffs.

Second, a tariff is equivalent to an import quota that restricts the quantity of imports to M_T, if the licenses to import under the quota are competitively auctioned by the government at the price $p_T - p_T^*$. In this case, the quota generates the same domestic prices and quantities and raises the same amount of revenue as the tariff. In contrast, if the quota licenses are given to foreign firms, the quota is strictly worse than the tariff, because it generates the same domestic prices and quantities but does not raise any revenue. Voluntary export restraints (VERs) correspond to the case where the right to import is given to foreign firms and hence are strictly worse than tariffs or competitively-auctioned quotas. While these relationships between tariff and quotas hold under perfect competition, the two sets of policies can have different effects under other market structures.[3]

4 Aggregate Effects of Tariffs

We now turn to the aggregate economy-wide effects of tariffs, including indirect effects in other industries. We use general equilibrium techniques to highlight the way in which international trade is analogous to an improvement in production technology, and the sense in which a tariff is a tax on this technological improvement.

4.1 Welfare Gains from Trade

We again consider a neoclassical environment with perfect competition, constant returns to scale and no market failures. There are two countries: home and foreign, where foreign variables are denoted by an asterisk. Home is assumed to be large relative to world markets, such that its imports and exports influence world prices. To illustrate general equilibrium effects as simply as possible, we consider the case in which there are only two goods (1 and 2).

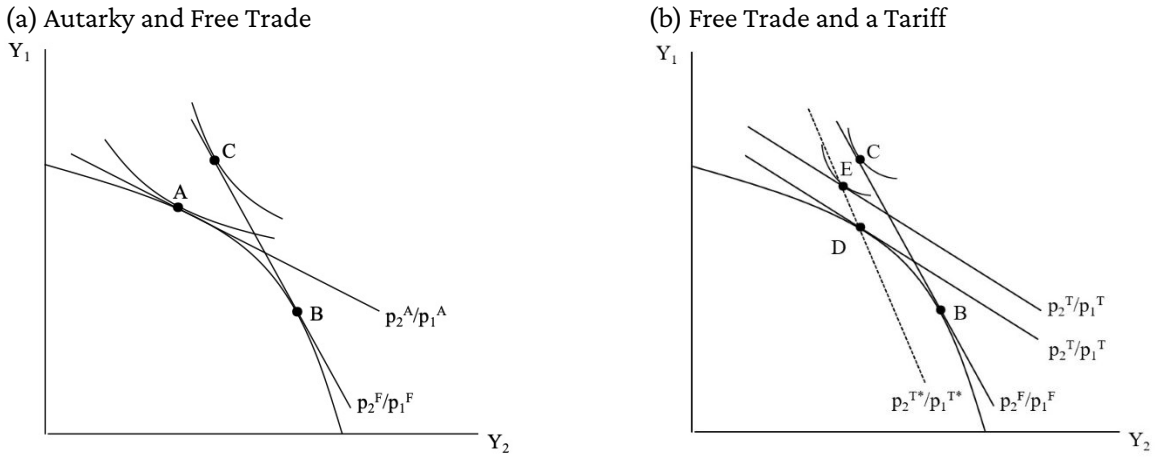
Figure 5 illustrates the home country's production and consumption possibilities, using a production possibility frontier (PPF) and indifference curves. In the closed economy (autarky), home must produce everything that it consumes. Therefore, the autarky equilibrium is at point A, where producers maximize profits (the slope of the PPF equals autarky relative prices), consumers maximize utility (the slope of the indifference curve equals autarky relative prices), and consumption equals production for each good.

When the economy is opened to free trade, home no longer needs to produce everything that it consumes. Instead, home can specialize in the good where it is relatively productive, sell that good on world markets, and use the revenue to obtain the other good from foreign. As long as relative prices on world markets are different from home's autarky prices, producers will produce more of the

[3] For comparisons of tariffs and quotas under domestic monopoly, see Bhagwati (1965) and Bhagwati (1968). For comparisons under oligopoly, see Krishna (1989).

good whose relative price has risen, and consumers will demand relatively more of the good whose relative price has fallen. The free trade equilibrium involves production at B (where the slope of the PPF equals free trade relative prices) and consumption at C (where the slope of the indifference curve equals free trade relative prices). Home exports good 2 (for which production at B exceeds consumption at C) and imports good 1 (for which production at B falls short of consumption at C).

Figure 5: Tariffs in General Equilibrium



Note: Panel (a) shows the autarky and free trade equilibria; p_2^A/p_1^A denotes autarky relative prices; p_2^F/p_1^F denotes free trade relative prices; Panel (b) shows the free trade and tariff equilibria; p_2^F/p_1^F denotes free trade relative prices; p_2^T/p_1^T denotes domestic relative prices under the tariff; and p_2^{T*}/p_1^{T*} denotes world relative prices under the tariff.

Comparing the closed and open economy equilibria, there are aggregate welfare gains from trade, in the sense that home is able to achieve a higher indifference curve under free trade at C than under autarky at A. We also see the sense in which international trade is like an improvement in production technology. In the open economy, home is able to consume at point C, outside of its production possibility frontier. This consumption bundle is technologically infeasible in the closed economy. But it is made feasible by the technology of trade at world market prices. Although home cannot produce the bundle of goods at C itself, it can consume this bundle under international trade, by specializing in the good that is relatively more efficient at producing, and using international trade to expand its ability to consume the good that it is relatively less efficient at producing.

These aggregate welfare gains are just an example of the standard gains from market-based exchange that we experience in our everyday lives. Most of us do not grow all of our own food or make all of our own clothes. Instead, we specialize in our chosen profession, sell our labor services in return for income, and use that income to purchase on markets the goods that we do not produce ourselves. International trade is simply an example of these gains from market-based exchange relative to self sufficiency. Since markets do not stop at countries' borders, these gains from market-based exchange hold internationally as well as domestically.

This insight that there are aggregate welfare gains from trade holds for both countries, such that international trade is mutually beneficial, positive sum and win-win (rather than zero-sum and win-lose). These mutual aggregate welfare gains are possible even if the home country is less efficient at producing both goods, such that its PPF lies everywhere inside the foreign country's PPF. As long as the two countries have different autarky prices, free international trade will ensure a single world market price that differs from both countries' autarky prices, at which both countries can achieve higher welfare than under autarky by specializing and trading.

Another way of viewing these aggregate welfare gains is in terms of revealed preference. The autarky consumption bundle A is feasible in the open economy, in the sense that it lies inside the budget constraint under free trade (the price line passing through B and C). However, the representative consumer instead chooses the free trade consumption bundle C. Therefore, this free trade consumption bundle C must be weakly preferred to the autarky consumption bundle A.

For expositional simplicity, we have developed this revealed preference argument in a setting with two goods and two countries. But the argument holds more generally with many goods and countries, non-traded goods, and intermediate inputs as well as final consumption goods. Under the standard neoclassical assumptions considered here, there exist mutual aggregate welfare gains from trade for all countries (e.g., Dixit and Norman 1980). As long as relative goods prices differ in the open economy and the closed economy, countries can consume outside of their production possibility frontiers, by specializing and trading (see Online Appendix D).

4.2 Welfare Effects of a Tariff

Now suppose that the home country introduces a tariff, which increases good 1's relative price in the domestic market, and reduces its relative price in the world market because home is large relative to world markets:

$$\frac{p_1^T}{p_2^T} = \frac{p_1^{T*} + t}{p_2^{T*}} > \frac{p_1^F}{p_2^F} > \frac{p_1^{T*}}{p_2^{T*}},$$

where we assume that tariff revenue is redistributed lump sum to the representative consumer.

Equilibrium production under the tariff occurs at D (where the slope of the PPF equals domestic relative prices). Equilibrium consumption under the tariff must satisfy two conditions. First, the production bundle at D can be traded with foreign at world prices, such that the representative consumer's budget constraint is shown by the straight line passing through D with slope world relative prices (p_1^{T*}/p_2^{T*}). Therefore, equilibrium consumption must lie somewhere along this budget constraint. Second, consumers maximize utility given domestic relative prices ($p_1^T/p_2^T > p_1^{T*}/p_2^{T*}$), which implies that equilibrium consumption must lie at a point of tangency between domestic relative prices and the representative consumer's indifferences curves. The equilibrium consumption point E satisfies both these conditions, with domestic relative prices tangent to the representative

consumer's indifference curves at a point along her budget constraint. The equilibrium value of consumption at domestic prices is shown by the line passing through E with slope domestic prices. The equilibrium value of production at domestic prices is shown by the line passing through D with slope domestic prices. The gap between these two lines corresponds to the tariff revenue that is redistributed lump sum to the representative consumer.

As in the partial equilibrium section above, the tariff both distorts domestic production and consumption decisions (which are made based on domestic relative prices under the tariff (p_1^T/p_2^T) rather than free trade relative prices (p_1^F/p_2^F)), and leads to an improvement in the terms of trade (a reduction in the price of imports relative to exports on world markets (fall in p_1^{T*}/p_2^{T*})). Whether the tariff is welfare increasing or reducing depends on whether the deadweight welfare losses from the distortion of domestic production and consumption decisions are larger or smaller than the improvement in the terms of trade. Figure 5 shows the case where the deadweight welfare losses dominate and the tariff is welfare reducing, with consumption under the tariff at E on a lower indifference curve than under free trade at C.

Comparing the production and consumption bundles under the tariff (at D and E) to those under free trade (at B and C), we see that production and consumption are closer together under the tariff than under free trade, implying a reduction in the volume of trade. In the same way that trade is like an improvement in production technology, because market-based exchange provides a new technology for obtaining goods, the tariff operates like a tax on this technology, because it reduces the extent to which the economy makes use of this market-based exchange.

4.3 Large Versus Small Countries

This general equilibrium analysis yields similar predictions for large and small countries as the partial equilibrium analysis above. A small country that faces exogenous prices on world markets experiences no improvement in the terms of trade ($p_1^{T*}/p_2^{T*} = p_1^F/p_2^F$), which implies that a tariff is necessarily welfare reducing. For a large country starting from free trade, the welfare gain from the terms of trade improvement is first order, and the welfare losses from the distortion of production and consumption decisions are second-order. Therefore, a small tariff is welfare improving for a large country, under the assumption of no retaliation. Furthermore, there exists a positive and finite optimum tariff for a large country. However, if retaliation occurs, the foreign tariff offsets the impact of the home tariff on the terms of trade. As a result, the two large countries can end up with little improvement in the terms of trade, but deadweight welfare losses from the distortion of domestic production and consumption decisions, thereby implying a welfare reduction from the tariff.

