From Protection to Retaliation: The Welfare Cost of Trade Wars

Cristian Espinosa*

This version: October 25, 2024

Click Here For The Latest Version

This paper explores the welfare costs of trade impediments imposed during Trump's administration. These crucially depends on the accurate identification of trade elasticities—the import demand elasticity and the inverse export supply elasticity. I propose a novel instrument to identify these: retaliatory tariffs imposed on sectors different from those targeted by the trade partner. Under WTO rules, countries must match the tariff rate imposed by the trade partner but can choose which products to target. By focusing on price-elastic goods, countries maximize punishment by driving away demand from foreign competitors. Using 2018 Canadian retaliation against the U.S., I estimate an inverse export supply elasticity of zero and an import demand elasticity of 5.2, significantly higher than the 2.5, commonly reported in the literature. This suggests that trade policies tend to target extremes of the elasticity distribution: revenue-raising tariffs on inelastic goods and retaliatory tariffs on elastic goods. By constructing an interval for the average demand elasticity between 2.5 and 5.2, I estimate the U.S. welfare costs to range between $11 and $22 billion, effectively doubling prior estimates.

Keywords: Trade Policy, Trade Wars, Welfare Costs, Trade Elasticities
JEL Classification: D72, F13, F14, F42, O19

*University College London (UCL). Email: cristian.espinosa@ucl.ac.uk. I am deeply indebted to Morten Ravn and Franck Portier for their guidance and support throughout this project. I would also like to thank José-Víctor Ríos-Rull, Raffaella Giacomini, and Kalina Manova for their valuable discussions and continuous support. Finally, I am grateful to all seminar participants at UCL and various institutions for their suggestions, which have substantially improved this paper. All views expressed in this paper are my own responsibility.

1 Introduction

The rise of protectionism in recent years has highlighted the critical need to measure the welfare costs of trade shocks accurately. Central to these measurements are trade elasticities, particularly the price elasticity of demand for imports and the price elasticity of supply for exports (e.g., Arkolakis et al. (2012); Costinot and Rodríguez-Clare (2014)). Recent advancements in the literature have used tariffs to identify these elasticities and quantify the welfare costs of the U.S. trade war (e.g., Fajgelbaum et al. (2020); Amiti et al. (2019)). In this paper, I propose a novel instrument for identifying these elasticities: retaliatory tariffs imposed on industries not originally targeted by the trading partner. This instrument provides exogenous variation, crucial for accurate identification of trade elasticities. My findings indicate that these elasticities are twice as large as previous estimates, leading to significantly higher welfare costs of trade impediments.

Import tariffs, when imposed on specific goods, create a wedge between the price paid by domestic consumers and the price received by foreign sellers. This wedge results in a deadweight loss in the market, as both producer and consumer surplus decrease. The extent of this loss depends on the price elasticity of demand for imports and the price elasticity of supply for exports. If the demand and supply curves are linear, the distortion corresponds to Harberger triangles, representing efficiency loss. Accurately measuring these trade elasticities is essential for determining the welfare costs of tariffs. Import tariffs can serve as instruments in an instrumental variables (IV) approach to identify both elasticities. To estimate the demand elasticity, one can regress (in log changes) import quantities on the duty-inclusive price of imports, using tariffs as instruments for the duty-inclusive price. If tariffs generate exogenous price variation, the IV estimation can recover the demand elasticity which is the slope of the demand equation in this regression. Similarly, to identify the (inverse) supply elasticity of exports, one can regress the duty-exclusive price of imports on import quantities, using tariffs as instruments for the latter.

The identifying assumption requires that tariff rates be exogenous with respect to productivity and demand shocks in the goods on which they are imposed. If tariffs are systematically higher on goods with low idiosyncratic shocks, this creates a negative correlation between the instrument and the error term. This can occur when governments aim to protect certain industries while raising revenue by imposing higher tariffs on sectors with low demand elasticity that are at a comparative disadvantage, thus generating revenue through protectionist policies. This would violate the exogeneity assumption and lead to biased estimates of trade elasticities. Specifically, the negative correlation between the idiosyncratic shocks and the tariff rate causes the estimated elasticities to be biased toward zero.

To address this challenge, I use retaliatory tariff rates imposed on industries not targeted by the trade partner as an instrument. The key identifying assumption is that under WTO rules, the retaliatory response is constrained to match the tariff rates imposed by the trade partner, but countries have discretion in selecting which goods to target. When tariff rates, correlated with idiosyncratic shocks in goods protected by the trade partner, are imposed on a different sector (henceforth, cross-sector retaliation), they are orthogonal to the idiosyncratic shocks of the targeted goods. Using these cross-sector tariffs as an instrument for the duty-inclusive price generates an unbiased estimate of the demand elasticity for the goods subject to cross-sector retaliation. A similar approach applies to the identification of the export supply elasticity.

Goods targeted by cross-sector retaliation typically have higher elasticities compared to those affected by protectionist measures. Retaliation serves as a response to a trade partner's defection, aiming to increase the likelihood that the counterpart will withdraw its tariffs. This tit-for-tat strategy is constrained by the tariff level but allows flexibility in the selection of goods. Retaliating countries target goods with high demand elasticities that are relevant to the trade partner, reducing demand for foreign producers, impacting their profits, and ultimately pressuring the partner to lift tariffs. This suggests that cross-sector retaliation focuses on goods in the upper tail of the import demand elasticity distribution, while protectionist measures tend to target goods with lower demand elasticity. Since these policies target different extremes of the elasticity distribution, it is not possible to recover a single point estimate for the average elasticity. However, by combining results from protective policies in the U.S. during the recent trade war with the findings of this paper, one can establish bounds for the average elasticity and, consequently, for welfare losses.

Using Canadian data on the universe of imports, I analyze the 2018 Canadian retaliation against U.S. tariffs on steel and aluminum. Employing cross-sector retaliatory tariff rates as an instrument, I estimate the demand elasticity for imports to be 5.2, while the supply elasticity for exports is estimated to be zero. In comparison, studies of the U.S. trade war estimate demand and supply elasticities at 2.5 and zero, respectively (e.g., Fajgelbaum et al. (2020)). This indicates that the average demand elasticity lies between 2.5 and 5.2, implying that the welfare costs of tariffs could increase from \$11 to \$22 billion—effectively doubling the estimates in the literature. This approach can be applied when assessing the broader effects of tariffs on the economy, beyond the empirical effects of protective policies. The discrepancy with prior estimates is attributed to two factors: (i) the selection of goods targeted by trade policy, and (ii) estimation bias in the protective component, which the instrument proposed in this paper addresses.

The dataset comprises administrative records from the Canadian International Trade

Division, featuring monthly data on Canadian imports at the HS-10 level from 1988 to 2020. Each observation captures the import of a specific variety (trade partner-product pair) at the HS-10 level, the highest level of disaggregation available. This granularity enables precise measurement of the effects of tariffs at the product level. The data include information on prices, quantities, and import duties collected at the border. For estimation purposes, I focus on the period from 2018 to 2019, when U.S. protective tariffs were imposed and Canada retaliated. This rich dataset allows the identification of key stylized facts about the transition from protectionism to retaliation, providing critical motivation for the theoretical model.

Temporary trade barriers, which operate outside the traditional framework of fixed-bound tariffs, are used discretionarily by governments on specific goods (see Espinosa (2022)).[1] These barriers often respond to negative economic shocks, creating a correlation with business cycle fluctuations (e.g., Bown and Crowley (2013, 2014)). This suggests they are employed for stabilization purposes, particularly to raise revenue during economic downturns. Under protectionist policies, countries typically impose these tariffs on intermediate inputs. Most of these tariffs are concentrated in the metal industry, which generally exhibits low demand elasticities (around two; see Ossa (2015)). This is particularly true for the U.S., where steel production represents a significant share in swing states and is a sector frequently subject to such tariffs. Through these measures, the government can raise revenue while protecting key industries with strong lobbying influence, especially during election cycles (see Waugh (2019) and Fajgelbaum et al. (2020)).

Second, when implementing retaliation, countries match the tariff rates imposed by the trade partner but target a different set of goods than when employing protectionist measures. In Canada, half of the retaliation focused on a diverse range of consumption goods, which generally have higher demand elasticities compared to those targeted under protectionism. The requirement to match tariff rates, governed by WTO rules, is designed to encourage a return to free trade rather than act as a punitive measure. This pattern was also evident during the most recent trade war.

In May 2018, the U.S. imposed tariffs of 25% on steel and 10% on aluminum imports, affecting $12.4 billion of Canadian exports and raising the average tariff rate by 16%.[2] Canada retaliated within a month, imposing tariffs of the same magnitude on $12.7 billion of U.S. exports, keeping the average tariff rate at a level similar to that of the U.S. Half of Canada's retaliatory tariffs targeted the metal industry, while the other half applied to final goods.[3]

[1]These trade remedies include antidumping policies, safeguards, and quotas.

[2]U.S. tariffs on steel and aluminum in 2018 were designed to increase capacity utilization to at least 80%. In 2017, capacity utilization was 72.3% in the steel sector and 39% in the aluminum sector.

[3]Data based on 2017 annual import values, representing the pre-trade war period.

Retaliation in the same industries that the U.S. had protected (henceforth, within-sector retaliation) raises endogeneity concerns if used as an instrument for identifying elasticities. Retaliatory tariff rates in these sectors are likely correlated with the idiosyncratic shocks affecting these products, as they belong to the same industries originally protected by the U.S. Nonetheless, I include them in the estimations for comparison with the existing literature to assess how closely these estimates align with those based on the Trump tariffs.

In the political economy landscape, the timing of the U.S. tariffs coincided with an economic slowdown, a period when lobby groups were advocating for favorable government policies. During his political campaign, President Trump vowed to protect the steel industry, and after securing victories in several swing states within the Rust Belt, he fulfilled this electoral promise by implementing the tariffs in 2018. In response, Canada targeted iconic U.S. products such as bourbon whiskey—a key industry in Kentucky, a state where Trump won in 2016, and which competes with European whiskey brands (see Lake and Nie (2023) for a broader discussion of similar strategies).

To rationalize these findings and support the identification strategy used in the estimation section, I employ a two-country political economy model illustrating the dynamics between protection and retaliation. The foreign country has a strong incentive to impose tariffs during recessions, as the government's marginal utility from tariff revenue increases. This effect is amplified if the home country is experiencing a boom, allowing foreign firms to extract more resources from home producers. Tariffs also benefit foreign firms in their domestic market by enabling them to raise prices without reducing markups, which, in turn, drives lobbying efforts for protection. Lobby strength is modeled as structural noise, where the tariff rate is inversely related to the demand elasticity of each sector, but the decision is moderated by the government's weight on lobbying from various industries. The home country commits to a state-contingent retaliation plan to deter prolonged protectionism. Although retaliation is less effective during foreign recessions, when domestic firms' profits are low, the home country must still retaliate to prevent the foreign country from maintaining tariffs during normal conditions. As the foreign economy improves, retaliation becomes more impactful. Targeting goods with high demand elasticities in sectors sensitive to the foreign economy maximizes the punishment, increasing the probability of tariff withdrawal in normal conditions. This strategy represents a subgame perfect Nash equilibrium.

Related literature

The literature on trade wars is well-established, spanning from mid-20th-century contributions like Johnson (1953), Markusen and Wigle (1989), Bagwell and Staiger (1999), and

Broda et al. (2008). Since the Smoot-Hawley Tariff Act, economists have analyzed the effects of unilateral Nash tariffs in the economy. Johnson (1953) suggests that a country with significant market power might gain from imposing tariffs, even with retaliation, by improving its terms of trade. However, Bagwell and Staiger (1999) challenge this, showing that unilateral tariffs provoke retaliation, leading to trade wars where all countries are worse off than under free trade. Their work emphasizes the importance of international cooperation for maximizing global welfare. Similarly, Broda et al. (2008) analyze optimal tariff rates countries could impose assuming others don't retaliate. While tariffs cause efficiency losses, they can create terms-of-trade gains depending on a country's market power. The magnitude of this effect depends on the inverse export supply elasticity: higher values force trade partners to lower prices in response to tariffs, cushioning the drop in import quantities and allowing governments to extract rents from foreign competitors.

Another strand of the literature examines optimal tariffs under political economy considerations (Grossman and Helpman (1994, 1995), Goldberg and Maggi (1999), Eicher and Osang (2002), Ossa (2014)). Grossman and Helpman (1994) shows how domestic lobby groups can drive tariffs even without international market power. In their framework, organized industries offer political contributions in exchange for protection, with governments weighing these against consumer welfare losses. Optimal tariffs depend on protected goods' demand elasticities and lobbying strength—inelastic demand allows higher tariffs due to lower consumer welfare losses, while stronger lobbies secure higher protection through greater contributions. Goldberg and Maggi (1999) provides empirical support for these predictions using U.S. trade protection data.

Accurate measurement of trade elasticities is essential for calculating optimal tariff rates, and various methodologies have emerged in the literature (Feenstra (1994), Broda et al. (2008), Caliendo and Parro (2014), Ossa (2014), Boehm et al. (2023)). Feenstra (1994), building on Krugman (1979, 1980), uses a nested CES model to identify trade elasticities, where this equals the elasticity of substitution across imported varieties from different source countries. Broda et al. (2008) and Broda and Weinstein (2006) extend this approach to calculate optimal tariffs, finding a median elasticity of 3.1 across imported varieties for U.S. imports. However, not all estimates have structural interpretations. Recently, Boehm et al. (2023) estimates trade flow elasticities to tariffs across time horizons using Most Favored Nation (MFN) tariffs, finding 0.76 in the short run and 2 in the long run. Caliendo and Parro (2014), following Eaton and Kortum (2002)'s gravity equations, find substantial variation across industries, with a median elasticity of 3.3 using cross-country information.

Gravity equation models originate from the work of Anderson (1979); Anderson and van Wincoop (2003), relating bilateral trade flows to countries' economic sizes and trade

costs, with geographic distance serving as a key proxy. Studies such as Eaton and Kortum (2002) and Caliendo and Parro (2014) incorporate gravity equations into general equilibrium frameworks to assess how changes in trade costs, like tariffs, impact trade flows across industries and countries. By exploiting variations in trade policies and utilizing detailed trade data, these models allow for the estimation of trade elasticities. These elasticities typically range between 3 and 8, with a median estimate of around 5 (see, e.g., Head and Mayer (2014)). Notably, these diverse methodologies and definitions of trade elasticities highlight the complexity inherent in accurately estimating them.

More recently, papers analyzing the effect of the trade war have utilized tariffs to measure trade elasticities. Fajgelbaum et al. (2020) use U.S. import data at the HS-10 level to estimate these elasticities. Using steel and aluminum tariff rates as instruments for the duty-inclusive price, they find a demand elasticity of 2.5, which corresponds to the elasticity of substitution across imported varieties. They estimate the export supply elasticity to be zero, implying that the welfare costs in the affected markets amount to $11 billion. Another paper estimating the impact of the 2018 U.S. tariffs is Amiti et al. (2019). In their analysis, they regress import quantities directly on the tariff measures to arrive at a demand elasticity of 1.3. This result is comparable to what Fajgelbaum et al. (2020) obtain in their OLS estimation; however, this OLS result is a downward-biased version of their IV estimate. Most studies find that the export supply elasticity is close to zero, implying a flat supply curve and complete pass-through of tariffs to consumer prices. These findings are supported by Amiti et al. (2019), Fajgelbaum et al. (2020), Flaaen et al. (2020), and Cavallo et al. (2021).

Retaliatory measures against the U.S. targeted consumption goods, automobiles, and agricultural commodities, with China focusing heavily on the latter. Waugh (2019) shows these tariffs were imposed on highly exposed counties, reducing U.S. export capacity. Estimating the elasticity of retaliatory tariffs is challenging due to limited data at the HS 6-digit level, which lacks granularity and obscures variations in trade flows. Amiti et al. (2019) estimate the demand elasticity of U.S. export quantities to foreign retaliatory tariffs as 1.2, leading to a decline in sector employment. The inverse export supply elasticity is marginal, indicating almost complete pass-through of tariffs to prices. Similarly, Fajgelbaum et al. (2020) estimate the elasticity at 1.04. Full pass-through to prices means U.S. exporters bear the full cost with minimal price adjustment by foreign producers.

This modest elasticity estimate contrasts sharply with the 5.2 estimate found in this paper, which is closer to estimates from gravity equation models. This paper reconciles two strands of the literature. Trade war studies report low elasticities because Trump's protective tariffs targeted varieties with low import demand elasticity. In contrast, this paper shows that

when the upper tail of the elasticity distribution is targeted, the estimated elasticities align more closely with those from gravity models, albeit for different reasons. The contribution to the literature is twofold: (i) I propose a novel instrument to identify trade elasticities and (ii) I construct an interval for the average elasticity. The average demand elasticity is bounded between 2.5 and 5.2, implying the welfare costs could double to $22 billion.

The rest of the paper is organized as follows: Section 2 presents the data and stylized facts. Section 3 introduces the theoretical model. Section 4 outlines the identification strategy. Section 5 discusses the estimation results, followed by the conclusion.

2 Empirical Evidence

2.1 Data

The dataset includes administrative records from the Canadian International Trade Division, consisting of monthly data on Canadian imports at the HS-10 level from 1988 to 2020. Each observation represents the import of varieties (trade partner-product pair) at the HS-10 level in a given month. The data include information on prices, quantities, and import duties collected at the border.

The strength of this database lies in its detailed reporting on imported products. HS-10 imports represent the most granular level at which trade data are recorded, making it critical for analyzing tariff impacts, as tariffs are applied at this specific tariff line. This level of detail allows for a more precise examination of how prices and quantities respond to tariff changes. Compared to other available databases, such as TRAINS and UN Comtrade, which generally provide data at the HS-6 level, this database offers a significant advantage in terms of granularity. It is more comparable to the U.S. counterpart (USA Trade Online), frequently used in studies analyzing the impact of the U.S. trade war.

For estimation purposes, data from 2018 to 2019 will be used. This period is particularly relevant as it captures Canada's retaliation against U.S. tariffs on steel and aluminum. The next section presents stylized facts that align with the key features discussed in the model section.

Stylized facts

This section addresses three empirical facts present in the literature: (i) tariffs exhibit a countercyclical profile, (ii) they are predominantly imposed on intermediate inputs, and (iii) retaliation matches the tariff rates imposed by the counterpart but shifts toward consumption goods. To show some of these facts, I will also use historical data on Canadian temporary

trade barriers[4]. The tariffs in this database are expressed as a percentage of prices rather than values, as is typically reported.[5]

I will decompose these tariffs into protective and retaliatory components, following the definitions used in Feinberg and Reynolds (2006, 2018)[6]. This decomposition is used to analyze the behavior of episodes where a country imposed tariffs discretionarily, compared to when the tariffs were a reaction to a trade partner's tariffs. First, to address the countercyclical profile, I focus on Canada's two most recent recessions. During these periods, I will analyze the timing of tariffs from the quarter at the peak and the two surrounding quarters. Figure 1 illustrates this relationship:

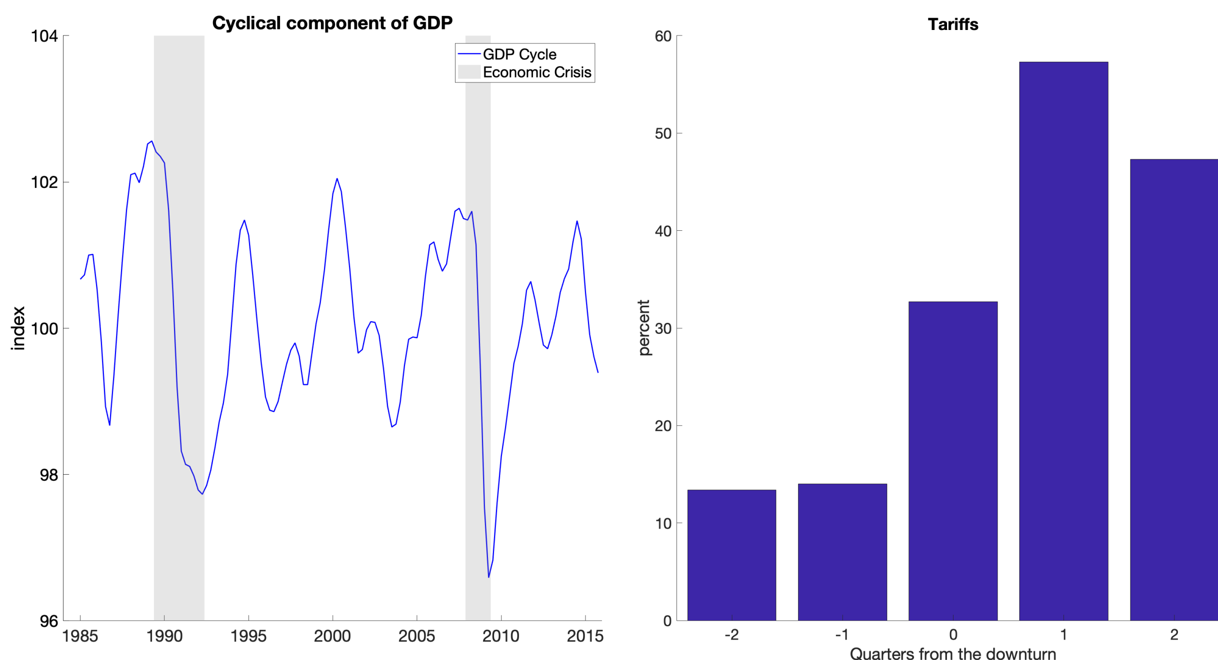


Figure 1: Countercyclical tariffs

It is important to note that, in this graph, during economic downturns, countries tend to impose higher import tariffs on competitors. This suggests that tariffs are used as a discretionary tool, for example, to raise revenue during recessions.

[4] This information is from Bown (2016) and covers Canada's antidumping and countervailing duties between 1985 and 2016.

[5] The most common tool for temporary trade barriers is antidumping policies. These are measured by the dumping margin, defined as the difference between the normal value and the export price, expressed as a percentage of the export price. This margin is applied to specific products to counteract dumping practices by trade partners.

[6] Retaliation is defined as an action taken within a year of the original tariff increase by a trading partner. This allows for a distinction between protective and retaliatory measures.

Appendix B.1 examines the decomposition between the intensive and extensive margins. To do this, I classify periods as expansions or contractions, following the OECD's definition, which is based on the cyclical component of quarterly GDP.[7]

The results of regressing tariffs on the contraction dummy indicator, both using OLS and a probit model, show that protective tariffs are about 10 percentage points higher during recessions and 20% more likely to be imposed. However, no significant effect is observed for the retaliatory component. This supports the conventional view that protective tariffs are used as a stabilizing tool during economic downturns.

Second, import tariffs are predominantly imposed on intermediate inputs. Figure 2 shows that 84% of cases involving temporary trade barriers are concentrated on these types of goods.

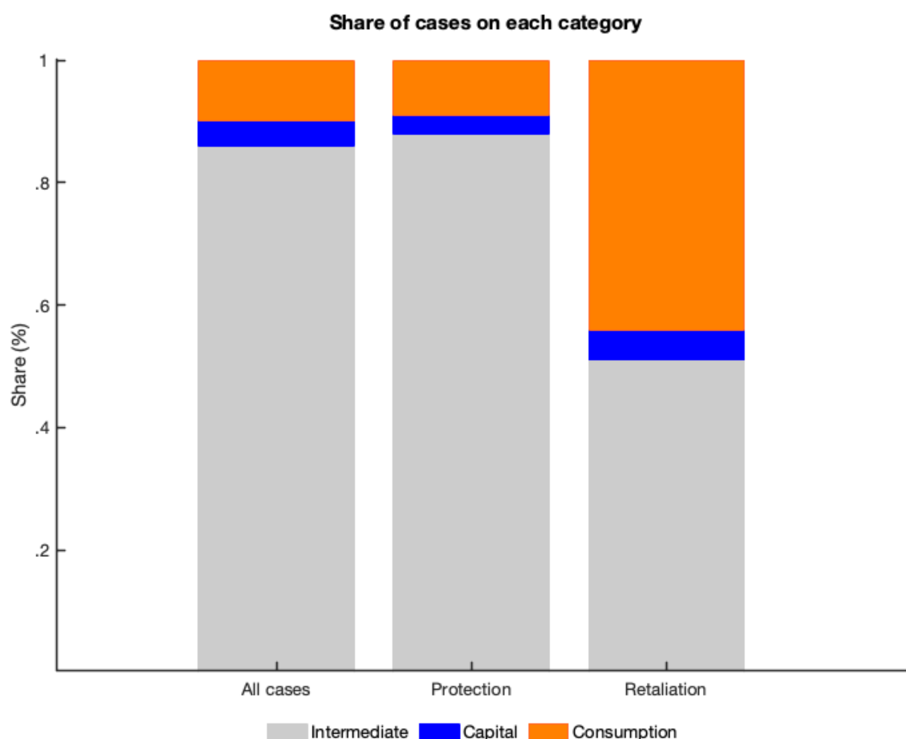


Figure 2: Composition of tariff's cases in Canada

Protective episodes focus heavily on intermediate goods, particularly in the metal industry. This pattern is consistent with the aggregate data, where protection accounts for just over 90% of the cases in the sample. However, this sharply contrasts with retaliation cases, where half of the tariffs are imposed on consumption goods. Compared to these, intermediate goods are harder to substitute in the short run since they are used as inputs for other industries.