For expositional simplicity, we have developed these general equilibrium arguments for two goods and two countries, but these insights apply more generally under our conventional neoclassical assumptions. Costinot et al. (2015) analyze optimal tariffs in a Ricardian model of trade with

two countries and a continuum of goods. The optimal trade taxes that maximize domestic welfare are uniform across imported goods and weakly monotone with respect to comparative advantage across exported goods. Therefore, these optimal trade taxes can be implemented by a zero import tariff and export taxes that are weakly increasing in comparative advantage, reflecting the fact that countries have more room to manipulate world prices in comparative advantage sectors. Alternatively, and equivalently, these optimal trade taxes can be implemented by a uniform positive import tariff accompanied by export subsidies that are weakly decreasing with comparative advantage.

4.4 Tariffs and Trade Deficits

In this general equilibrium analysis, we assume that consumers are on their budget constraint, such that expenditure is equal to income, which equivalently implies that trade is balanced with the value of exports at world prices equal to the value of imports at world prices:

$$p_1 C_1 + p_2 C_2 = p_1 Y_1 + p_2 Y_2, \tag{8}$$

$$p_1 \left(C_1 - Y_1 \right) = p_2 \left(Y_2 - C_2 \right).$$

Therefore, the distortionary effects of import tariffs hold without multilateral trade deficits, and are driven by tariffs acting as a tax on the technology of market-based exchange.

In reality, countries can run multilateral trade deficits and surpluses, which are driven by intertemporal decisions about consumption and saving. A multilateral trade deficit involves a country spending more than its income today, in return for spending less than its income in the future. This multilateral trade deficit can be financed by capital inflows from the rest of the world (selling IOUs to the rest of the world), such that the balance of payments equals zero as an accounting identity. In contrast, a multilateral trade surplus involves a country spending less than its income today, in return for spending more than its income in the future. This multilateral trade surplus can be offset by capital outflows to the rest of the world (buying IOUs from the rest of the world), such that the balance of payments equals zero as an accounting identity. Therefore, these multilateral trade surpluses and deficits also reflect a welfare gain from trade, namely a welfare gain from intertemporal trade between current and future consumption (Obstfeld and Rogoff 1996). In a model of trade between countries at a point in time, trade over time, and trade across states of nature, Fitzgerald (2025) finds substantially larger welfare gains from this three-dimensional trade than from trade along one of these dimensions alone.

In principle, the introduction of tariffs can affect multilateral trade deficits through a number of mechanisms. First, if the elasticity of demand with respect to real income differs between imported and exported goods, the reduction in real income caused by tariffs affects imports and exports unevenly (see Costinot and Werning 2025). Second, tariffs can affect savings and investment by changing the values of countries' external asset and liability positions and rates of return to savings and

investment (see Aguiar et al. 2025, Bayas-Erazo and Lorenzoni 2025, Ignatenko et al. 2025, Kleinman et al. 2025b, Caliendo et al. 2025, Itskhoki and Mukhin 2025). But the direction of these effects on savings and investment is subtle and in general can be either positive or negative.

In a world of many countries and goods, each country can have complex patterns of bilateral deficits and surpluses with individual partners, even if multilateral trade deficits are zero. These bilateral deficits and surpluses are a consequence of market-based exchange. Britain can specialize in producing whiskey and export it to Japan, and use the resulting revenue to purchase cars from Germany, in which case it can have bilateral trade surplus with Japan, and a bilateral trade deficit with Germany. Again we are aware of this feature from our daily lives. We specialize in a career that we are relatively good at, sell our labor services on the market, and use the revenue obtained to purchase the goods that we are relatively bad at supplying. As a result, most of us have bilateral surpluses with our employers, and bilateral deficits with our grocery stores. Since markets do not stop at borders, the same is true for countries as whole. Only in a world of bilateral bartering of goods, without market-based exchange, would all bilateral deficits and surpluses equal zero.

4.5 Policy Equivalences

Considering trade and tariffs in general equilibrium highlights a further policy equivalence. In the neoclassical setting considered here, an import tariff is equivalent to an export tax, as summarized in the Lerner Symmetry Theorem (Lerner 1936). An import tariff raises the price of the good imported, whereas an export tax reduces the price of the good exported. But both of these policies deliver the same change in the relative prices of the two goods, which is what matters for production, consumption and trade in Figure 5.[4] An implication of this result is that a large country can use either an import tariff or an export tax to achieve an improvement in its terms of trade.

In contrast, an import subsidy has the opposite effect on relative prices as an import tariff, and an export subsidy has the opposite effect on relative prices as an export tax. While import tariffs or export taxes reduce trade volumes and improve a large country's terms of trade, import or export subsidies increase trade volumes and deteriorate a large country's terms of trade. Therefore, under our conventional neoclassical assumptions, import or export subsidies are particularly pernicious trade policies, because they not only create deadweight welfare losses from the distortion of domestic consumer and producer decisions, but also lead to a deterioration in a country's terms of trade.

An important corollary of the Lerner Symmetry Theorem is that an import tariff affects exports as well as imports, a point that is often overlooked in policy debates. In the general equilibrium framework underlying Figure 5, this follows directly from two closely-related equilibrium conditions. First, factor market clearing implies that the expansion of the import-competing sector under

[4] For an analysis of the conditions under which the Lerner Symmetry Theorem holds in a wider range of economic environments, see Costinot and Werning (2019).

a tariff draws resources away from the export sector, reducing its output. Second, the trade balance condition (8) requires that any reduction in the value of imports be matched by a corresponding reduction in the value of exports. Therefore, an import tariff does not merely restrict foreign goods, it also reshapes domestic production and consumption, and hence both sides of trade flows.

4.6 Intermediate Inputs and Global Value Chains (GVCs)

We noted above that the existence of aggregate welfare gains from trade is robust to the introduction of intermediate inputs. Trade in such intermediate inputs grew particularly rapidly in the late-twentieth century, with the emergence of GVCs, in which stages of production are fragmented across national borders (e.g., Feenstra 1998). In the presence of such trade in intermediate inputs, tariffs can be particularly costly, because they are paid on the full gross value of a good each time that it crosses national borders (e.g., Yi 2003). While tariffs on final consumption goods protect domestic firms from foreign competition in product markets, tariffs on imported intermediate inputs raise the production costs of domestic firms in input markets. For this reason, countries have historically imposed higher tariffs on downstream goods than upstream goods ("tariff escalation"). One line of research computes "effective rates of protection," taking into account the effect of tariffs on domestic value added (e.g., Corden 1966 and Corden 1974). Another line of research provides evidence that output tariffs (in product markets) have opposite effects on domestic firms from input tariffs (in input markets), including for example Amiti and Konings (2007) and Goldberg et al. (2010).

5 Distributional Consequences

If international trade acts like an improvement in technology and delivers aggregate welfare gains, this raises the question of why many countries choose to introduce tariffs and tax this technology of market-based exchange. One reason is that although there are aggregate welfare gains from trade for a country as a whole, there are winners and losers within countries. In principle, the winners could compensate the losers and still be better off, thereby ensuring a Pareto improvement (the Kaldor-Hicks compensation criterion).[5] But this compensation does not typically occur in practice.

5.1 Industry Rents

Perhaps the starkest illustration of these distributional consequences of international trade is the so-called specific-factors or Ricardo-Viner model, in which changes in the relative prices of goods induced by international trade leads to changes in rents across industries.[6] Consider a small open economy that faces exogenous prices on world markets. The economy can produce two goods

[5] See Hicks (1939), Kaldor (1939) and Dixit and Norman (1986).

[6] For the original expositions of the specific-factors model, see Jones (1971) and Samuelson (1971).

$j \in \{A, M\}$: manufacturing (M) and agriculture (A). The economy is endowed with an exogenous supply of labor (L), which is perfectly mobile between industries, such that $L_A + L_M = L$. The economy is also endowed with two specific factors that are perfectly immobile between industries: capital (K) that is only used in manufacturing and land (H) that is only used in agriculture. Production technologies are constant returns to scale in the mobile and specific factors, such that there is diminishing marginal returns to the mobile factor in each sector. Markets are perfectly competitive. We suppose that the economy has a comparative advantage in manufacturing, such that under free trade it exports manufacturing and imports agriculture.

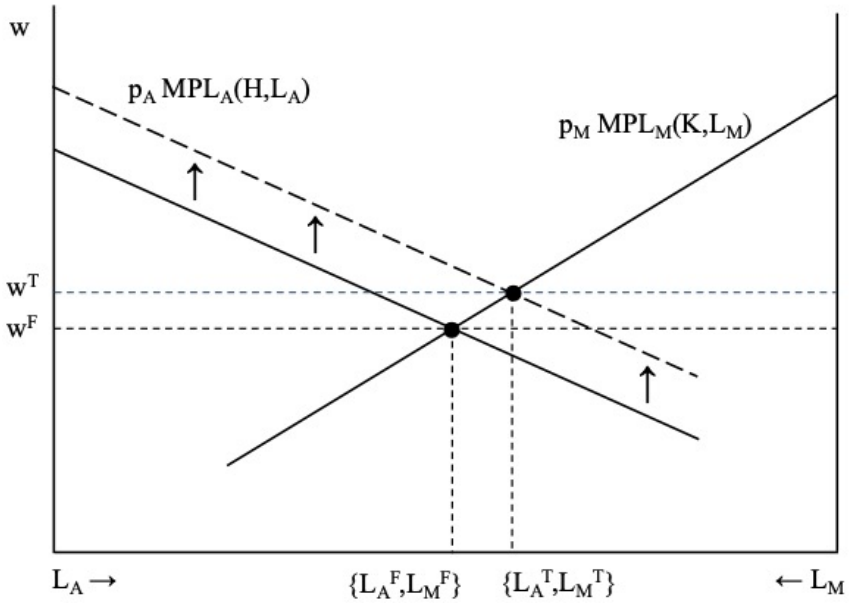
Given the exogenous prices of the two goods on world markets $\{p_A^*, p_M^*\}$, the general equilibrium of the economy can be represented by the so-called scissor diagram shown in Figure 6. The downward-sloping solid line starting at the left axis shows the value marginal product of labor in agriculture under free trade. The downward-sloping solid line starting at the right axis shows the value marginal product of labor in manufacturing under free trade. The intersection of these two solid lines determines the allocation of labor to the two sectors (L_A^F, L_M^F) and the common wage in both sectors under free trade (w^F) .