[7] The OECD defines contractions and expansions using the cyclical component of quarterly GDP.

Long-term supply contracts between firms delay the adjustment of these inputs. Protecting relatively inelastic industries ensures a higher source of government revenue, or alternatively, for a given amount of revenue, minimizes the distortion in these sectors. These considerations are central when governments aim to maximize revenue. Third, during retaliation, tariff rates are matched with those of the counterpart. As the retaliatory response is regulated by the WTO, tariffs are set reciprocally to those imposed by the trading partner. For example, during the trade war, Canada mirrored the 25% and 10% tariffs imposed by the U.S., while maintaining a similar average rate—16% in the U.S. and 15% in Canada. The left panel of Figure 3 illustrates this:

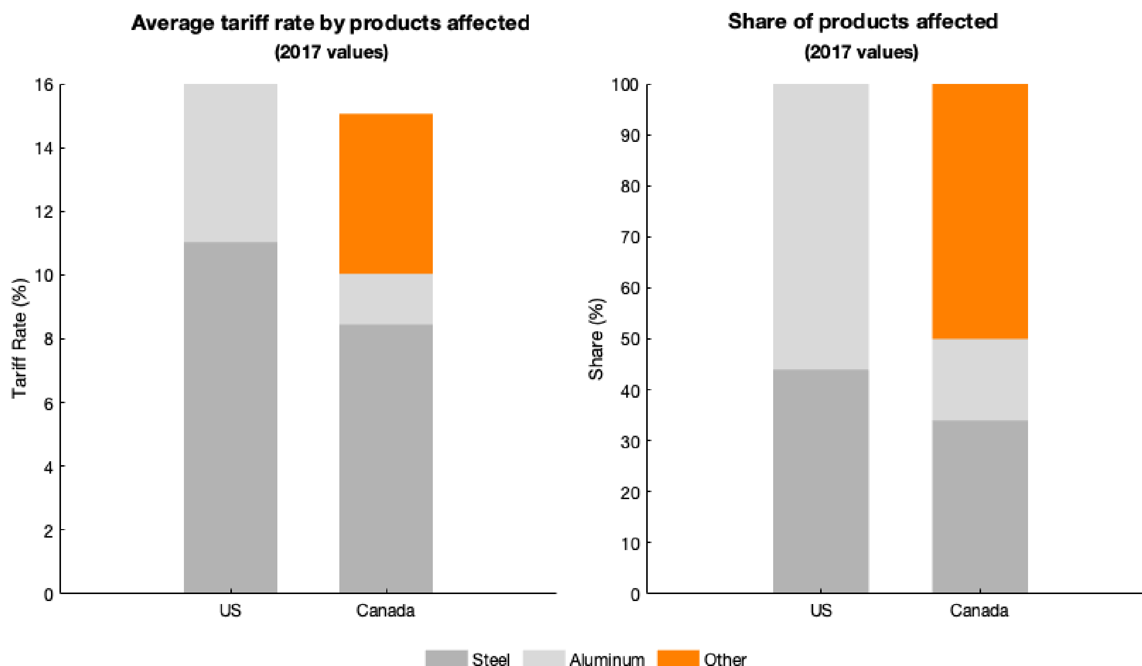


Figure 3: Canadian retaliation against US protective tariffs

Each bar reflects the contribution to the average tariff by type of good, weighted by the 2017 import share value. The right panel shows the share of goods targeted by Canadian retaliation. The basket of goods, in 2017 values, is equivalent to the products covered by U.S. protectionism. However, half of the retaliation was directed at sectors different from those protected. This leads to the fourth and final empirical fact. The retaliatory response shifted toward consumption goods. As shown in Table 1, which categorizes the products subject to this policy by economic activity using the BEC indicator, tariffs on steel and aluminum were set at 25% and 10%, respectively. These are the U.S.-protected products that Canada also targeted. Industries outside these sectors were subject to 10% tariffs, primarily targeting

final consumption goods, which account for around 40% of the value share. These include foods, beverages, and durable and non-durable goods. Appendix B.2 provides a detailed breakdown of these goods.

Table 1: Retaliatory tariffs by sectors

Type of good (BEC Indicator)	Products (units)	Value (2017 $bn)	Value share (%)	Tariff (%)	Av. Tariff rate (weighted, %)
Steel	329	4,326	34	25	8.5
Aluminum	41	2,048	16	10	1.6
Food and beverages	46	2,397	19	10	1.9
Consumer goods, durables	59	1,239	10	10	1.0
Consumer goods, non-durables	25	1,337	10	10	1.0
Transport equipment, non-industrial	19	511	4	10	0.4
Capital goods (except transport)	4	536	4	10	0.4
Other Industrial supplies	23	368	3	10	0.3
	546	12,763			15.1

This behavior, as also highlighted in the second empirical fact, suggests that it is optimal for the government to target goods with different characteristics. More importantly, compared to protectionist measures, these goods have higher elasticity. The rationale behind the government's objective function is to target goods from competitors that are strategically significant to the foreign government. This strategy aims to decrease demand, thereby harming both competitors and the trade partner. Consequently, this approach increases the likelihood of tariff withdrawal, a feature that is incorporated into the model.

3 Theoretical Framework

The model consists of two countries: Home (H) and Foreign (F). The Home country is composed of a continuum of small open economies (SOEs), which together form the domestic economy but individually lack market power. In contrast, Foreign is a large country with significant market power, capable of influencing international prices and trade flows. The economy operates within a multi-industry framework, where each industry is indexed by $s = 1, \ldots, S$, and within each industry, there are multiple varieties of tradable goods, indexed by $j = 1, \ldots, J$. These varieties serve as the basis for both inter-industry and intra-industry trade between Home and Foreign.

Labor markets in both countries consist of L units of labor. Workers supply labor to the industries and earn after-tax wages, with governments in both Home and Foreign imposing taxes on labor income. Labor is mobile across industries but immobile between countries. The Foreign country has market power to impose uniform tariffs at the industry level to

manipulate the terms of trade in its favor. By contrast, the Home country lacks market power. Finally, both countries have the option to impose discretionary tariffs at the product level.

3.1 Households

The representative agent's utility function in each country depends on consumption, government spending, and the disutility of labor:

$$U = \prod_{s} C_s^{\beta_s} + \ln(G - \bar{G}_m) - \frac{L^{1+\frac{1}{\kappa}}}{1+\frac{1}{\kappa}} \tag{1}$$

Aggregate consumption is modeled as a Cobb-Douglas function of industry-level consumption, with the parameters β_s representing the Cobb-Douglas industry expenditure weights, satisfying $\sum_s \beta_s = 1$. Government expenditure follows a Stone-Geary form, where $\bar{G}_m$ denotes the minimum subsistence level of government spending. Labor disutility is specified as a Constant Relative Risk Aversion (CRRA) function, and the labor supply Frisch elasticity is constant and equal to κ.

The representative agent's budget constraint is given by $PC = \Pi + w(1-\tau_L)L + T$, where P is the aggregate price level, taken as a numeraire, C is total consumption, w is the wage rate, L is labor supply, τ_L denotes the labor income tax rate, Π represents domestic firms' profits, and T are the government's lump-sum transfers. Consumption at the industry level follows a two tier Nested Constant Elasticity of Substitution (CES). At the top tier, expenditures in 4-digit NAICS sectors are allocated between domestically produced goods and foreign imports. The bottom tier is a CES bundle over imported varieties across products at the HS10 digit level. This tier can be further disaggregated across trading partners in a multi-country framework, something explored in the empirical section[8]. Both tiers are:

$$\begin{aligned} C_s &= \left((1-\psi_s)^{\frac{1}{\rho_s}} Y_{Hs}^{\frac{\rho_s - 1}{\rho}} + \psi_s^{\frac{1}{\rho_s}} Y_{Fs}^{\frac{\rho_s - 1}{\rho_s}} \right)^{\frac{\rho_s}{\rho_s - 1}} \\ Y_{Fs} &= \left(\sum_j d_{Fsj}^{\frac{1}{\lambda_\mathbf{s}}} Y_{Fsj}^{\frac{\lambda_\mathbf{s} - 1}{\lambda_\mathbf{s}}} \right)^{\frac{\lambda_\mathbf{s}}{\lambda_\mathbf{s} - 1}} \end{aligned} \tag{2}$$

At the upper tier, ρ_s governs the elasticity of substitution between domestic and foreign composites, while ψ_s represents the sectoral expenditure share on foreign goods. In the

[8] For simplicity, I am assuming that the elasticity of substitution between the two bundles is the same. In effect, that the elasticity of substitution across imported products is the same as the one between imported varieties (the elasticity of substitution between products across different trading partners)

bottom tier, λ_s governs the elasticity of substitution between imported products Y_{Fs} within sectors s, while d_{Fsj} represents the expenditure share on each product, subject to demand shocks. The demand for imported products follows by minimizing expenditure subject to the Nested-CES structure:

$$Y_{Fsj} = d_{Fsj} \left(\frac{(1+\tau_{sj})P^*_{Fsj}}{P_{Fs}} \right)^{-\lambda_s} Y_{Fs} \tag{3}$$

These depend on the relative duty-inclusive (consumer) price P_{Fsj} to the imported sector price, the price elasticity of demand, demand expenditure shocks, and the imported sectoral demand. Import tariffs generate a wedge between the producer and the consumer price, such that $P_{Fsj} = (1+\tau_{sj})P^*_{Fsj}$. Finally, preferences in the foreign country are symmetric to those in Home. However, in this case, the duty-inclusive price is $P^*_{Hsj} = (1+\tau^*_{sj})P_{Hsj}$, where P^*_{Hsj} is the price Home producers charge abroad, and P_{Hsj} is the price they charge domestically. The elasticities are identical across both countries.

3.2 Firms

In each industry, foreign monopolistically competitive firms produce goods using a technology that exhibits decreasing returns to scale with respect to labor input:

$$Y_{Fsj} = A^*_{sj}(L^*_{Fsj})^{\sigma^*_s} \tag{4}$$

Productivity, $A^*_{sj} = e^{\varepsilon^*_{A_{sj}}}$, depends on two components: aggregate and idiosyncratic shocks, such that $\varepsilon_{A^*_{sj}} = \xi^*_A + \xi^*_{A_{sj}}$. Firms minimize costs subject to equations (3) and (4), which yields the optimal pricing function:

$$P^*_{Fsj} = \left(\frac{\lambda_s}{\lambda_s - 1} \right) \left(\frac{W^*}{\sigma^*_s A^*_{sj}} \right) \left(\frac{Y_{Fsj}}{A^*_{sj}} \right)^{\omega^*_s}, \text{ where } \omega^*_s = \left(\frac{1-\sigma^*_s}{\sigma^*_s} \right) \tag{5}$$

The inverse export supply elasticity, denoted by ω^*_s, captures the firm's price response to changes in quantities. Additionally, in each country, monopolistic firms also produce goods for their domestic markets, operating under the same technology described above. This implies that total production in the foreign country, $Y^*_{sj} = Y^*_{Fsj} + Y_{Fsj}$, is split between domestic production and exports.