We suppose that this small open economy introduces a specific tariff on agricultural imports ($t > 0$), which raises the domestic price of agriculture to $p_A = p_A^* + t$. This increase in the domestic price of agriculture shifts the value marginal product of labor in agriculture upwards, as shown by the downward-sloping dashed line starting at the left axis. This increase in the value marginal product of labor in agriculture leads to an expansion of employment in agriculture and a reduction in employment in manufacturing, until the value marginal product of labor is again equalized in the two sectors, as shown formally in Online Appendix E. The wage rises less than proportionately to the increase in the domestic price of agriculture (from w^F to w^T), which implies that the real wage in terms of the manufacturing good (w/p_M) rises, whereas the real wage in terms of the agricultural good (w/p_A) falls. Therefore, the tariff has an ambiguous effect on the real income of mobile workers, depending on their expenditure shares on manufacturing and agriculture.

In contrast, the tariff has unambiguous and opposite effects on the real income of landowners and capitalists. The real income of landowners in terms of agriculture is determined by the marginal physical product of land in agriculture ($\frac{q}{p_A} = MPH_A(\frac{L_A}{H}, 1)$). Since the tariff raises employment in agriculture, it raises the marginal physical product of land, and hence raises the real income of landowners in terms of agriculture. Since the price of agriculture has risen, while the price of manufacturing has remained constant, it also follows that the real income of landowners in terms of manufacturing has risen. The real income of capitalists in terms of manufacturing is determined analogously by the marginal physical product of capital in manufacturing ($\frac{r}{p_M} = MPK_M(\frac{L_M}{K}, 1)$). Since the tariff reduces employment in manufacturing, it reduces the marginal physical product of capital, and hence reduces the real income of capitalists in terms of manufacturing. Since the price

of agriculture has risen, while the price of manufacturing has remained constant, it also follows that the real income of capitalists in terms of agriculture has fallen.

Figure 6: Income Distributional Consequences



Note: Specific factors model of a small open economy facing exogenous prices of agriculture and manufacturing on world markets (p_A^*, p_M^*); the small open economy introduces a specific tariff of t on imports of agricultural goods, which raises the domestic price of agriculture from p_A^* to $p_A = p_A^* + t$; F indexes the free trade equilibrium and T indexes the tariff equilibrium; $\{L_A, L_M\}$ denote labor allocations to agriculture and manufacturing respectively; w is the wage; H is the supply of land; K is the supply of capital; $MPL_A(\cdot)$ is marginal physical product of labor in agriculture; $MPL_M(\cdot)$ is marginal physical product of labor in manufacturing.

Therefore, in this small open economy with a comparative advantage in manufacturing, land owners gain in real terms from tariff protection (and lose from open trade), whereas capitalists lose in real terms from tariff protection (and gain from freer trade). This distributional conflict was at the heart of debates about the Corn Laws (tariffs on imports of cereal grains) in Britain in the 19th century. While landowners resisted the removal of these tariffs, manufacturers and workers lobbied for their repeal (through the Anti-Corn Law League). After thirty nights of heated parliamentary debate, Britain ultimately repealed or abolished the Corn Laws in 1846.[7]

Once one recognizes that international trade has income distributional consequences by changing the relative prices of goods, one can rationalize tariffs as a policy to offset these income distributional effects of international trade. This argument in favor of tariffs comes with two main limitations. First, the redistribution of income achieved by tariffs comes at the cost of a reduction in the aggregate welfare gains from international trade, because the tariffs act as a tax on international

[7]For empirical evidence on the distributional consequences from the Repeal of the Corn Laws and the "invasion" of Europe by new world cereal grains, see Irwin and Chepeliev (2021) and Heblich et al. (2025).

trade. Second, tariffs are typically not the first-best or most targeted policy to redistribute income, because they not only distort producer decisions (as shown in Figure 6) but also distort consumer decisions, as shown in Sections 3 and 4 above.

In the short-run, the specific-factors model's assumption that some factors of production are perfectly immobile between industries is arguably a reasonable approximation. In the long-run, many factors of production may have a degree of mobility across industries. Even with perfect factor mobility, tariffs and trade typically have income distributional consequences for different factors of production, as in the Stolper-Samuelson Theorem of the Heckscher-Ohlin model.[8] In between these extremes of perfect immobility and perfect mobility, there are intermediate cases, in which factors of production can be imperfectly reallocated between industries, as in Neary (1978), Artuç et al. (2010), Dix-Carneiro (2014), Traiberman (2019), and Galle et al. (2023).

In both the specific-factors and Heckscher-Ohlin models, preferences are homothetic, and the income distributional consequences of trade and tariffs are driven by labor market mechanisms.[9] In contrast, if consumer preferences are non-homothetic, trade and tariffs also have distributional consequences through an expenditure channel, because trade and tariffs affect relative prices, and rich and poor consumers have different expenditure shares across goods. In principle, this expenditure channel can either raise or reduce the aggregate welfare gains from trade and the aggregate welfare losses from tariffs. Using cross-country data, Fajgelbaum and Khandelwal (2016) find that international trade typically favors low-income consumers through this expenditure channel, because their expenditure is more concentrated in traded sectors. In contrast, using U.S. data, Borusyak and Jaravel (2021) find that expenditure shares are relatively flat with income, but that international trade raises inequality among workers with similar levels of income and education.

5.2 Trade and Technology

This analysis of the distributional consequences of trade and tariffs again highlights that international trade acts like an improvement in production technology. The shifts in the value marginal productivity of labor in the agricultural sector in Figure 6 also could be achieved by changes in productivity. For example, an improvement in agricultural productivity would also raise the real income landowners and reduce the real income of capitalists. Therefore, one could argue that the distributional consequences of trade should be treated in many ways just like the distributional consequences of technology (e.g., Costinot and Werning 2023). In the same way that international trade generates aggregate welfare gains combined with winners and losers, so do advances in technology such as computers, automation and artificial intelligence. Taxing any of these technological im-

[8] The classic theoretical formalizations are Stolper and Samuelson (1941) and Jones (1965). For empirical evidence on these theoretical predictions, see Leamer (1998) and Feenstra and Hanson (1999).

[9] Models of firm heterogeneity in differentiated product markets provide a further labor market mechanism through which trade has income distributional consequences, as in Helpman et al. (2010) and Helpman et al. (2017).

provements reduces aggregate welfare and redistributes income between different groups in society. The case for or against such taxation depends on the weights that the policy maker puts on the welfare of these different groups. Whether tariffs are part of the optimal policy mix depends on how distortionary they are relative to other redistributive tax policies.

5.3 Geography

The specific-factors model focuses on distributional conflict at the aggregate economy-wide level, based on the industry affiliation of factors of production. More recent research has highlighted geography as an important dimension along which the income distributional consequences of international trade occur, because traded industries are often highly geographically concentrated. Therefore, the negative effect of an international trade shock for an industry can be especially severe if it leads to the loss of the main source of employment in a town, city or region, and workers are geographically immobile between locations. Examples include the impact of the China Shock in the United States (e.g., Autor et al. 2013 and Autor et al. 2014) and Brazil's and India's trade liberalizations (e.g., Topalova 2010, Kovak 2013, and Dix-Carneiro and Kovak 2017).

If industries in the specific-factors model are thought of as being located in specific regions within countries (or interpreted as region-industry pairs), this model provides a useful framework for interpreting these distributional consequences of trade across regions within countries. Recent research has developed general equilibrium trade models, in which labor reallocation across regions and sectors occurs gradually because of migration frictions, and shown that these models are able to rationalize empirical findings for the impact of the China shock in the United States (e.g., Caliendo et al. 2019, Adão et al. 2026a, and Rodríguez-Clare et al. 2026).

In the same way that trade can have adverse consequences for towns, cities or regions, because traded industries are often geographically concentrated, so too can technological innovations. For example, Kodak's decline, because of the displacement of analog photography by digital photography led to a wider decline in the city of Rochester (e.g., Atteridge and Strambo 2021). Paralleling the discussion of trade and technology above, although tariffs can be used to redistribute income towards regions adversely affected by an industry trade shock, they are not typically the first-best policy, because of the associated distortion of consumer decisions. If the goal is to redistribute income from rich to poor regardless of region, the income tax schedule is typically a more targeted policy instrument. If the goal is to redistribute income to particular regions, there are typically other more targeted place-based policies (e.g., Gaubert et al. 2025).

5.4 Political Economy

These distributional consequences of trade provide political economy reasons why countries can choose to introduce tariffs, even if they reduce aggregate real income (e.g., Grossman and Helpman 1994 and Grossman and Helpman 1995).[10] If some groups within society lose from trade, they may lobby in favor of tariffs. Furthermore, the losers from trade may be small in number and highly concentrated (e.g., import-competing firms or industries), while the winners from trade may be large in number and highly dispersed (e.g., individual consumers throughout the economy). Therefore, it may be easier for the concentrated losers from trade to overcome the free-rider problem and lobby for tariffs than it is for the diffuse winners from trade to do so.

6 International Trade Agreements

One key insight from the partial and general equilibrium analysis above is that a large country can improve its welfare by introducing an optimal import tariff. However, if all large countries do so, each may end up achieving little improvement in its terms of trade, at the cost of distorting domestic production and consumption decisions. Therefore, countries face a Prisoners' Dilemma. Starting from free trade, each has a unilateral incentive to introduce an import tariff, but if they all do so, they can end up worse off than if they could all commit to free trade.

6.1 National Objectives

Bagwell and Staiger (1999) provide a formal analysis of this Prisoners' Dilemma and its implications for the design of international trade agreements, such as the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO). The economy consists of a home and foreign country (foreign variables are denoted by an asterisk), each of which is sufficiently large to influence world market prices. There are two goods x and y. Home's (foreign's) import good is x (y). Denote home's and foreign's domestic relative price of good x by p and p^*, respectively. Home and foreign have *ad valorem* import tariffs of t_V and t_V^*, respectively, and we define the resulting tariff wedges as $T = 1 + t_V$ and $T^* = 1 + t_V^*$. Denote the world relative price of x by p^w. Since home imports x whereas foreign exports x, domestic relative prices in home and foreign are related to world prices as $p = Tp^w$ and $p^* = \frac{p^w}{T^*}$.

The home and foreign governments' objectives are assumed to depend on both domestic and world prices:

$$W\left(p\left(T, p^w\right), p^w\right), \qquad W^*\left(p^*\left(T^*, p^w\right), p^w\right), \tag{9}$$

[10] See Rodrik (1995) and Helpman (1997) for reviews of the literature on the political economy of trade protection. For empirical evidence, see Goldberg and Maggi (1999) and Adão et al. (2023).

where domestic prices themselves depend on the tariff wedge and world prices.

This specification accommodates a range of assumptions about government objectives, including both national utility maximization and domestic political economy considerations. For expositional convenience, we refer to the government's objective as welfare, but we take it as understood that it can include these domestic political economy considerations. Holding domestic prices fixed, each government is assumed to achieve higher welfare when its terms of trade improves (when the world relative price of good x (p^w) falls for home and rises for foreign):

$$\frac{\partial W\left(p, p^w\right)}{\partial p^w} < 0, \qquad \frac{\partial W^*\left(p, p^w\right)}{\partial p^w} > 0, \tag{10}$$

where we have suppressed the implicit dependence of domestic prices on the tariff and world prices to reduce notational clutter.

6.2 Nash Non-cooperative Equilibrium

In the absence of an international trade agreement, each country is assumed to choose its own tariff to maximize its objective, taking as given its trade partner's tariff. The resulting first-order conditions implicitly define the reaction functions of the two governments:

$$W_p \frac{dp}{dT} + W_{\tilde{p}^w} \frac{d\tilde{p}^w}{dT} = 0, \tag{11}$$

$$W^*_{p^*} \frac{dp^*}{dT^*} + W^*_{\tilde{p}^w} \frac{d\tilde{p}^w}{dT^*} = 0, \tag{12}$$

where a tilde above a variable denotes the equilibrium value and the Nash non-cooperative equilibrium is defined by the intersection of these two reaction functions.

6.3 Efficient Trade Agreements

An efficient trade agreement achieves a Pareto optimum, in which it is impossible to raise one country's welfare without reducing the other country's welfare, which corresponds to a point of tangency between the two countries' isowelfare contours at which the following condition is satisfied:

$$\left.\frac{dT}{dT^*}\right|_{dW=0} = \left.\frac{dT}{dT^*}\right|_{dW^*=0}, \tag{13}$$

where the first-order conditions (11) and (12) imply that this condition cannot be satisfied at the Nash equilibrium, as shown in Online Appendix F.

The reason that the Nash non-cooperative equilibrium is inefficient is that each country chooses its tariff taking into account that a higher tariff improves its own terms of trade, which has the negative externality of worsening its trade partner's terms of trade. To demonstrate that this terms of

trade externality is the source of the inefficiency, Bagwell and Staiger (1999) introduce the concept of politically-optimal tariffs, which correspond to the tariffs that would be chosen by governments if they ignored the effect of their tariff choices on the terms of trade. From the two countries' objectives (9), the first-order conditions for politically-optimal tariffs are:

$$W_p \frac{dp}{dT} = 0, \tag{14}$$

$$W^*_{p^*} \frac{dp^*}{dT^*} = 0, \tag{15}$$

which together imply that the efficiency condition (13) is satisfied, as shown in Online Appendix F.

The efficiency of these politically optimal tariffs makes clear that the purpose of international trade agreements is to overcome the terms of trade externality between countries. Bagwell and Staiger (1999) show that this insight provides microfoundations for the core principles of *reciprocity* and *nondiscrimination* that underlie the GATT and the WTO. Reciprocity is the principle that countries offer (or potentially withdraw) tariff concessions that involve equal improvements in market access in foreign markets for domestic firms as granted in the domestic market for foreign firms. Bagwell and Staiger (1999) interprets this definition of reciprocity as corresponding to equal changes in the value of trade at initial world prices. Non-discrimination is the principle that countries offer the same tariff to all trade partners on any given product (also referred to as the most-favored nation (MFN) principle). Together, these principles constrain tariff changes so that world prices remain unchanged, removing the incentive for governments to manipulate their terms of trade and supporting efficient outcomes.

Bagwell and Staiger (2011) provide empirical evidence in support of this terms of trade perspective on international trade agreements, using data on tariff negotiations for new members of the WTO. Consistent with pre-negotiation tariffs being chosen to exploit market power in international trade, the magnitude of the negotiated tariff reductions is positively related to the pre-negotiation volume of imports. Furthermore, this relationship is strongest when the importing country is large relative to world markets, and when the import volume is supplied by current WTO members.

6.4 Rules Versus Bilateral Bargaining

Although the Nash equilibrium is inefficient and countries can achieve mutual welfare gains through trade negotiations that move them towards the efficiency frontier, there remains the question of the division of these welfare gains between countries. Starting at the Nash equilibrium and bargaining according to the principles of reciprocity and nondiscrimination according to a rules-based international order yields one possible division of the surplus. But other possible divisions of the surplus could be achieved through a power-based international order, in which countries bargain bilaterally or through other bargaining protocols.

An important question in this context is under what conditions powerful countries have an incentive to commit themselves to multilateral rules. Mattoo and Staiger (2020) argue that this depends on the extent of their hegemonic dominance. When a country is sufficiently powerful, it may benefit from committing to rules in order to induce weaker trading partners to participate in mutually beneficial agreements. As its dominance erodes, however, the incentive to remain constrained by rules may weaken, and a shift toward power-based bargaining may become more attractive.

A power-based international order can also bring greater uncertainty over future tariff commitments, because policies remain subject to renegotiation. Such trade policy uncertainty can discourage investments that involve upfront sunk entry costs (e.g., Handley and Limão 2015, Baker et al. 2016, and Handley and Limao 2017).[11] Greater trade policy could be viewed as particularly costly economically, because it discourages trade and distorts consumption and production decisions, but unlike a tariff it does not generate any government revenue.

Although the terms of trade externality provides microeconomic foundations for reciprocity, this principle of reciprocity is different from the idea that countries should apply the same tariffs on one another on a good-by-good basis (e.g., the EU tariff on U.S. cars should be the same as the U.S. tariff on EU cars). When countries negotiate over tariff concessions, the scope for mutually-beneficial agreement can be greater if a country can make a concession in an area where its trade partner has strong preferences but it does not, in return for a concession elsewhere where it has strong preferences but its trade partner does not.

The GATT and WTO allow free trade agreements (FTAs) as an exception to the principle of nondiscrimination, in which members of the agreement eliminate tariffs between themselves, but maintain tariffs with non-member countries. These FTAs proliferated in the period after the Second World War, including for example the Canada-U.S. Free Trade Agreement (CUSFTA) in 1989, which was absorbed into the North American Free Trade Agreement (NAFTA) in 1994, which in turn became the U.S.-Mexico-Canada Trade Agreement (USMCA) in 2020. This proliferation of FTAs raises the question of whether this preferential liberalization has helped or hindered the process of multilateral trade liberalization, as discussed in Limão (2006) and Estevadeordal et al. (2008).

6.5 Other Arguments for International Trade Agreements

Other rationales for international trade agreements have been advanced. The U.S. Reciprocal Trade Agreements Act of 1934 (RTAA) empowered the President to negotiate bilateral tariff reductions, in part with the view that the political economy forces for tariff protection in the domestic market could be offset by the political economy forces for tariff reductions in foreign markets (e.g., Krugman 1997 and Maggi and Ossa 2023). Although the model of international trade agreements above allows for

[11] A growing body of research provides evidence on the effects of trade policy uncertainty, including Alessandria et al. (2024), Alessandria et al. (2025) and Amiti et al. (2021).

political economy forces, Maggi and Rodríguez-Clare (1998) and Maggi and Rodriguez-Clare (2007) argue that international trade agreements may have an additional role in allowing domestic governments to make credible commitments to not introduce tariffs, thereby avoiding the private-sector making upfront investments to influence subsequent tariff choices.

In the perfectly competitive environment of Bagwell and Staiger (1999), the terms of trade externality is the sole problem for an international agreement to solve. In models of imperfect competition with home market effects, Ossa (2011) shows that there is a production relocation externality, as governments have an incentive to use tariffs for industrial policy purposes to expand domestic manufacturing at the expense of foreign manufacturing. Bagwell and Staiger (2012a) and Bagwell and Staiger (2012b) demonstrate that even in such environments the terms-of-trade externality is the only problem for trade agreements to solve if governments have access to a full set of domestic policy instruments. The intuition is that the economy behaves as if it were perfectly competitive when governments can use domestic policies to address internal distortions.

While most research on international trade agreements has focused on trade in final goods, the offshoring of production stages through GVCs introduces new issues of incomplete contracts and hold up in the presence of relationship-specific investments (Antràs and Staiger 2012).

7 Quantitative Trade Models

A major breakthrough in international trade in recent years has been the development of quantitative trade models following Eaton and Kortum (2002). These quantitative frameworks are sufficiently rich to capture key features of the data, such as many asymmetric countries and a rich geography of bilateral trade costs. Yet these models remain tractable and amenable to a theoretical analysis of their properties, including the existence and uniqueness of the equilibrium. In contrast to earlier computable general equilibrium (CGE) models, these quantitative trade models typically have only a small number of structural parameters to estimate.[12] Therefore, they lend themselves to credible identification of these parameters, using quasi-experimental sources of exogenous variation. Since these quantitative trade models are able to rationalize the data on bilateral trade and income as an equilibrium outcome, they can be used to undertake counterfactuals for the impact of empirically-relevant public-policy interventions, such as tariffs between particular pairs of countries, and to compare observed and optimal trade policies.[13]

[12] For a synthesis of earlier research on CGE models, see Shoven and Whalley (1992).

[13] For a broader discussion of the interplay between theory and data in international trade, see Donaldson (2022).

7.1 Constant Elasticity Trade Models

A particularly influential class of quantitative trade models is those with a constant elasticity gravity equation, as characterized in Arkolakis et al. (2012). This class of models includes those in which trade arises from the differentiation of goods across countries (Armington 1969); Ricardian technology differences (Eaton and Kortum 2002); the differentiation of goods across firms and increasing returns to scale (Krugman 1980); and producer heterogeneity in differentiated product markets with a Pareto productivity distribution (Melitz 2003 and Chaney 2008). These models have different reasons for trade (e.g., product differentiation versus technology differences), different assumptions about production technologies (e.g., constant versus increasing returns to scale); and different market structures (e.g., perfect competition versus monopolistic competition). But all of these models have a single production sector, a single factor of production, and satisfy the three macro restrictions of balanced trade, a constant share (potentially zero) of aggregate profits in aggregate revenue, and a constant partial trade elasticity.[14]

We consider a world of many countries indexed by $n, i \in \{1, \ldots, N\}$. The representative agent in country n has a labor endowment $\overline{\ell}_n$. From expenditure minimization in this class of models, the share of expenditure of importer n on exporter i (s_{ni}) can be written as the following constant elasticity gravity equation:

$$s_{ni} = \frac{\left(T_{ni} w_i \tau_{ni} / z_i\right)^{-\theta}}{\sum_{j=1}^{N} \left(T_{nj} w_j \tau_{nj} / z_j\right)^{-\theta}}, \tag{16}$$

where w_i denotes the wage; z_i corresponds to country productivity; τ_{ni} are iceberg bilateral costs of trade, such that $\tau_{ni} \geq 1$ units of a good must be shipped from exporter i in order for one unit to arrive in importer n, with $\tau_{ni} > 1$ for $n \neq i$ and $\tau_{nn} = 1$; $T_{ni} = 1 + t_{ni}$ captures tariff barriers, where t_{ni} is the *ad valorem* tariff imposed by importer n on exporter i; and tariff revenue in each country is assumed to be redistributed lump sum to the representative consumer.