3.3 Equilibrium for Given Tariffs

The price and quantity equilibrium for imported products can be obtained by solving equations (3) and (5) in terms of the tariff rate. Expressing the variables in log deviations (denoted by lowercase letters) yields:

$$y_{Fsj} = \left[\frac{1}{(1+\omega_s^*\lambda_s)}\right]\left(-\lambda_s(1+\tau_{sj}) + \lambda_s(1+\omega_s^*)\varepsilon_{A_{sj}^*} + \varepsilon_{d_{Fsj}^*} + \phi_{y_{sj}}^*\right) \tag{6}$$

$$p_{Fsj}^* = \left[\frac{1}{(1+\omega_s^*\lambda_s)}\right]\left(-\omega_s^*\lambda_s(1+\tau_{sj}) - (1+\omega_s^*)\varepsilon_{A_{sj}^*} + \omega_s^*\varepsilon_{d_{Fsj}^*} + \phi_{p_{sj}^*}^*\right) \tag{7}$$

where ϕ_{sj}^* denotes a linear combination of variables at the sectoral and aggregate levels in each equation[9]. The rest of the equations follow from (6) and (7):

$$p_{Fsj} = (1+\tau_{sj}) + p_{Fsj}^* \tag{8}$$

$$p_{Fs} = \sum_j [d_{Fsj} p_{Fsj}] \tag{9}$$

$$p_s = \sum_s [(1-\psi_s)p_{Hs} + \psi_s p_{Fs}] \tag{10}$$

$$\pi_{Fsj} = (p_{Fsj}^* + y_{Fsj}) \tag{11}$$

$$r_{sj} = \tau_{sj} + \pi_{Fsj} \tag{12}$$

$$w = \sum_{sj} \beta_s \pi_{sj} \tag{13}$$

$$\ell = \kappa[w + (1-\tau_L)] \tag{14}$$

The first three equations represent the duty-inclusive price, as well as the price indices for imported products and at the sector level. The pass-through of tariffs to duty-inclusive prices is given by $1/(1+\omega_s^*\lambda_s)$, which is complete when the inverse export supply elasticity is equal to zero. The remaining equations pertain to foreign profits, tariff revenue, wages, and labor supply. Following Ossa (2014), firm profits are proportional to industry sales, and consequently, the variables in these equations are proportional as well. Additionally, consumption at the product level is equal to $C_{sj} = Y_{Hsj} + Y_{Fsj}$, the sum of domestic production and imports.

A similar set of equations arises when analyzing the Foreign country, these depending

[9]These are variables that involve general equilibrium effects at higher levels of aggregation. In the empirical section, I will use fixed effects to control for them.

on Foreign's state variables and the import tariffs imposed by the Home country. The equilibrium for these variables depends on both, state variables and policy instruments. The former comprise a set of productivity and demand shocks, while the latter consist of taxes and tariffs imposed by each government. We denote these, respectively, as:

$$\mathcal{S} = \{\mathcal{S}_{sj}, \mathcal{S}^*_{sj}\}, \text{ where } \mathcal{S}_{sj} = \{\varepsilon_{A_{sj}}, \varepsilon_{d_{sj}}\}, \text{ and } \mathcal{S}^*_{sj} = \{\varepsilon^*_{A_{sj}}, \varepsilon^*_{d_{sj}}\}$$
$$\mathcal{T} = \{\mathcal{T}_{sj}, \mathcal{T}^*_{sj}\}, \text{ where } \mathcal{T}_{sj} = \{\tau_\ell, \tau_{sj}\}, \text{ and } \mathcal{T}^*_{sj} = \{\tau^*_\ell, \tau^*_{sj}\}$$

3.4 Governments

Each government chooses a set of policy instruments. Strategic interactions make these choices depend not only on economic conditions but also on the other country's policy instruments. There are two states of the world: bad times and normal times. In the bad state, a sufficiently negative productivity shock occurs, such that $\xi_A < 0$, while in normal times, the economy faces no aggregate shocks ($\xi_A = 0$). Assume that the Foreign country starts in the bad state and remains there with probability q. The Home country is assumed to be in the normal state, which is absorbing.

The economy consists of two periods, zero and one. At time zero, the Home country commits to a state-contingent strategy: if the Foreign government imposes a tariff $\tau^*_{sj} > 0$, the Home government responds with equivalent tariffs on a sector of its choice. Assume that at the start of each period, the state is realized, and governments take their choices at the end. In this period, the bad state occurs for the Foreign economy, prompting the imposition of tariffs. The Home country retaliates with the following policy rule:

$$\tau_{s'j'}(\mathcal{S}^*_{sj}) : \ \tau_{s'j'} = \tau_{sj} \tag{15}$$

At time one, the Foreign country decides whether to withdraw the tariff. This decision follows a stochastic choice model that takes into account the Home country's best response. Furthermore, the Home country's actions influence the probability of Foreign's tariff withdrawal. The sequential game is represented in Figure 4:

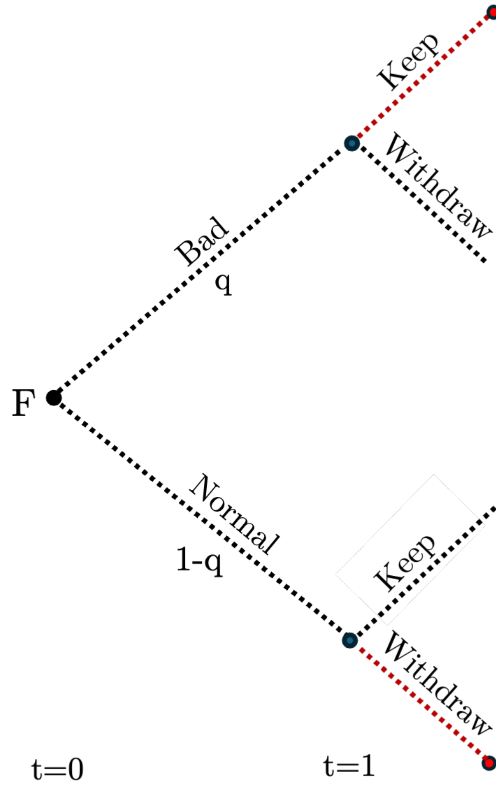


Figure 4: Sequential game

The red dashed lines represent the Subgame Perfect Nash Equilibrium (SPNE) in each state. Home's retaliation affects the withdrawal probability only in the normal state, making withdrawal the SPNE. In the bad state, the absence of retaliation costs leads the Foreign government to maintain its tariffs.

3.4.1 Foreign Government

The government's budget constraint is defined as:

$$\Psi^*(\mathcal{S}): \ \tau_L^* w^* + \tau_s P_{Hs}^* Y_{Hs}^* + \tau_{sj} P_{Hsj}^* Y_{Hsj}^* - T^* - G^*$$

Government revenue consists of labor income taxes, as well as uniform and discretionary tariffs at the sector and product levels, respectively. Government spending is divided between lump-sum transfers and exogenous expenditures[10]. At time zero, the foreign country has already imposed uniform tariffs to exploit its market power. These tariffs were set to

[10]For example, this could be the provision of public goods, which enters the utility function of the representative agent.

maximize sector welfare and are equal to the inverse export supply elasticity, $\tau_s = \omega_s$[11]. Discretionary are equal to zero before the realization of the shock.

The bad state implies a drop in government revenue and, consequently, of the budget constraint, $\partial \Psi^*_{sj}/\partial \mathcal{S}^*_{sj} < 0$ [12]. Given (1), this increases the marginal utility of government revenue, leaving the government with two options: (i) raise taxes or (ii) impose tariffs on goods. Labor taxes reduce labor supply in (14), consequently affecting firms profits and production:

$$\frac{\partial u(L^*)}{\partial \mathcal{T}^*_{sj}} < 0, \ \frac{\partial u(C^*)}{\partial \mathcal{T}^*_{sj}} < 0$$

Import tariffs sharply increase the marginal benefit of government revenue. However, they also reduce the consumer surplus in the affected market:

$$\frac{\partial u(G^*)}{\partial \mathcal{T}^*_{sj}} > 0, \ \frac{\partial u(C^*)}{\partial \mathcal{T}^*_{sj}} < 0$$

Given the above, applying tariffs on international trade is the most efficient policy tool. The government however, needs to trade off these two forces.

Political Economy

Government preferences are given by the following objective function:

$$\tilde{W}^*_s = \sum_j \tilde{\theta}^*_s \tilde{W}^*_{sj}$$

As in Ossa (2014), $\tilde{W}_s$ is a weighted average of the welfare function at the sector level. The political economy weights, $\hat{\theta}_s$, represent the importance the government assigns to various lobby groups within each industry. The objective function can alternatively be expressed as:

$$\tilde{W}^*_s = \theta W_s + \sum_j \theta^*_s W^*_{sj}$$

where $\theta^*_s = (\tilde{\theta}^*_s - \theta)$, and welfare, W^*_s, is the sum of labor income, consumer surplus, producer surplus, and tariff revenue. Welfare of groups contributing to the political campaign of the elected government is denoted by W^*_{sj}. The weights θ and θ^*_s correspond to sector and product-level welfare functions, respectively.

[11] See, e.g., Broda et al. (2008). A tariff equal to ω_s allows the government to capture a portion of the foreign producers' surplus, thereby maximizing its own welfare at the sector level. Since the inverse export supply elasticity measures how responsive producers are to lowering prices given a change in tariffs, import quantities are not significantly affected.

[12] In particular, $\mathcal{S}^*_{sj} = \{\xi_A < 0, \xi_{A_{sj}} = 0, \varepsilon_{d_{sj}} = 0\}$

Following Grossman and Helpman (1994, 1995), industries with greater electoral contributions from lobbyists receive higher weights in product-level welfare. In the bad state, the government also prioritizes products that generate higher revenue, and these preferences are incorporated into the product-level welfare. Thus, W_{sj}^* can be rewritten as the sum of these two components:

$$\tilde{W}_s^* - \theta^* W_s^*(\tau_s^*) = \sum_j (\theta_s^* \pi_{Fsj}^* + \delta_b r_{sj}^*) \tag{16}$$

Uniform tariffs at the sector level are chosen to maximize welfare W_s^* and are set equal to the inverse of the export supply elasticity. The right-hand side then represents the government's deviation from tariffs that exploit its market power. The first term is the weight on the profits of domestic firms in the foreign country. The second term is the government's revenue, with δ_b in the second term equaling one in the bad state and zero otherwise. The deviation reflects the government's weighting of lobbyists and the magnitude of the negative aggregate shock. Figure 5 illustrates the parameter combinations under which the bad state materializes. Large negative shocks, high values of θ_s, or a combination of both trigger this state. The

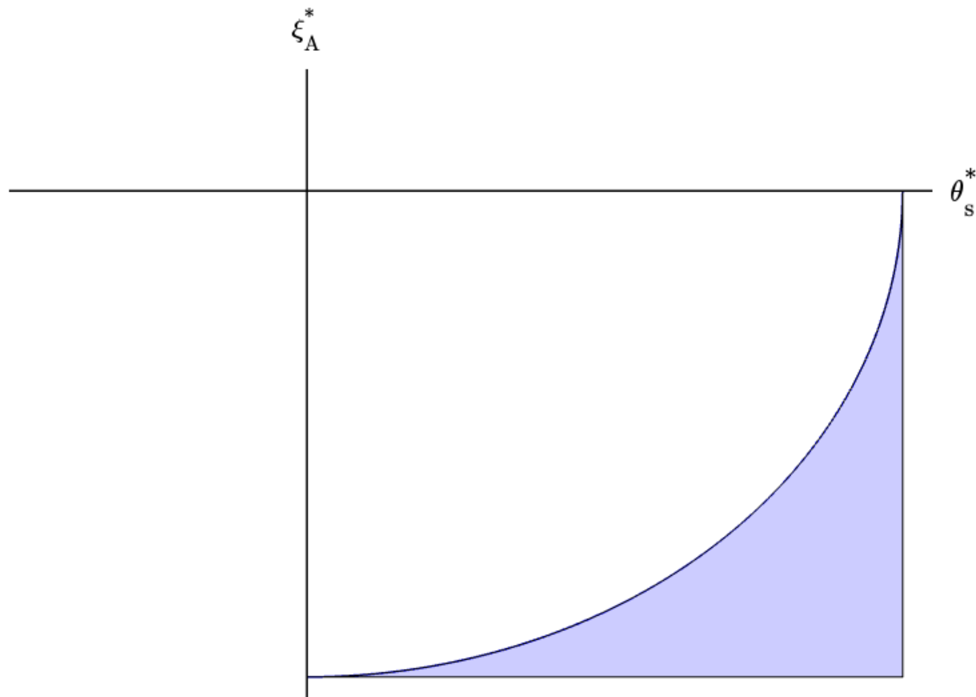


Figure 5: Bad state region

further to the right in the region, the more the government aligns with the lobbyists' interests, reflecting the influence of a populist president. A tariff on a given product has a dual effect: it raises revenue and protects domestic producers in the foreign country. Depending on the tariff's pass-through, it raises import prices, allowing domestic producers to increase their prices without adjusting their markups. When a tariff is imposed on goods with low demand elasticity, it produces three effects: (i) generates significant government revenue, (ii) minimizes distortion by reducing the adverse effect on consumer surplus, and (iii) increases tariff pass-through, benefiting domestic producers.