Income accounting requires that the income of each exporter i equals the sum across importers n of expenditure on the goods produced by that exporter. Using cost minimization, the macro restriction on aggregate profits and expenditure minimization, we can write this income accounting equation as:

$$w_i \overline{\ell}_i = \sum_{n=1}^{N} \frac{s_{ni}}{T_{ni}} \frac{w_n \overline{\ell}_n + d_n}{1 - \sum_{j=1}^{N} \frac{T_{nj}-1}{T_{nj}} s_{nj}}, \tag{17}$$

where income from production on the left-hand side equals the wage (w_i) times the economy's labor supply ($\overline{\ell}_i$); expenditure equals income from production plus the trade deficit (which is typically taken as exogenous), adjusted for the tariff revenue that is redistributed lump-sum to the represen-

[14] For surveys of this class of quantitative models and their use to evaluate actual and counterfactual trade policies, see Costinot and Rodríguez-Clare (2014), Ossa (2016a), Caliendo and Parro (2022), and Eaton and Kortum (2024).

tative consumer.[15]

General equilibrium reduces to solving for the N wages in each country (w_n) such that the system of N equations (17) holds. Given this solution for wages in each country, we can recover all other endogenous variables. This system of equations has an interpretation as an excess demand system for labor in each country. In the absence of tariffs, countries' wages are gross substitutes in this system of equations, and conditions for the existence and uniqueness of the wage vector (up to a choice of numeraire) can be provided (see Alvarez and Lucas 2007 and Allen et al. 2020).

7.2 Welfare Effects of Trade

We begin by examining the aggregate welfare effects of trade in the absence of tariffs ($t_{ni} = 0$ and $T_{ni} = 1$ for all n, i). In this case, the welfare gains from opening the closed economy to trade can be expressed solely in terms of the open-economy domestic trade share (s_{nn}) and a partial elasticity of trade with respect to trade costs (θ):

$$\frac{\mathcal{W}_n^O}{\mathcal{W}_n^A} = \left(\frac{1}{s_{nn}^O}\right)^{\frac{1}{\theta}}, \tag{18}$$

where the superscript O denotes the open-economy; the superscript A denotes autarky; $\mathcal{W}_n$ denotes welfare (real income); and the domestic trade share (s_{nn}) corresponds to the share of a country's expenditure on its own goods, which equals one under autarky.

We can thus compute the welfare gains from opening the closed economy using observable sufficient statistics and without having to undertake a counterfactual analysis of an autarky equilibrium that could differ substantially from the open-economy equilibrium. The open-economy domestic trade share (s_{nn}^O) can be measured directly from the data in the open-economy equilibrium. The elasticity of trade with respect to trade costs (θ) in principle can be estimated using the gravity equation (16) and data on bilateral trade and bilateral trade costs.

An upper bound on the welfare losses from tariffs can be found by considering the limiting case of prohibitive tariffs that take the economy to autarky. Applying the sufficient statistics formula (18), Costinot and Rodríguez-Clare (2018) estimate these welfare losses for the United States to be from 2-8 percent of GDP. Given a GDP of $29.2 trillion and $132.2 million households in 2024, this corresponds to $4,417.6-$17,670.2 per household, compared to a median household income of $83,730. Therefore, although prohibitive tariffs are extreme, these welfare losses are non-negligible as a share of income for many households in the United States. Smaller countries naturally have higher open-economy domestic trade shares and hence larger welfare losses from autarky.

Although these sufficient statistics are model based, these predicted welfare gains from trade align relatively closely to the empirical findings from studies that have examined natural experi-

[15] Research at the intersection of international trade and international macroeconomics increasingly models these trade deficits as endogenous, including Reyes-Heroles (2016), Eaton et al. (2016), and Kleinman et al. (2025b).

ments that approximate movements from autarky to open trade (or vice versa). Using the natural experiment of Japan's rapid opening to trade in the mid-19th century, Bernhofen and Brown (2005) estimate an upper bound to the estimated welfare gains from trade of around 8-9 percent of real gross domestic product (GDP). Using the natural experiment of the embargo on international shipping imposed by the United States in 1808, Irwin (2005) estimates a welfare cost of the embargo of about 5 percent of U.S. real GDP at the time.

Allowing for multiple industries with heterogeneous trade elasticities magnifies the welfare gains from trade (see Costinot et al. 2012 and Ossa 2016b). For example, if oil is a critical input for a modern industrial economy, with a low elasticity of substitution with other goods, and an economy does not have domestic supplies of oil, the gains from international trade can become large. Introducing intermediate inputs also magnifies the welfare gains from trade, because the gains from trade are accrued at each stage of production (e.g., Costinot and Rodríguez-Clare 2014, Melitz and Redding 2014, and Antràs and Gortari 2020). In contrast, introducing non-traded goods reduces the welfare gains from trade, because these gains are only accrued within the traded sector (e.g., Eaton and Kortum 2002). Allowing for variable trade elasticities can either raise or reduce the welfare gains from trade (e.g., Melitz and Redding 2015 and Adão et al. 2026b).

Static trade models are well suited to measuring the level effects of trade in a given steady state, but they cannot account for sustained trade-led growth experiences, such as the rapid recovery of Japan and Germany in the post–World War II period, the sharp rise in living standards in the Asian Tiger economies—Singapore, Hong Kong, South Korea, and Taiwan—starting in the 1960s, or more recently the transformative growth experience of China and Central and Eastern Europe beginning in the 1990s. These historical episodes have motivated work on the dynamic gains from trade through channels such as capital accumulation, endogenous innovation and knowledge diffusion, which typically magnify the comparative steady-state welfare gains from trade (e.g., Ravikumar et al. 2019, Kleinman et al. 2025b, Sampson 2016, Buera and Oberfield 2020, Perla et al. 2021).

7.3 Welfare Effects of Trade Policy

To evaluate the impact of changes in trade policy, the welfare expression in equation (18) must be generalized to take into account tariff revenue. This class of quantitative trade models can be used for both *ex ante* policy evaluation (before a policy is enacted) and *ex post* policy evaluation (after the policy is enacted). Both approaches involve solving the system of general equilibrium conditions in the model for the counterfactual impact of the change in tariffs, holding all else constant.

In the class of models with a constant trade elasticity, counterfactuals can be undertaken using exact-hat algebra techniques following Dekle et al. (2007). According to this approach, we can solve for these counterfactuals in terms of relative changes in the endogenous variables ($\widehat{x} = x'/x$) between the counterfactual equilibrium (denoted with a prime) and the observed equilibrium (de-

noted without a prime). We use only the assumed counterfactual policy change and the observed endogenous variables in the initial equilibrium in the data, without needing to know the unobserved levels of model fundamentals (such as country productivities and bilateral trade costs). Therefore, the "hat" in "exact-hat" refers to solving the model in relative changes, and the "exact" refers to solving for general equilibrium in the full non-linear model.

Using equations (16) and (17), we can re-write the system of general equilibrium conditions in this class of models in terms of these counterfactual relative changes and the initial values of the endogenous variables as follows:

$$\widehat{w}_i y_i = \sum_{n=1}^{N} \frac{\widehat{s}_{ni} s_{ni}}{\widehat{T}_{ni} T_{ni}} \frac{\widehat{w}_n y_n + d_n}{1 - \sum_{j=1}^{N} \frac{\widehat{T}_{nj} T_{nj} - 1}{\widehat{T}_{nj} T_{nj}} \widehat{s}_{nj} s_{nj}}, \tag{19}$$

$$\widehat{s}_{ni} = \frac{\left(\widehat{T}_{ni} \widehat{w}_i\right)^{-\theta}}{\sum_{j=1}^{N} s_{nj} \left(\widehat{T}_{nj} \widehat{w}_j\right)^{-\theta}},$$

where $y_i \equiv w_i \bar{\ell}_i$ denotes gross domestic product (GDP) in the initial equilibrium and we have held trade deficits, trade costs, and productivity constant ($\widehat{d}_n = \widehat{\tau}_{ni} = \widehat{z}_i = 1$).

We observe GDP (y_i), trade shares (s_{ni}), tariffs (T_{ni}) and deficits (d_n) in the initial equilibrium in the data and assume a counterfactual relative change in tariffs ($\widehat{T}_{ni}$). Therefore, the general equilibrium conditions (19) provide a system of N equations in the N counterfactual changes in relative wages. This system of equations can be solved using a standard tatonnement algorithm. Given an initial guess for counterfactual relative changes in wages ($\widehat{w}_i^0$), evaluate the left and right-hand sides of equation (19), and compute excess demand or supply for each country. If the two sides of the equation are equal to one another for each country, this initial guess is the equilibrium vector of relative changes in wages. If not, update the initial guess for each country based on excess demand or supply, and iterate until convergence. From the solution to this system of equations, we obtain the implied changes in the factoral terms of trade (relative wages $\widehat{w}_i / \widehat{w}_n$), and hence in domestic trade shares ($\widehat{s}_{nn}$) , in response to the changes in tariffs. They can then be used to calculate changes in welfare, as explained further in the appendix.

7.4 Empirical Applications

This class of quantitative trade models, and extensions of them, have been used to evaluate a range of actual and counterfactual trade policies. Caliendo and Parro (2015) evaluate the economic impact of NAFTA using a quantitative trade model that incorporates multiple industries and input-output linkages. NAFTA's tariff reductions are estimated to have raised Mexican and U.S. welfare by 1.31 and 0.08 percent, respectively, and reduced Canada's welfare by 0.06 percent.

Fajgelbaum et al. (2020) evaluate the impact of the 2018-2019 U.S. tariffs and foreign retaliation using a quantitative trade model that distinguishes three tiers of substitution: among varieties of an imported product, among import products, and among imported and domestic aggregates. The estimated losses to U.S. consumers and firms that buy imports is $51 billion, which corresponds to about 0.27 percent of GDP. After taking account of tariff revenue and gains to domestic producers, the estimated aggregate real income loss is $7.2 billion, which corresponds to around 0.04 percent of GDP. U.S. import tariffs were clustered in sectors that were concentrated in politically-competitive counties. In contrast, foreign retaliation focused on industries that were concentrated in heavily-Republican counties.

Quantitative trade models have also been used to evaluate the welfare implications of trade wars and trade talks. Ossa (2014) develops a multi-country, multi-industry quantitative trade model that incorporates inter-industry trade, intra-industry trade, and the political economy of trade policy. Countries choose import tariffs seeking to manipulate the terms of trade, shift profits away from other countries, and protect politically-influential industries. Unilateral optimal tariffs in the absence of foreign retaliation are relatively large, averaging around 62 percent. Nash non-cooperative tariffs are relatively close to the unilaterally optimal tariffs, averaging around 63 percent across countries. Cooperative trade negotiations starting at the Nash equilibrium can raise welfare by up to 3.6 percent on average and involve substantial reductions in tariffs to close to free trade.[16]

Bagwell et al. (2020) combine a multi-sector quantitative model of international trade with a model of interconnected bilateral negotiations over tariffs to evaluate the most-favored nation (MFN) principle as a feature of a rule-based international order. The model is estimated using data on 1990 trade flows and tariff outcomes from the Uruguay Round of GATT/WTO negotiations. The estimated model is used to undertake counterfactuals for what would have happened if the MFN requirement were abandoned and countries negotiated over discriminatory tariffs. Removing the MFN requirement eliminates the entire real income gains from the Uruguay Round and leads to a small reduction in welfare from this round of negotiation relative to the pre-existing status quo. Intuitively, discriminatory tariff reductions impose negative terms-of-trade externalities on excluded third countries, which induces bilateral negotiators to over-liberalize relative to the multilateral optimum. In addition, tariff discrimination itself is inefficient, as it distorts trade patterns across partners. Together, these two forces account for the welfare losses from abandoning MFN.

[16] Using a sufficient statistics approach, Lashkaripour (2021) also finds substantial Nash non-cooperative tariffs (around 38-49 percent), and estimates an average reduction in welfare from a trade war from 2.4-2.8 percent. Blanchard et al. (2025) provides quantitative evidence on the impact of GVCs on countries' optimal tariffs.

8 Arguments for Protection

While the traditional economic analysis of tariffs emphasizes the trade-off between the deadweight welfare losses from the distortion of producer and consumer decisions and the terms of trade improvement, a range of other arguments for tariffs and other forms of import protection have been proposed. We now turn to consider each of these arguments in turn.

8.1 Domestic Distortions

The classic result that a tariff is welfare reducing for a small country depends on the assumption that the initial equilibrium in the absence of a tariff is efficient. In general, this initial equilibrium can feature domestic distortions that introduce wedges between private and social marginal benefits or between private and social marginal costs. In the presence of these domestic distortions, the world is second-best, and a tariff that increases domestic production and reduces domestic consumption of a good can be either welfare improving or reducing (e.g., Bhagwati and Ramaswami 1963; Bhagwati 1971; Baqaee and Farhi 2024).

Whether the tariff is welfare improving or reducing depends on whether it reallocates production towards goods where too little is produced and away from goods where too much is produced (or the reverse), and whether it reallocates consumption away from goods where too much is consumed and towards goods where too little is consumed (or the reverse). However, a classic result from the economics of the second-best is that policy interventions should be targeted as close as possible to the source of the market failure, in order to avoid introducing additional distortions.

Consider for example the partial equilibrium setting in Figure 4 and suppose that there is a positive externality from producing a good, such that the social marginal cost curve lies below the private marginal cost curve (which equals supply under perfect competition). In this case, a tariff that increases production of the good could improve welfare, because too little of the good is produced in the absence of the tariff. However, the tariff also distorts consumer decisions. A policy more closely targeted towards the source of the market failure would be a production subsidy, which would yield a higher level of welfare than the tariff. However, the production subsidy must be financed, which could require other distortionary taxation.

8.2 Infant Industry Argument

Perhaps the best known argument for a tariff is the infant-industry argument, which argues that an industry in its infancy may need protection from import competition in order to enable it to develop and reach its potential, at which point it will become competitive on world markets and no longer need protection. Mill (1848) emphasized the requirement that the industry ultimately become competitive, such that only temporary tariff protection is required. Using quasi-experimental variation

from Britain's blockade during the Napoleonic Wars, Juhász (2018) provides compelling empirical evidence that this temporary protection allowed the French cotton spinning industry to develop and become competitive, even after the end of the Napoleonic Wars.[17]

However, the requirement that the industry ultimately become competitive on world markets is not sufficient for this argument to be valid. Bastable (1903) and Bardhan (1971) stress the additional requirement that the net present value of the stream of profits in the industry is non-negative, such that initial losses are more than offset by future profits, even after discounting. Even this requirement is not sufficient, since a cost-benefit analysis should also take into account the losses to consumers from the higher prices induced by the tariff (e.g., Irwin 2000). Finally, if the development of capabilities that allows the industry to become competitive occurs within firm boundaries, firms should be willing to borrow on credit markets to finance the initial losses until the industry becomes competitive, such that tariff protection is not required in order for the industry to develop. If firms are not able to borrow to finance the initial losses because of credit market imperfections, government policy should be targeted towards alleviating those credit market imperfections, rather than introducing a tariff that will also distort consumer decisions.

Therefore, the infant industry argument ultimately relies on some form of market failure, such that firms are not able to internalize the benefits of the development of capabilities for their industry.

8.3 External Economies of Scale

Another classic and related argument for a tariff is external economies of scale, where each firm's productivity depends on the scale of the industry as a whole, and each firm is too small to internalize its impact on the scale of the industry as a whole.

This argument was first proposed by Graham (1923), further developed in Kemp (1969), and formalized in Ethier (1982). In the presence of such external economies of scale within an industry, the economy can produce too little of a good, and a tariff that increases domestic production of the good can be welfare improving. Furthermore, the economy's PPF can be characterized by decreasing opportunity costs of production, such that it is concave rather than convex to the origin. As a result, there can be multiple equilibrium patterns of specialization for given world relative prices, with different levels of welfare. Therefore, there can be scope for public policy interventions to be welfare improving by shifting the economy between multiple equilibria.

Recent work shows, however, that such multiplicity is not a generic feature of scale-based trade models. Embedding industry-level external economies of scale into a multi-industry gravity framework, Kucheryavyy et al. (2023) demonstrate that the equilibrium is unique and consistent with comparative advantage provided that the scale elasticity is sufficiently small relative to the trade

[17] For additional evidence on the infant industry argument for protection, see Krueger and Tuncer (1982).

elasticity. In particular, if the product of the two elasticities does not exceed one, all countries gain from trade and the multiplicity problem disappears.

Although tariffs can be welfare improving under external economies of scale, the first-best policy intervention is typically a production subsidy, which is more closely targeted at the source of the market failure, although this production subsidy must again be financed by other distortionary taxation. This argument for a production subsidy relates to the large theoretical and empirical literature concerned with industrial policy, as reviewed in Juhász et al. (2024). Industrial policies featured prominently in the development strategies of a number of East Asian countries, including China and South Korea. There is some evidence that these policies promoted economic development in the targeted industries (e.g., Kalouptsidi 2024 for Chinese shipbuilding and Lane 2025 for South Korea). But there is less evidence on whether these industrial policies improved aggregate welfare and other examples can be found where policies of import substitution appeared to be less successful such as in Latin America (e.g., Edwards 2009, Irwin 2021).

Using a multi-sector quantitative trade model, Bartelme et al. (2025) estimate substantial external economies of scale for a number of manufacturing sectors, but find relatively small welfare gains from the optimal industrial policy. The reason is that the implied bilateral trade costs between countries are relatively large and the elasticity of substitution across sectors is relatively low (close to one). Therefore, the extent of reallocation of resources across countries and sectors induced by the optimal industrial policy is relatively small. Using a model of an input-output network with distortions, Liu (2019) develops a sufficient statistic for the social value of promoting a sector, and finds that this sufficient statistic has predictive power for sectoral policies in China and South Korea.[18]

Although external economies of scale can occur in a static model at a point in time, research on endogenous growth and trade emphasizes dynamic externalities from learning by doing (e.g., Krugman 1987, Lucas 1988, and Young 1991) or endogenous innovation (Romer 1990, Grossman and Helpman 1991, Rivera-Batiz and Romer 1991, and Aghion and Howitt 1992). In the presence of these dynamic externalities, an activist trade and industrial policy in principle can be welfare improving for both the country introducing the policy and its trade partners (Redding 1999).

8.4 Imperfect Competition

While neoclassical economics maintains the assumption of perfect competition, imperfectly competitive market structures can provide a rationale for activist trade and industrial policies. One important strand of this literature — often referred to as strategic trade policy — focuses on profit-shifting motives under oligopolistic competition.

If an industry is dominated by a foreign monopolist, an import tariff can be used to shift profits

[18] Using quasi-experimental evidence from South Korea's Heavy and Chemical Industry (HCI) Drive, Choi and Levchenko (2025) provide quantitative evidence that this policy raised South Korea's welfare by around 3-4 percent.

from the foreign monopolist to the domestic government in the form of tariff revenue (see Katrak 1977 and Brander and Spencer 1981). If an industry has an oligopolistic market structure, a range of activist trade policies can be rationalized to shift profits from foreign to domestic firms, although these typically do not take the form of an import tariff. If firms compete in foreign markets in quantities according to Cournot competition, export subsidies can be welfare improving (see Brander and Spencer 1985). In contrast, if firms compete in foreign markets in prices according to Bertrand competition, export taxes can be welfare improving (see Eaton and Grossman 1986).

Finally, in a setting with Cournot oligopolistic competition and static economies of scale, Krugman (1984) shows that import protection in the form of a tariff can act as export promotion. The import tariff increases the output of home firms and reduces the output of foreign firms in the domestic market, which lowers marginal costs for home firms relative to foreign firms, and thereby leads to home firms expanding and foreign firms contracting in the foreign markets.

In general, a challenge for designing an activist trade policy under imperfect competition is that the form of intervention can be highly dependent on the form of strategic interaction between firms (e.g., Cournot versus Bertrand competition). Many of these policy interventions are also subject to a similar issue of foreign retaliation as the optimum tariff argument discussed above.

8.5 National Security and Supply Chain Resilience

Recent years have heightened concerns about the resilience of global supply chains. Transportation disruptions following COVID-19, policy uncertainty at the national and multilateral levels, growing national security concerns over access to critical goods, and rising geopolitical tensions—including between China and the United States and in the context of the Russia–Ukraine war—have all reinforced perceptions of vulnerability.