Foreign import tariffs weigh these two properties. Industries with low demand elasticity and a high degree of lobbying are more likely to be selected for protection. The degree of protection to domestic competitors is largely a by-product of trade elasticities. The foreign government chooses tariffs to maximize the following value function:

$$V_b^*(\mathcal{S}) = \max_{\tau_{sj}^*} \sum_j \theta_s^* W_{sj}^*(\mathcal{T}_{sj}^*, \mathcal{S}) + \beta \left[q V_b^*(\mathcal{S}') + (1-q) V_n^*(\mathcal{S}') \right] \tag{17}$$

Proposition 1. *Given the government's value function (17), subject to (6)-(14) and (16), the tariff rate maximizes these preferences is given by:*

$$\tau_{sj}^* = \left(\frac{\theta_s^* z_{sj}}{\lambda_s (1 + \omega_s^*)} \right)$$

where z_{sj} is the share of Home's exports on sector's expenditure.

Proof. See *Appendix A.1* □

The optimal tariff decreases with demand elasticity and increases with lobby weights and the expenditure on Home exports. In equilibrium, z_{sj} depends on state variables, combining productivity and demand shocks at the product level. This creates a correlation between the tariff rate and idiosyncratic shocks.

3.4.2 Home Government

The Home government commits to retaliation, which increases the probability that Foreign will withdraw their tariffs in period one, but this comes at the cost of consumer surplus. As a result, only a share of Home's SOEs chooses to take this action. For the remaining economies that choose to retaliate, their objective is to maximize welfare subject to (15).

The corresponding value function is:

$$V_b(\mathcal{S}) = \max_{\mathcal{T}_{s'j'}} W_{sj}(\mathcal{T}_{s'j'}, \mathcal{S}) + \beta \left[q V_b(\mathcal{S}') + (1-q) p_n V_n(\mathcal{S}') \right] \tag{18}$$

Home's objective is to restore welfare levels to those prior to the imposition of tariffs. Retaliation affects the continuation value in the value functions during normal times. The extent of this impact depends on Home's strategy in selecting which industries to target with this action. The impact of retaliation on Foreign's producer surplus depends on the scale of the productivity shock in the bad state. This shock reduces firms' profits, rendering the punishment level insignificant in the bad state. Consequently, the probability of withdrawal in this scenario is zero. In normal times, however, the scale of profits is much higher, making the punishment considerable. Therefore, only in this state, the probability of withdrawal, $1-p_n$, is positive, which is what Home aims to influence. The strategy trades-off the effectiveness of retaliation with the costs associated with it.

3.5 Strategic Interactions

On each state, there is a matrix of welfare payoffs for each government. These corresponds to $t = 1$ decision tree of Figure 4. Each country decides to withdraw or not their tariffs. Foreign strategies are labeled in the first column, while Home's are the first row. The payoffs matrix in the bad state is:

	Withdraw	Keep
Withdraw	$(0, 0)$	$(-ps^*_{s'j'}, -cs_{s'j'})$
Keep	$(\theta^*_s W^*_{sj}, -ps_{sj})$	$(\theta^*_s W^*_{sj}, -ps_{sj} - cs_{s'j'})$

Table 2: Payoffs Matrix in bad times

The Foreign government can secure a profitable deviation embedded in W^*_{sj}, benefiting both domestic producers and the government. Retaliation bears no significant cost[13], and therefore, the SPNE is to keep tariffs during bad times. In normal times, payoffs are:

[13] Technically, retaliation still incurs a cost, but it is negligible compared to normal times, and thus assumed to be near zero for illustration purposes.

	Withdraw	Keep
Withdraw	$(0, 0)$	$(-ps^*_{s'j'}, -cs_{s'j'})$
Keep	$(\theta^*_s W^*_{sj}, -ps_{sj})$	$(\theta^*_s W^*_{sj} - ps^*_{s'j'}, -ps_{sj} - cs_{s'j'})$

Table 3: Payoffs Matrix in normal times

Compared to the bad state, retaliation has a significant impact on Foreign, increasing the probability of withdrawal. However, Home must weigh this against the higher cost to consumer surplus in this state. By targeting Foreign's gains, retaliation reduces the effectiveness of any deviation in normal times. Consequently, Foreign becomes more likely to abandon its tariffs, making free trade the SPNE in this scenario.

Proposition 2. *Given the value function in (18), and assuming $q < 1$, there exists a cutoff for the withdrawal probability, $1 - p_n$, above which retaliation becomes the dominant strategy. This is given by:*

$$(1 - \tilde{p}_n) = \left[\frac{cs_{n_{s'j'}} - cs_{b_{s'j'}}}{ps_{sj} + cs_{s'j'}}\right] + \left[\frac{cs_{b_{s'j'}}}{ps_{sj} + cs_{n_{s'j'}}}\right]\left(\frac{1}{\beta(1-q)}\right)$$

where $cs_{n_{s'j'}} > cs_{b_{s'j'}}$, with $cs_{n_{s'j'}}$ and $cs_{b_{s'j'}}$ denoting consumer surplus in the normal and bad states, respectively.

Proof. See *Appendix A.2* □

This represents the minimum withdrawal probability at which retaliation becomes a sustainable strategy. The Home country's objective is to impose tariffs in a way that ensures this probability exceeds the cutoff.

Stochastic choice model

Assume Foreign's value functions are subject to shocks $\{\varepsilon^{k^*}, \varepsilon^{w^*}\}$. The decision to withdraw in normal times can be expressed as:

$$V^*_n(\mathcal{S}) = \max\{V^{w^*}_n(\mathcal{S}) + \varepsilon^{w^*}, V^{k^*}_n(\mathcal{S}) + \varepsilon^{k^*}\}$$

The withdrawal decision occurs when the utility of withdrawing is higher, with the probability:

$$P\left(\varepsilon^{w^*} - \varepsilon^{k^*} > V^{k^*}_n(\mathcal{S}) - V^{w^*}_n(\mathcal{S})\right) \tag{19}$$

If the shocks to the value functions follow an extreme value type I distribution, this probability can expressed as:

$$1 - p_n = \left(\frac{1}{1 + \exp\left[\Delta V_n^{k^*}\right]} \right)$$

where $\Delta V_n^{k^*} = (V_n^{k^*} - V_n^{w^*})$. Home actions reduce the value of $V_n^{k^*}$, increasing the withdrawal probability. Therefore, there exists a cutoff at which the foreign government is indifferent between withdrawing or not in normal times. Define $\eta = (\varepsilon^w - \varepsilon^k)$, and let $\tilde{\eta}$ be the cutoff defined by:

$$\tilde{\eta} = \inf\{\eta | \Delta V_n^{k^*} \geq 0\}$$

Foreign withdraws whenever $\eta > \tilde{\eta}$. Home retaliation aims to lower this cutoff to maximize the probability of withdrawal. That is, during normal times, the foreign country is more likely to give up its tariffs.

Withdrawal Probability

The effect that retaliation has on Foreign is a reduction in the producer surplus. Since the home country lacks market power, it cannot influence world prices, meaning $\omega_s^* = 0 \ \forall s$. Thus, the impact of Home's retaliation depends on the demand elasticity of the good and the weight the foreign government assigns to it.

Proposition 3. *If $\Delta\lambda_{s'} > 0$ or $\Delta\theta_{s'} > 0$, the cutoff for the withdrawal probability is strictly decreasing in these arguments. This is defined is defined as:*

$$\tilde{\eta} = \frac{1}{1 + \exp(\Delta \tilde{V}_n^{k^*})}$$

where $\Delta \tilde{V}_n^{k^*} = \frac{\theta_s z_{sj}}{1+\omega_s^* \lambda_s} - z_{s'j'} \left(\Delta\lambda_{s'}\theta_{s'} + \Delta\theta_{s'}\lambda_s + \lambda_s\theta_s\right)$ and $z_{s'j'}$ is the ratio of Foreign's exports of product $s'j'$ to Home's sectoral expenditure.

Proof. See Appendix A.3 □

As the level of the tariff rate, determined by Foreign, is fixed, Home chooses the location of tariffs to maximize the probability of withdrawal. Formally:

$$\left[(1 + \tau_{s'j'}) | \tau_{sj}^*\right] = (D_{s'j'} | D_{sj}^* = 1)(1 + \tau_{sj}^*)$$

where $D_{s'j'} = 1$ if this sector is targeted by retaliation (zero otherwise). From Proposition 3, the sector in which to retaliate is a combination of products of high demand elasticity, high

relevance to the trade partner, or both:

$$(D_{s'j'}|D^*_{sj}=1) = -\left[\Delta\lambda_{s'}\theta_{s'} + \Delta\theta_{s'}\lambda_s + \lambda_s\theta_s\right]$$

However, the extent of this impact is moderated by the parameter $z_{s'j'}$, which measures the Foreign country's exposure to retaliation. This means that only a portion of Home's SOEs can effectively retaliate, depending on how much they can influence the probability of withdrawal.

Proposition 4. *There exists a cutoff value $z_{s'j'}$ such that only a share $\alpha \in (0,1)$ of Home's SOEs choose to retaliate. Given Foreign's tariffs, denote this cutoff as:*

$$\tilde{z}_{s'j'} = \frac{\theta_{sj}\pi^*_{F_{sj}}}{\theta_{s'}\pi_{F_{s'j'}}}\left[1 - \frac{1}{\theta_{sj}\pi^*_{F_{sj}}}\ln\left(\frac{1}{1-\tilde{p}_n} - 1\right)\right]$$

The demand expenditure shock $\tilde{d}_{Fs'j'}(\tilde{z}_{s'j'})$ is such that the proportion of countries retaliating is equal to $\alpha = 1 - F\left(\tilde{d}_{Fs'j'}(\tilde{z}_{s'j'})\right)$.

Proof. *See Appendix A.4* □

Only a share α can trade off the benefits of retaliation, by affecting the withdrawal, against the costs this imposes on their own economy. In bad times, the Foreign country anticipates this, and because the punishment is insignificant, it fully benefits from the deviation. In normal times, however, the marginal utility of tariffs rests solely on the protection provided to domestic industries. When compared to the costs of retaliation on other exposed industries, it is likely that these costs outweigh the benefits, making Foreign more inclined to withdraw in this state.

4 Identification strategy

The import demand and export supply equations can be described by:

$$y_{Fsjit} = \phi_{jt} + \phi_{it} + \phi_{is} - \lambda_s p_{Fsjit} + \xi^d_{sjit}$$
$$p^*_{Fsjit} = \phi_{jt} + \phi_{it} + \phi_{is} + \omega^*_s y_{Fsjit} + \xi^s_{sjit}$$

Subscript i refers to imports from multiple trade partners, so these equations describe the import and export of varieties (i.e., trade partner-product pairs). The error terms in each equation can be correlated within varieties in the same sector and across countries, but they are orthogonal across industries.

The terms ϕ represent a collection of fixed effects that control for product-level seasonal effects, aggregate shocks, and industry characteristics. These fixed effects are essential for capturing general equilibrium effects, accounting for variables such as exchange rate fluctuations, wages, sector-level disturbances, and foreign tariffs.

The identification of the demand elasticity, λ_s, interpreted as the elasticity of substitution across imported varieties, and the inverse export supply elasticity, ω_s^*, can be achieved through Instrumental Variables (IV) estimation. The instrument is, retaliatory tariffs imposed on sector s' in response to tariff rates on sector s. The IV approach must satisfy the relevance and exogeneity conditions:

$$\mathbb{E}\left[\tau_{sjit}^* \times \{p_{Fs'j'it}, y_{Fs'j'it}\}\right] \neq 0$$
$$\mathbb{E}\left[\tau_{sjit}^* \times \{\xi_{s'j'it}^d, \xi_{s'j'it}^s\}\right] = 0$$

First, the tariff rate increases the duty-inclusive price and reduces imports of sector s'. Second, and as in the theoretical model, import tariffs are correlated with idiosyncratic shocks, i.e., $\tau_{sjit}^* = \psi_s \xi_{sjit}$[14]. However, when imposed on sector s', they are orthogonal to the error term in these equations. To identify each elasticity, estimate the following:

$$\mathbb{E}\left[\tau_{sjit}^* \times y_{Fs'j'it}\right] = -\lambda_{s'}\mathbb{E}[\tau_{sjit}^* \times p_{Fs'j'it}] + \mathbb{E}\left[\tau_{sjit}^* \times \xi_{s'j'it}^d\right]$$
$$\mathbb{E}\left[\tau_{sjit}^* \times p_{Fs'j'it}^*\right] = \omega_{s'}^*\mathbb{E}[\tau_{sjit}^* \times y_{Fs'j'it}] + \mathbb{E}\left[\tau_{sjit}^* \times \xi_{s'j'it}^s\right]$$

If exogeneity holds in both equations, the IV estimator identifies $\lambda_{s'}$ and $\omega_{s'}^*$. It is crucial, however, to control for $(D_{s'j'}|D_{sj}^* = 1)$, which reflects the likelihood of targeting demand-elastic varieties during retaliation. Since this depends on differences in elasticities and industry lobby weights, sector-level fixed effect captures this source of variation.

Event study

This section conducts an event study to examine the presence of anticipation effects and pre-trends between targeted and untargeted varieties. Taking period zero as the point when Canada implemented the retaliation (July 2018), I analyze the evolution of the data six months before and after this event. Periods earlier than six months before (-6) are excluded, while those beyond six months after (+6) are grouped together. The regression specification

[14]The tariff rate depends on the product's expenditure. In equilibrium, this is influenced by the idiosyncratic shocks to demand and supply at the variety level.

is as follows:

$$\ln(x_{sjit}) = \phi_{ji} + \phi_{jt} + \phi_{it} + \sum_{h=-6}^{6} \beta_{0h} \mathbb{1}\{\text{event}_{sji} = 1\} + \sum_{h=-6}^{6} \beta_{1h} \mathbb{1}\{\text{event}_{sji} = 1\} \times \text{target}_{sji} + \epsilon_{sjit}$$

where the first three terms on the right-hand side represent product-country, product-time, and country-time fixed effects. This setup ensures that β_{1h} is identified using variation between target and untargeted varieties. Dummy variable "target$_{sji}$" captures those varieties affected by tariffs, while "event$_{sji}$" is the tariff enactment date. The dependent variable, include import values, quantities, duty-inclusive prices, and duty-exclusive prices. Figure 6 illustrates these results:

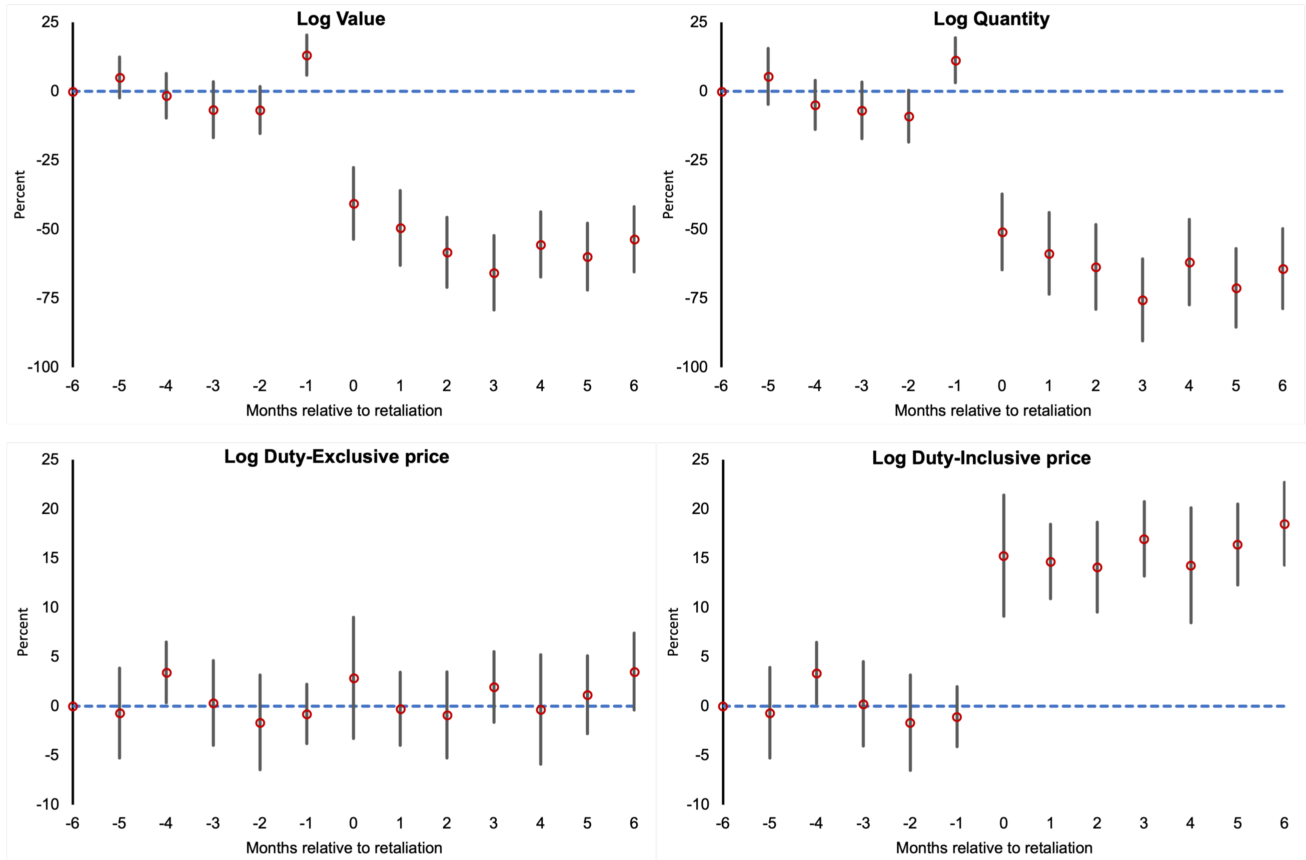


Figure 6: Event study

The results show a significant drop in values at the time of retaliation, approximately 50%, which is primarily explained by a similar decrease in quantities. The duty-exclusive price

remains unchanged, indicating full pass-through from tariffs to duty-inclusive prices, as foreign producers do not absorb the tariffs by reducing markups. This outcome also suggests a flat supply curve, consistent with the insignificant foreign export supply elasticities reported in the literature.

Another important observation is the absence of significant pre-trend dynamics in any of the cases. However, mild anticipation effects are noted in the month preceding the tariff's enactment, particularly visible in the graphs for import values and quantities. This behavior is largely driven by the steel and aluminum sector. Appendix B.3 decomposes the dynamics of these variables into within-sector and cross-sector retaliatory tariffs.

From this analysis, it is evident that the anticipation effect is entirely explained by the within-sector component, as the same behavior is observed in both values and quantities during period -1. Cross-sector retaliatory tariffs do not exhibit this issue, and therefore, this is not a concern when using them as an instrument.

5 Results

This section presents the baseline results for the elasticity estimation, organized as follows. First, the elasticity is estimated using all tariff changes as an instrument. Second, a decomposition is provided between within-sector and cross-sector tariffs. Lastly, the welfare costs of tariffs are analyzed.

The estimations control for fixed effects at the product-time, country-time, and country-sector levels. The first controls for seasonal patterns and product-specific dynamics, the second for aggregate variables such as exchange rates, and the third accounts for sector characteristics at the country level, including those relevant for selection. All variables are expressed in log differences, and the duty-inclusive price is instrumented using tariff changes. Table 4 presents the baseline estimation:

Table 4: OLS and IV estimation using all tariff changes

	OLS		IV - All Tariffs	
	λ_s	ω_s^*	λ_s	ω_s^*
$\hat{\beta}$	-0.76	-0.22	-2.37	-0.05
se($\hat{\beta}$)	(0.02)	(0.00)	(0.33)	(0.03)
Product x time FE	Yes	Yes	Yes	Yes
Country x time FE	Yes	Yes	Yes	Yes
Country x sector FE	Yes	Yes	Yes	Yes
1st-stage F			165	65
R2	0.27	0.27	.	.
N	2,409,339	2,409,339	2,409,339	2,409,339

Notes: Standard errors clustered by trade partner and product at the HS-8 level.

The OLS coefficient is -0.76, biased towards zero due to endogeneity. When using tariffs as an instrument, the coefficient increases (in absolute terms) to -2.37, which is larger than the OLS estimate. As for the supply elasticity, it is negative and marginal in both cases and becomes insignificant in the IV estimation. This suggests an elastic supply curve, implying a complete pass-through of tariffs into duty-inclusive prices. Using the model's results, the average effect on trade values can be expressed as:

$$\Delta \ln \left(P^*_{Fsjit} Y_{Fsjit}\right) = -\left[\frac{\lambda_s(1+\omega_s^*)}{1+\omega_s^*\lambda_s}\right] \tau_{sjit} \approx -33\%$$

Applying the average Canadian tariff increase and the estimates from the table above leads to an average drop of 33%, driven primarily by the demand side, given that the supply elasticity is zero.

When comparing these results with the existing literature, the IV coefficients are close to the commonly reported -2.5 for demand elasticity and zero for supply elasticity. Consequently, the drop in trade values is similar, suggesting that this analysis, using Canadian data, replicates the findings from studies on the U.S. experience.

However, import tariffs may obscure the effect of the cross-sector retaliatory component. To address this, the decomposition is used to run the same regressions. Table 5 presents the results:

Table 5: IV estimation of tariff decomposition

	IV within-sector		IV cross-sector	
	λ_s	ω_s^*	λ_s	ω_s^*
$\hat{\beta}$	-1.87	-0.12	-5.23	0.10
se($\hat{\beta}$)	(0.28)	(0.04)	(1.45)	(0.05)
Product x time FE	Yes	Yes	Yes	Yes
Country x time FE	Yes	Yes	Yes	Yes
Country x sector FE	Yes	Yes	Yes	Yes
1st-stage F	163	46	21	24
R2	.	.	.	.
N	2,409,339	2,409,339	2,409,339	2,409,339

Notes: Standard errors clustered by trade partner and product at the HS-8 level.

The result of -2.37 is largely driven by the elasticity of the within-sector component, estimated at -1.87. This suggests that the selection toward inelastic varieties dominates the aggregate measure. This value represents the lower bound estimate ($\hat{\lambda}_L$) in the interval for the average effect.

Conversely, cross-sector retaliatory tariffs consistently estimate the upper bound ($\hat{\lambda}_H$), with an elasticity of -5.2, more than twice the magnitude of the lower bound. To test whether the lower and upper bounds are statistically distinct, I perform the following test:

$$H_0 : \hat{\lambda}_L = \hat{\lambda}_H$$
$$\text{F} = 5.2, \quad \text{P}_v = 2.4\%$$

At the 5% confidence level, the test rejects the null hypothesis that both bounds are equal, establishing a meaningful range for the average elasticity.

On the supply side, within-sector tariffs yield a negative estimate for this elasticity, indicating that endogeneity concerns may still be present when using these tariffs as an instrument. In contrast, retaliatory tariffs provide a positive, though small, estimate, suggesting that supply factors are not central to explaining average trade effects.

Regarding the relevance condition, the instrument exceeds the rule of thumb threshold of 10 in all specifications. However, it is somewhat lower in panel data estimations, likely because the instrument is relevant only for US imports and not for those from the rest of

the world. This suggests that in split samples focused solely on US trade, the instrument would be much stronger.

The standard errors, clustered by trade partner and products at the 8-digit level, are higher for the cross-sector retaliatory tariffs. This is due to the smaller number of observations for each treatment. Within-sector retaliatory tariffs have twice as many observations as the cross-sector ones, which accounts for the larger standard errors in the latter specification. Despite this, the estimated demand elasticities remain significant in both cases. To illustrate the results, Figure 7 portrays a visual representation of the estimates:

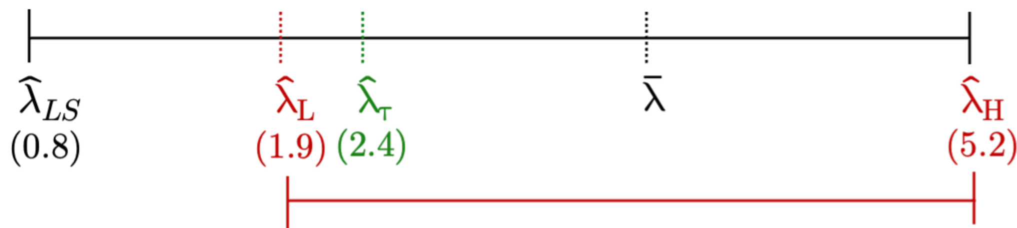


Figure 7: Average elasticity bounds

The average elasticity lies within the interval of 1.9 to 5.2, marked in red. The elasticity estimated using all tariff changes falls closer to the lower end of this range. The exact location of the average elasticity depends on the unknown distribution. The OLS estimate, which is heavily downward biased, lies outside this interval.