While specialization and trade increase aggregate welfare, they may also leave a country reliant on foreign suppliers for critical inputs such as advanced semiconductors or rare-earth minerals. Such dependencies can create "chokepoints" that confer geoeconomic leverage on the supplying country. This leverage can potentially be used to extract economic rents or political concessions, as emphasized in the emerging literature on geoeconomics (e.g., Clayton et al. 2026 and Liu and Yang 2025). Moreover, even the anticipation that trade partners may exploit such leverage can distort equilibrium specialization patterns. Countries may diversify or reshore production beyond what would be implied by purely economic fundamentals, thereby forgoing some of the aggregate gains from trade (Becko and O'Connor 2024 and Clayton et al. 2024).[19]

These concerns raise the question of how firms and governments should respond to supply chain risk. At the firm level, resilience may involve diversifying suppliers across countries, maintaining in-

[19] For surveys of this recent literature on geoeconomics, see Mohr and Trebesch (2025) and Clayton et al. (2025). For empirical evidence on the relationship between economic exposure and political alignment, see Kleinman et al. (2024).

ventories, or reshoring particular stages of production (Elliott et al. 2022, Grossman et al. 2023, and Grossman et al. 2024b). In the presence of uncertainty and risk aversion, sourcing decisions resemble portfolio choices: firms care not only about expected costs, but also about variance and covariance across alternative supply relationships (Kleinman et al. 2025a). From this perspective, reshoring is not automatically synonymous with diversification or resilience; in some cases, concentrating production domestically may increase exposure to correlated domestic shocks.

The appropriate role for policy depends on the source of the inefficiency. If private firms fully internalize risk and capital markets function well, decentralized sourcing decisions may already reflect optimal diversification. However, if there are externalities—such as systemic supply chain risk, coordination failures, or national security spillovers—policy intervention may be justified. Even in such cases, tariffs are unlikely to be first-best instruments, given their distortionary effects on consumption and production. More targeted policies such as subsidies may better address the underlying market failure.

More broadly, rising geopolitical tensions raise the question of how to weigh national security considerations against economic efficiency. Although it is difficult to place a monetary value on national security, economic analysis can quantify the efficiency costs of alternative policies. If a country chooses to sacrifice economic efficiency in the name of national security, revealed preference implies that the perceived gains from enhanced national security exceed the measured economic losses. The role of economic analysis is therefore not to deny national security concerns, but to clarify the magnitude of the trade-offs involved.

9 Evidence from the Recent U.S. Tariffs

We now summarize recent evidence on the effects of the 2018-2019 and 2025-2026 U.S. tariffs and examine the extent to which they are consistent with predictions of conventional economics. We focus mainly on the 2018-2019 tariffs for three main reasons. First, the outcome of the 2016 presidential election was uncertain, which implies that it is unlikely that the tariffs were anticipated, and there is little evidence of pre-trends in the treated industries. Second, the new tariffs were sufficiently large to create meaningful variation across products, time and countries, which makes it possible to examine their effects using conventional datasets. Third, there is a substantial time period after the tariffs were introduced and before the COVID-19 pandemic to examine their effects.

9.1 U.S. Tariffs During 2018-2019 and 2025-2026

During the course of 2018, six waves of U.S. tariffs were introduced. In January 2018, a first wave of tariffs introduced import duties of 30 percent on solar panels and 20-50 percent on washing machines (around $10 billion of U.S. imports). In March 2018, a second wave levied tariffs of 10 percent

on aluminum and 25 percent on steel (around $18 billion of U.S. imports). At first, Canada, Mexico and the European Union were exempt from these tariffs. In June 2018, a third wave of tariffs ended these exemptions (around $22 billion of U.S. imports).

These early waves of tariffs were small in comparison to the subsequent three waves of tariffs imposed on China. In July 2018, a fourth wave of 25 percent tariffs was imposed on $34 billion of U.S. imports from China. In August 2018, a fifth wave of 25 percent tariffs were introduced on $16 billion of U.S. imports from China. Finally, in September 2018, a sixth wave of 10 percent tariffs was imposed on an additional $200 billion of U.S. imports from China. Further increases in tariff protection remained under debate. Initially, the U.S. postponed raising the tariffs on wave 6 goods to 25 percent in early December 2018, before later raising them to this level in May 2019. A further wave of U.S. tariffs on $112 billion of U.S. imports from China was imposed in September 2019, before the outbreak of the COVID-19 pandemic.

The U.S. imposed these tariffs without waiting for authorization from the WTO's dispute resolution process. Instead, a variety of U.S.-based legal justifications were put forward for the tariffs. Section 201 of the 1974 Trade Act allows protection if an import surge is a cause of substantial injury to an industry. Section 232 of the Trade Expansion Act permits protection if imports threaten national security. Section 301 of the Trade Act of 1974 allows the United States to impose tariffs if a trading partner violates a trade agreement or engages in unreasonable practices that burden U.S. commerce. In response, a number of U.S. trade partners filed cases against the United States at the WTO, and imposed retaliatory tariffs of their own. Although the U.S. tariffs were introduced under the first Trump administration, most were maintained under the Biden administration. Additionally, the Biden administration introduced export controls on China, designed to restrict its ability to produce advanced semiconductors, and introduced subsidies to promote domestic semiconductor production and the transition to clean energy sources through the CHIPS and Science Act, the Inflation Reduction Act, and the Infrastructure Investment and Jobs Act.

Although these early waves of U.S. tariffs marked a sharp break from past trade liberalization, they were dwarfed by the U.S. tariffs introduced during 2025-2026, as evident from Figure 2 above. Despite ongoing trade negotiations, the import-weighted average U.S. tariff remains a little under 20 percent, at a comparable level to the 1930s, but in a more integrated world economy. In contrast to prior waves of tariffs, many of the 2025-2026 tariffs were imposed under the International Emergency Economic Powers Act (IEEPA) and the declaration of a national emergency regarding border security and drug trafficking. Although the U.S. Supreme Court ruled that the IEEPA tariffs were unconstitutional, the second Trump administration has announced plans for further tariffs under other U.S.-based legal justifications.

9.2 Import Prices and Values

Amiti et al. (2019) provide empirical evidence on the effects of the 2018-2019 tariffs on import prices and values. Import values and quantities are measured for ten-digit Harmonized Tariff Schedule (HTS) goods using U.S. customs data, where there are more than 19,000 of these categories (e.g., "Baseball and softball gloves and mitts"). Dividing the import values by the quantities, one obtains unit values as a measure of prices. These unit values are measured before tariffs are applied and hence they correspond to foreign export prices. Multiplying the unit values by the duty rates from the U.S. international trade commission, one obtains import prices (inclusive of the tariffs).

We begin by denoting the price of a HTS10 good i from country j in month t by p_{ijt} . We next compute the twelve-month relative change in prices for that good and country as $\widehat{p}_{ijt} = p_{ijt}/p_{ijt-12}$, where using twelve-month relative changes controls for seasonality. We then aggregate the relative change in prices for each good-country pair within a tariff wave using import share weights: $p_{wt} = \prod_{i,j \in w} \widehat{p}_{ijt}^{s_{ij}^w}$, where s_{ij}^w is the logarithmic mean of the import shares for good i and country j in the relevant months for 2017 and 2018 among all good-country pairs included in a tariff wave. Our use of logarithmic mean import shares implies that this price index corresponds to a Sato-Vartia price index that is exact for constant elasticity of substitution preferences. We compute these price indexes for each of the six tariff waves during 2018 and for untreated good-country pairs that received no new tariffs during 2018. We drop petroleum imports, because of the volatility of these prices.

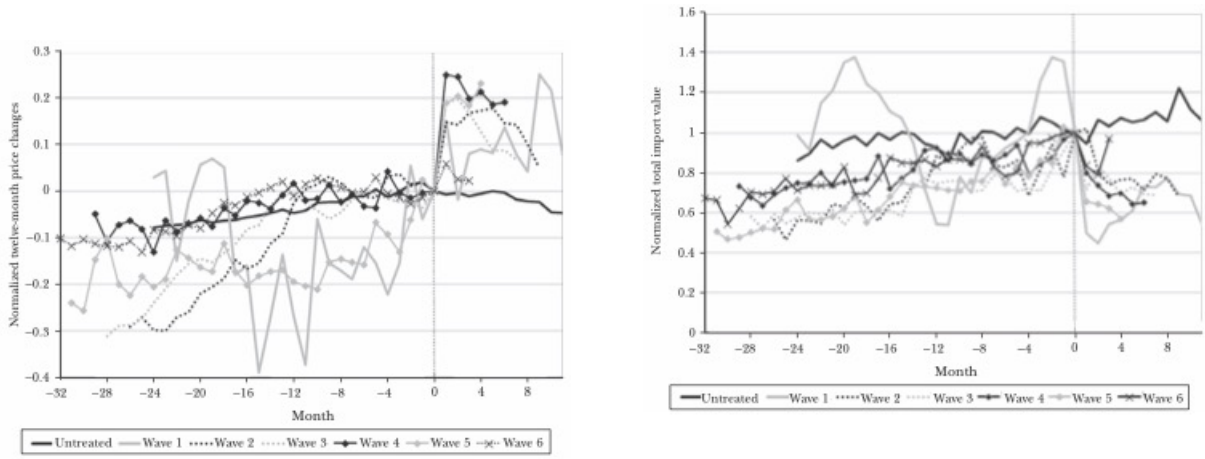
Figure 7a shows these twelve-month proportional changes in import prices. The zero on the horizontal axis corresponds to the month before each of the six tariff waves started (where month zero for untreated good-country pairs is the same as for the first tariff wave). We subtract the price change in the month before the tariff was implemented from each price change, so a zero on the vertical axis corresponds to a price change that equals its value before the tariffs were implemented. Several features are apparent. First, the "untreated" prices are relatively flat, suggesting that the movements for the treated groups are the result of the tariffs. Second, we see substantial increases in the prices of the goods subject to the tariffs, which are comparable in magnitude to the tariffs imposed, suggesting that much of the tariffs were passed on to U.S. importers, wholesalers, retailers, or consumers. Third, although there is some pre-trend for the specific goods in waves one and five, there is little evidence of pre-trends for other waves, again supporting the idea that the movements in prices after the tariffs are imposed are capturing the impact of the tariffs.

Figure 7b shows an analogous figure for the total value of imports for each group of goods and countries. In this case, we normalize the import value in month zero to be one for all goods, so that the import values are all relative to imports in the last month before the tariffs were imposed. The figure shows a surge in imports for wave 1 (washing machines and solar panels) before the tariffs were imposed, which likely reflects importers moving forward their orders in anticipation of the tariffs being imposed. For the other tariff waves, imports were on average increasing faster than for

untreated goods and countries before the tariffs were applied. For all tariff waves, import values decline sharply after the imposition of the tariffs, with declines of around 25-30 percent. In contrast, imports for untreated goods and countries rise by around 10 percent over the same period, which could in part be explained by substitution away from treated goods and countries.