Welfare Effects

The welfare implications are a nonlinear function of trade elasticities. Averaging between the two bounds could lead to overestimation or underestimation of the welfare consequences of tariffs.

This calculation incorporates the model's equations and the estimated elasticities of demand and supply. Since the export supply elasticity approaches zero, the average deadweight loss has a linear relationship with the import demand elasticity. Figure 8 illustrates this relationship.

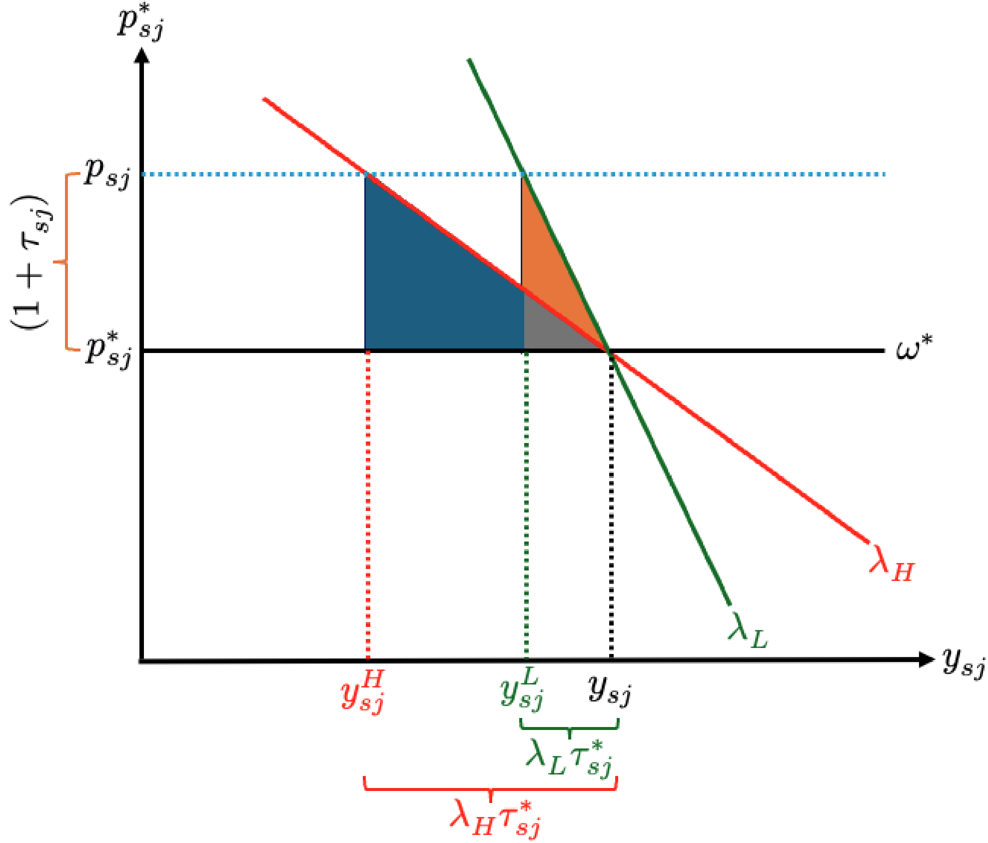


Figure 8: Welfare cost of tariffs

The deadweight loss (DWL) in the case of low demand elasticity (λ_L) is represented by the sum of the gray and orange areas. In the case of high demand elasticity (λ_H), it corresponds to the gray and blue areas. Since λ_H is twice as large as λ_L, the welfare cost is doubled.

To calculate this, the model's equations and the estimated elasticities of demand and supply are used. The DWL, in levels, can be expressed as:

$$DWL = \frac{1}{2}\left(P^*_{sjit} \times Y_{Fsjit}\right)\tau_{sjit}y_{Fsjit} = -\frac{1}{2}\lambda_s\tau^2_{sjit}\left(P^*_{sjit} \times Y_{Fsjit}\right)$$

Since the elasticity estimate is approximately three times higher under retaliation compared to protection, holding other factors constant, the welfare cost is proportional to this difference. As a result, if tariff rates are identical in both cases, the deadweight loss is $7.6 billion compared to $2.7 billion.

However, in this case, Canada imposed an average tariff rate of 20% on the protected industries and 10% on the others. Accounting for these differences, the deadweight loss remained the same across the two scenarios. Table 6 summarizes these findings:

Table 6: Tariff's welfare costs

Imports	$\hat{\lambda}$	$\Delta\tau$	DWL
12.4b	-2.5	16.6	11b
12.4b	-5.2	16.6	22b

In the U.S., the value of imports affected by tariffs, based on 2017 figures (prior to the trade war), totaled $12.4 billion. The Trump administration's tariff policies led to an average tariff rate increase of 16.6%. To assess the impact, we use the estimated demand elasticity for both the lower and upper bounds.

These findings suggest that the welfare losses in the United States resulting from the Trump administration's tariffs may be significantly larger than previously reported in the literature—potentially twice as high. Using a lower bound elasticity of 2.5, and an upper bound elasticity of 5.2, I estimate the deadweight loss to increase from $11 billion to $22 billion.

While the estimated welfare losses show a substantial increase, they remain relatively modest at the aggregate level. Relative to total U.S. imports in 2017, the impact reflects an increase from 0.4% to 0.8% of total import value. However, at the industry level, these changes can be quite significant. For example, in the metal industry, the impact rises from 20% to 40% of the sector's output.

Robustness checks

The result remain robust to several specifications. One of them is that if these effects are driven by trade between Canada and the US. Certainly, tariff rates were raised towards this trade partner, keeping the remaining ones unchanged. To isolate this, interact the variables with a US dummy indicator and re-run the regressions:

Table 7: Robustness - Estimation using US tariffs

	IV within-sector		IV cross-sector	
	λ_s	ω_s^*	λ_s	ω_s^*
$\hat{\beta}$	-1.69	-0.11	-5.6	0.10
se($\hat{\beta}$)	(0.22)	(0.04)	(1.67)	(0.04)
Product x time FE	Yes	Yes	Yes	Yes
Country x time FE	Yes	Yes	Yes	Yes
Country x sector FE	Yes	Yes	Yes	Yes
1st-stage F	217	55	24	26
R2	.	.	.	.
N	2,409,339	2,409,339	2,409,339	2,409,339

Notes: Standard errors clustered by trade partner and product at the HS-8 level.

Table 7 shows that the estimates are very close to the ones obtained in the result. Moreover, the null hypothesis $H_0 : \hat{\lambda}_L = \hat{\lambda}_H$ is rejected: F = 5.3 ($P_v = 2.2\%$).

This suggests that the estimations using the whole sample are driven by the retaliation against the US. Tariffs against other trading partners remained unchanged during the trade war, and tariffs on targeted HS-10 products increased only for the US. This explains why the results are entirely driven by this counterpart.

To explore if tariffs against the rest of the world play a role in the results, I will run the regressions using these and controls. Table 8 illustrates this:

Table 8: Robustness - Estimation using US tariffs with controls

	IV - Protective		IV - Retaliatory	
	λ_s	ω_s^*	λ_s	ω_s^*
$\hat{\beta}$	-1.76	-0.13	-5.5	0.10
se($\hat{\beta}$)	(0.23)	(0.04)	(1.62)	(0.04)
Product x time FE	Yes	Yes	Yes	Yes
Country x time FE	Yes	Yes	Yes	Yes
Country x sector FE	Yes	Yes	Yes	Yes
1st-stage F	216	55	24	26
R2	.	.	.	.
N	2,409,339	2,409,339	2,409,339	2,409,339

Notes: Standard errors clustered by trade partner and product at the HS-8 level.

The estimation for the elasticities remains roughly the same with respect to the previous results. The standard error however, are improved marginally. Tariffs against the rest of competitors are therefore not relevant for explaining the elasticity estimations. This is in line with the argument made before, as the dynamics are entirely explained by Canada and the US.

6 Conclusion

This paper examines the impact of tariffs on Canada's trade volumes and prices, using retaliatory tariffs as a novel instrument to address identification concerns. The main finding is a demand elasticity of 5.2, significantly higher than the typical estimate of 2.5 reported in the literature. Retaliatory tariffs, which target elastic goods, provide an upper bound of the elasticity distribution, while protective tariffs reflect the lower bound. By differentiating between these two, the paper estimates an average elasticity range between 2.5 and 5.2. This elasticity range leads to an interval for welfare costs, estimated between \$11 billion and \$22 billion. This highlights the substantial economic burden associated with tariffs and underscores the importance of understanding how trade elasticities vary across sectors.

Using a political economy model, this paper illustrates the strategic behavior of countries in their tariff imposition and retaliation, particularly during economic downturns. The foreign country's decision to impose tariffs during recessions is driven by the increased marginal utility of government revenue, while the home country's retaliatory strategy is designed to

dissuade prolonged protectionism and restore free trade in the long run.

Trade policies target the extremes of the elasticity distribution. Protective tariffs are imposed on industries with low demand elasticity, as this raises revenue while protecting domestic producers. Retaliatory tariffs, on the contrary, are designed to maximize economic damage by focusing on elastic goods. When analyzing the broader effects of tariffs, it is essential to consider their selection across industries. This heterogeneity significantly influences welfare costs, and neglecting it can understate the true economic impact. Accounting for this variation suggests that actual welfare costs are likely higher, as higher elasticities imply greater deadweight losses.

Potential areas for further research include a detailed analysis of the distribution of elasticities. Expanding the focus beyond Canada's retaliation to include data from other trade partners, such as the European Union and Mexico, could provide a more comprehensive measure of the average elasticity interval, especially if the range of products covered varies significantly across these countries.

References

Amiti, M., Redding, S. J., and Weinstein, D. E. (2019). The impact of the 2018 tariffs on prices and welfare. *Journal of Economic Perspectives*, 33(4):187–210.

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *The American Economic Review*, 69(1):106–116.

Anderson, J. E. and van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, 93(1):170–192.

Arkolakis, C., Costinot, A., and Rodríguez-Clare, A. (2012). New trade models, same old gains? *American Economic Review*, 102(1):94–130.

Bagwell, K. and Staiger, R. W. (1999). An economic theory of GATT. *American Economic Review*, 89(1):215–248.

Boehm, C. E., Levchenko, A. A., and Pandalai-Nayar, N. (2023). The long and short (run) of trade elasticities. *American Economic Review*, 113(4):861–905.

Bown, C. P. (2016). Temporary trade barriers database. *The World Bank*.

Bown, C. P. and Crowley, M. A. (2013). Import protection, business cycles, and exchange rates: Evidence from the great recession. *Journal of International Economics*.

Bown, C. P. and Crowley, M. A. (2014). Emerging economies, trade policy, and macroeconomic shocks. *Journal of Development Economics*.

Broda, C., Limao, N., and Weinstein, D. E. (2008). Optimal tariffs and market power: The evidence. *American Economic Review*, 98(5):2032–65.

Broda, C. and Weinstein, D. E. (2006). Globalization and the Gains From Variety. *The Quarterly Journal of Economics*, 121(2):541–585.

Caliendo, L. and Parro, F. (2014). Estimates of the Trade and Welfare Effects of NAFTA. *The Review of Economic Studies*, 82(1):1–44.

Cavallo, A., Gopinath, G., Neiman, B., and Tang, J. (2021). Tariff pass-through at the border and at the store: Evidence from US trade policy. *American Economic Review: Insights*, 3(1):19–34.

Costinot, A. and Rodríguez-Clare, A. (2014). Trade theory with numbers: Quantifying the consequences of globalization. In *Handbook of international economics*, volume 4, pages 197–261. Elsevier.

Eaton, J. and Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, 70(5):1741–1779.

Eicher, T. and Osang, T. (2002). Protection for sale: An empirical investigation: Comment. *The American Economic Review*, 92(5):1702–1710.

Espinosa, C. (2022). The macroeconomic effect of modern protectionism. Working Paper.

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., and Khandelwal, A. K. (2020). The Return to Protectionism. *The Quarterly Journal of Economics*, 135(1):1–55.

Feenstra, R. C. (1994). New product varieties and the measurement of international prices. *The American Economic Review*, 84(1):157–177.

Feinberg, R. M. and Reynolds, K. M. (2006). The spread of antidumping regimes and the role of retaliation in filings. *Southern Economic Journal*.

Feinberg, R. M. and Reynolds, K. M. (2018). How do countries respond to anti-dumping filings? dispute settlement and retaliatory anti-dumping. *The World Economy*.

Flaaen, A., Hortaçsu, A., and Tintelnot, F. (2020). The production relocation and price effects of us trade policy: The case of washing machines. *American Economic Review*, 110(7):2103–27.

Goldberg, P. K. and Maggi, G. (1999). Protection for sale: An empirical investigation. *American Economic Review*, 89(5):1135–1155.

Grossman, G. M. and Helpman, E. (1994). Protection for sale. *The American Economic Review*, 84(4):833–850.

Grossman, G. M. and Helpman, E. (1995). Trade wars and trade talks. *Journal of Political Economy*, 103(4):675–708.

Head, K. and Mayer, T. (2014). Chapter 3 - gravity equations: Workhorse,toolkit, and cookbook. In Gopinath, G., Helpman, E., and Rogoff, K., editors, *Handbook of International Economics*, volume 4 of *Handbook of International Economics*, pages 131–195. Elsevier.

Johnson, H. G. (1953). Optimum Tariffs and Retaliation. *The Review of Economic Studies*, 21(2):142–153.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review*, 70(5):950–959.

Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics*, 9(4):469–479.

Lake, J. and Nie, J. (2023). The 2020 US presidential election and trump's wars on trade and health insurance. *European Journal of Political Economy*, 78:102338.

Markusen, J. R. and Wigle, R. M. (1989). Nash equilibrium tariffs for the united states and canada: The roles of country size, scale economies, and capital mobility. *Journal of Political Economy*, 97(2):368–386.

Ossa, R. (2014). Trade wars and trade talks with data. *American Economic Review*, 104(12):4104–46.

Ossa, R. (2015). Why trade matters after all. *Journal of International Economics*, 97(2):266–277.

Waugh, M. E. (2019). The consumption response to trade shocks: Evidence from the us-china trade war. Working Paper 26353, National Bureau of Economic Research.

A Appendix A: Proofs

A.1 Proof of Proposition 1

Proof. The Foreign government trades off the marginal benefit of protecting domestic producers with the costs of the tariff's deadweight loss:

$$\frac{\theta_s \partial \pi^*_{Fsj}}{\partial \tau^*_{sj}} + \frac{1}{2}\frac{\partial \tau^*_{sj} p^*_{Hsj} y^*_{Hsj}}{\partial \tau^*_{sj}} = 0$$

where the first term represents foreign producers' profits, while the second term captures the distortion of tariff revenue from Home exports. The derivative of domestic producers' gains with respect to tariffs, using the envelope theorem, is equal to the percentage change in domestic prices[15]*. This effect can be derived from the foreign price indices (8), (9), and (10), and depends on the upper layer of the Nested CES in equation (2):*

$$\frac{\theta_s \partial \pi^*_{Fsj}}{\partial \tau^*_s} = \frac{\theta_s z_{sj}}{1 + \omega^*_s \lambda_s}$$

where z_{sj} is defined as in the proposition. The second term, tariff revenue, can be computed from the Home counterpart of equations (6) and (7). It corresponds to the tariff's distortion, which the government aims to minimize:

$$\frac{1}{2}\frac{\partial \tau^*_{sj} p^*_{Hsj} y^*_{Hsj}}{\partial \tau^*_s} = -\left[\frac{\lambda_s(1+\omega^*_s)}{1+\omega^*_s\lambda_s}\right]\tau^*_{sj}$$

Combine both terms and solve for the tariff to get the final expression in the proposition. □

A.2 Proof of Proposition 2

Proof. By iterating on the value functions, retaliation and withdrawal can be expressed as:

$$V^k_b(\mathcal{S}) = -(ps_{sj} + cs_{b_{s'j'}}) - \frac{\beta}{1-\beta}\Big((ps_{sj} + cs_{b_{s'j'}})q + (ps_{sj} + cs_{n_{s'j'}})(1-q)p_n\Big)$$

$$V^w_b(\mathcal{S}) = -\frac{ps_{sj}}{1-\beta}$$

[15]In log-deviations, this corresponds to the percentage change in domestic prices. In absolute terms, it is the product of this change and the quantity.

Condition $V_b^k(\mathcal{S}) \geq V_b^w(\mathcal{S})$ requires:

$$p_n \leq \left[\frac{ps_{sj} + cs_{b_{s'j'}}}{ps_{sj} + cs_{n_{s'j'}}}\right] - \left[\frac{cs_{b_{s'j'}}}{ps_{sj} + cs_{n_{s'j'}}}\right]\frac{1}{\beta(1-q)}$$

Re-expressing in terms of the withdrawal probability:

$$(1 - p_n) \geq \left[\frac{cs_{n_{s'j'}} - cs_{b_{s'j'}}}{ps_{sj} + cs_{s'j'}}\right] + \left[\frac{cs_{b_{s'j'}}}{ps_{sj} + cs_{n_{s'j'}}}\right]\frac{1}{\beta(1-q)}$$

Provided $q < 1$, this defines the probability threshold at which retaliation becomes a dominant strategy. Denote this cutoff as $(1 - \tilde{p}_n) \in [0, 1]$. □

A.3 Proof of Proposition 3

Proof. Express the difference in the foreign value function as:

$$\Delta V_n^{k^*} = \theta_{sj}\pi^*_{F_{sj}}(\tau^*_{sj}) - z_{s'j'}\theta_{s'}\pi_{F_{s'j'}}(\tau^*_{sj})$$

where $z_{s'j'}$ is the ratio of Foreign's exports of product $s'j'$ to sector expenditure. Differentiating with respect to the tariff:

$$\frac{\partial \Delta V_n^{k^*}}{\partial \tau^*_{sj}} = \frac{\theta_s \partial \pi^*_{F_{sj}}(\tau^*_{sj})}{\partial \tau^*_{sj}} - z_{s'j'}\frac{\theta_{s'}\partial \pi_{F_{s'j'}}(\tau^*_{sj})}{\partial \tau^*_{sj}}$$

The derivative of domestic producers' gains with respect to tariffs is equal to the expression in Proposition 1. The derivative with respect to the profits of foreign competitors can be computed from equation (11), which is equal to $\lambda_{s'}$. Combining both effects, we get:

$$\frac{\partial \Delta V_n^{k^*}}{\partial \tau^*_{sj}} = \frac{\theta_s z_{sj}}{1 + \omega^*_s \lambda_s} - z_{s'j'}\theta_{s'}\lambda_{s'}$$

Rewriting this as:

$$\frac{\partial \Delta V_n^{k^*}}{\partial \tau^*_{sj}} = \frac{\theta_s z_{sj}}{1 + \omega^*_s \lambda_s} - z_{s'j'}\left(\Delta\lambda_{s'}\theta_{s'} + \Delta\theta_{s'}\lambda_s + \lambda_s\theta_s\right)$$

where the terms in differences are taken with respect to their counterpart in sector s'. Denote this derivative as $\Delta\tilde{V}_n^{k^*}$ such that cutoff $\tilde{\eta}$ is equal to:

$$\tilde{\eta} = \frac{1}{1 + \exp(\Delta\tilde{V}_n^{k^*})}$$

If $\Delta\lambda_{s'} > 0$ and $\Delta\theta_{s'} > 0$, $\Delta\tilde{V}_n^{k^*}$ is strictly decreasing in these arguments, lowering the cutoff for $\tilde{\eta}$. □

A.4 Proof of Proposition 4

Proof. Condition from Proposition 2 requires the withdrawal probability to be above the cutoff:

$$\left(\frac{1}{1 + \exp\left[\Delta V_n^{k^*}(z_{s'j'})\right]}\right) \geq 1 - \tilde{p}_n$$

From Proposition 3, rewrite this by express $\Delta V_n^{w^*}$ in terms of $z_{s'j'}$:

$$z_{s'j'} \geq \frac{1}{\theta_{s'}\pi_{F_{s'j'}}}\left[\theta_{sj}\pi^*_{F_{sj}} - \ln\left(\frac{1}{1-\tilde{p}_n} - 1\right)\right]$$

Denote the right hand side of this equation as $\tilde{z}$ such that $z_{s'j'} \geq \tilde{z}_{s'j'}$. Note that this is pinned down by the demand shocks, as $z_{s'j'}$ can be expressed as the ratio of expenditure shocks, $z_{s'j'} = d_{Fs'j'}/d^*_{Fsj}$. Given $d^*_{Fs'j'}$, there exists a cutoff such that:

$$\tilde{d}_{Fs'j'} = \inf\left(\max\{d_{Fs'j'}\} : z_{s'j'}\left(\max\{d_{Fs'j'}\}\right) \geq \tilde{z}_{s'j'}\right)$$

If $d_{Fs'j'}$ follows a CDF denoted by $F(\cdot)$, the share of countries retaliating is equal to:

$$\alpha = 1 - F(\tilde{d}_{Fs'j'})$$

where α is the portion of SOEs for which it is optimal to take this action. □

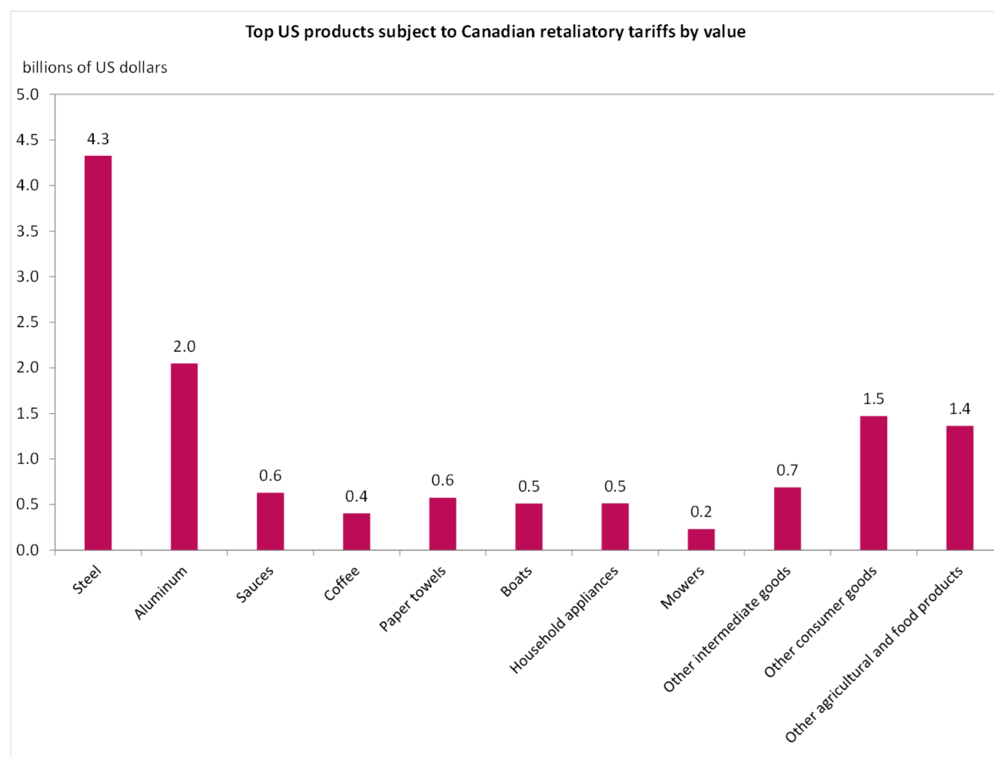
B Appendix B: Other Tables and Figures

B.1 Decomposition between protective and retaliatory tariffs

Series	Indicator	Coefficient	SE
Import tariffs	Contraction (levels)	6.1 (*)	3.49
	Contraction (probability)	0.09	0.08
Protective tariffs	Contraction (levels)	9.7 (***)	3.72
	Contraction (probability)	0.18 (**)	0.08
Retaliatory tariffs	Contraction (levels)	-2.6	2.66
	Contraction (probability)	-0.12	0.08

Notes: (***): $p < 0.01$, (**): $p < 0.05$, (*): $p < 0.1$. Standard errors are calculated using Newey West estimator with four lags. For efficiency reasons, time dummies are used to control for the tariffs of the top 5% upper tail. Results remain robust to their inclusion.

B.2 Retaliation decomposition by products



B.3 Event study decomposition