Figure 7: Twelve-Month Proportional Changes in Import Prices by Tariff Wave during 2018

(a) Import Prices (Inclusive of Tariff) (b) Import Values



Note: Panel (a) denotes import share–weighted averages of twelve-month relative changes in U.S. import unit values (import values divided by import quantities), inclusive of tariffs, by tariff wave and for unaffected countries and products. Proportional changes for each wave are normalized to equal zero in the month prior to the introduction of the tariff; for the untreated month, zero is defined as in the first tariff wave. Panel (b) denotes twelve-month proportional changes in the value of U.S. imports by tariff wave and for unaffected countries and products. Each series is normalized to the value one in the month prior to the introduction of the tariff; for the untreated month, zero is defined as in the first tariff wave. The six tariff waves during 2018 are defined as in Section 9.1 above. Source: Amiti et al. (2019).

This empirical finding in Figure 7a of almost complete passthrough of the 2018-2019 tariffs into import prices, with little fall in foreign exporter prices, has been confirmed by a range of studies, including Amiti et al. (2020), Fajgelbaum et al. (2020), and Cavallo et al. (2021), as surveyed in Fajgelbaum and Khandelwal (2022). More recent research for the 2025-2026 tariffs has continued to find high rates of passthrough into domestic prices at the border, including Cavallo et al. (2025), Gensler et al. (2025), Amiti et al. (2026), and Gopinath and Neiman (2026). These findings are consistent with constant markups and constant marginal costs, which imply complete passthrough of tariffs into import prices. However, from the perspective of conventional economic theory, the absence of reductions in foreign exporter prices is puzzling, because the U.S. is plausibly large relative to world markets, and hence one would expect a fall in its import volumes to lead to an improvement in its terms of trade. One caveat is that many of these empirical studies estimate rates of passthrough from relative comparisons across goods and countries and include country-time fixed effects, which would absorb any general equilibrium effects of changes in factor prices at the country level that are common across goods (the so-called missing-intercept problem).

Although there is abundant evidence of complete passthrough of tariffs into import prices at the border, there is much less evidence of the extent to which these tariffs have been passed through to the consumer versus absorbed by importers, wholesalers and retailers, in part because of the challenges of matching goods classifications between the import data and the consumer price index data. In a study of washing machines, Flaaen et al. (2020) find high rates of passthrough into consumer prices, and that the prices of dryers increased by around the same magnitude as washing machines, even though they were not themselves subject to tariffs. Using data on online prices from two large multichannel retailers, Cavallo et al. (2021) find that a 20 percent tariff is associated with only a 0.7 percent increase in retail prices, suggesting that most of the tariffs were absorbed through changes in importer, wholesaler or retailer markups. In a study of U.S. tariffs on European wine, Flaaen et al. (2025) find incomplete passthrough to consumer prices in percentage terms. But the price increase at the border from tariffs is magnified by markups along the distribution chain, such that the passthrough of the tariff to the consumer is more than complete in dollar terms.

One reason for the relatively modest impact of the U.S. tariffs on the consumer price index (CPI) so far is that the implemented tariff rates are only around half of the statutory tariff rates (see Gopinath and Neiman 2026). This gap is explained by a combination of exemptions, shipment lags, imperfect enforcement, and increased compliance with the rules of origin requirements of the USMCA for goods to enter tariff free.[20] Flaaen and Pierce (2025) distinguish between the impact of the 2018-2019 U.S. tariffs on output prices (protecting domestic firms) and input prices (anti-protecting domestic firms). U.S. manufacturing industries more exposed to tariff increases are found to experience relative reductions in employment, because the positive effect from import protection is more than offset by negative effects from higher input costs and foreign retaliatory tariffs.

The empirical finding of a large-scale reorganization of U.S. import sourcing in response to the tariffs in Figure 7b also has been confirmed by a number of studies. From 2017-2022, China's share in U.S. direct imports declined from around 21-16 percent, with third countries such as Vietnam and Mexico gaining much of this market share (e.g., Alfaro and Chor 2023, Fajgelbaum et al. 2024, Freund et al. 2024, Grossman et al. 2024a, Alfaro and Chor 2025, and Gopinath et al. 2025). In principle, some of this "great reallocation" could reflect pure transshipment, but there is evidence that much of it involved a reorganization of production and the genuine relocation of stages of production. Although this reallocation has reduced the direct dependence of the United States on trade with China, it continues to have substantial indirect exposure, through intermediate inputs imported by these third countries from China (e.g., Baldwin and Freeman 2023).

[20] Historically, *de minimis* import shipments with values below a threshold (most recently $800) were exempt from tariffs, but this exemption was ended during 2025 (Fajgelbaum and Khandelwal 2024).

9.3 Aggregate Economic Effects

Amiti et al. (2019) shows how the partial equilibrium techniques from Section 3 can be used to evaluate the aggregate economic effects of the U.S. tariffs. The finding that there was no effect of the 2018-2019 U.S. tariffs on foreign exporter prices implies a perfectly elastic foreign export supply curve, such that the entire incidence of the tariffs fell on domestic importers and consumers. Defining the U.S. import demand curve as the difference between domestic demand and supply, and assuming that this import demand curve has an approximately constant slope, the deadweight welfare loss from the tariff can be estimated from the following formula for the area of the Harberger triangle:

$$\frac{1}{2}p_1^*\tau_V\left(m_0 - m_1\right) = \frac{1}{2}\left(p_1^* m_1\right)\tau_V\left(\frac{m_0 - m_1}{m_1}\right),$$

where the subscript 1 denotes the equilibrium after the tariff; the subscript 0 is the equilibrium before the tariff; τ_V is the increase in the *ad valorem* tariff, such that $p_1^*\tau_V$ is the increase in the domestic price as a result of the tariff, and corresponds to the height of the triangle; and $(m_0 - m_1)$ is the change in imports as a result of the tariff, which corresponds to the width of the triangle.

In the expression on the right-hand side of the equation, the value of imports after the tariff $(p_1^* m_1)$ is observed in the data, and the percentage change in imports as a result of the tariff can be estimated from a regression of log changes in imports on log changes in tariffs:

$$\left(\frac{m_0 - m_1}{m_1}\right) \approx -\ln\left(\frac{m_1}{m_0}\right) = -\beta\ln\left(\frac{1+\tau_t}{1+\tau_{t-12}}\right),$$

where β is the regression coefficient of log changes in import quantities (or equivalently values, since foreign export prices do not change) on log changes in tariffs.

Using this approach Amiti et al. (2019) estimate a cumulative deadweight welfare loss from the 2018 tariffs of $8.2 billion, government tax revenue of $15.6 billion, and a total increase in cost to importers of $23.8 billion dollars over the course of 2018. This estimate is close in magnitude to that from the quantitative trade model of Fajgelbaum et al. (2020) and around the same magnitude as the estimated welfare gain from NAFTA in Caliendo and Parro (2015). As U.S. tariffs have risen during 2025-2026, the Harberger triangles for the estimated deadweight welfare losses grow approximately quadratically with the size of the tariffs. One reason why current U.S. trade policy may be particularly distortionary is the extent to which tariffs now vary across both trade partners and goods. Waugh (2026) computes the trade restrictiveness index of Anderson and Neary (1996), which measures the uniform tariff that leaves the representative agent with the same welfare as the actual heterogeneous tariffs. According to this metric, U.S. trade policy is roughly twice as restrictive as implied by the import-weighted average tariff.

10 Conclusions

This increased use of national policies of import protection, heightened concerns about the resilience of global supply chains, and rising geopolitical tensions between the U.S. and China have brought the economics of tariffs back to the center of the public policy debate.

Standard economic theory highlights that international trade acts like an improvement in production technology that is mutually beneficial (win-win) for all nations. Instead of producing everything domestically, countries can specialize in what they are relatively good at producing, and use the technology of market-based exchange to obtain other goods. A tariff is a tax on this technology of market-based exchange and is necessarily welfare reducing for a country that is too small relative to world markets to be able to affect world prices.

Although most taxes are distortionary, tariffs tend to be particularly distortionary, because they act like the combination of a consumption tax and a production subsidy, which simultaneously distorts both consumer and producer decisions. Additionally, the tax base for tariffs (import values) is typically much smaller than the tax bases for income or expenditure taxes. As a result, a higher tax rate must be set for a tariff than for income or expenditure taxes in order to raise the same amount of revenue, where the magnitude of the distortions increases with the square of the tax rate. Finally, the distortionary effects of tariffs are magnified in a world of GVCs, where stages of production span national borders, because the tariffs are incurred each time a good crosses national borders. Tariffs on final goods protect domestic suppliers from foreign competition. But tariffs on intermediate inputs raise production costs and anti-protect domestic suppliers.

The main conventional economic argument in favor of a tariff is terms of trade manipulation. A country that is large relative to world markets can use its market power to restrict import volumes, which reduces import prices relative to export prices, and enables the country to obtain more imports for a given amount of exports. This terms of trade improvement is a transfer from the rest of the world to the home country and is achieved at the cost of reducing world welfare. If all countries succumb to this unilateral incentive to introduce tariffs, and engage in a trade war, the effects of these tariffs on the terms of trade can be offsetting. Therefore, countries can end up with little improvement in the terms of trade, but welfare losses from the distortion of consumption and production decisions. If all countries could collectively commit not to introduce these tariffs, they could achieve a higher level of welfare than under the trade war. The rationale for international trade agreements, such as the WTO, is to achieve this international cooperation realize mutual welfare gains from trade.

Although international trade brings aggregate welfare gains for countries as a whole, it also creates winners and losers within countries, just like any other technological improvement, such as automation or artificial intelligence. These distributional consequences of international trade provide political economy forces for import protection, particularly when the losers from international

trade (firms in import-competing industries) are concentrated, and the winners from international trade (consumers throughout the economy) are dispersed. However, if policy-makers wish to redistribute income in response to these distributional consequences of trade and technology, tariffs are typically not the most efficient policy, because they simultaneously distort the decisions of producers and consumers. Other possible redistributive policies include domestic taxes and transfers and place-based policies towards regions adversely affected by trade and technology.

Although standard economic theory emphasizes the distortionary effects of tariffs, there are circumstances in which tariffs can be welfare improving in the presence of market failures and externalities. An example is when there are strong external economies of scale in an industry, in which case individual firms do not internalize that if they expanded output, they would benefit all domestic firms in the industry. Another example is when specialization and trade moves production of a critical good or input (e.g., advanced semi-conductors or rare earths) to a foreign country, thereby creating a chokepoint that can be exploited by that foreign country through the exertion of geopolitical power. In both cases, policies to support domestic production in the industry can be welfare enhancing. But the policies should be targeted towards the industry in question, rather than applied broadly, and production subsidies are typically more efficient than tariffs, because tariffs simultaneously distort the prices faced by both consumers and producers.

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