The Macroeconomic Effect of Modern Protectionism

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This paper estimates the dynamic effects of import tariffs on key macroeconomic aggregates in a small open economy. Due to the countercyclical profile of tariffs, the simultaneity between tariffs and GDP induces attenuation bias in the calculation of impulse response functions. To address this issue, we develop a novel instrument based on retaliatory tariffs, constructed from a database of temporary trade barriers. Retaliatory tariff rates are constrained by the World Trade Organization (WTO) to match those imposed by trade partners. The identifying assumption is that tariffs imposed by trade partners are orthogonal to the own economic activity shocks. Retaliation responds to a foreign partner's defection rather than to domestic economic conditions, allowing the identification of an exogenous import tariff shock using an SVAR-IV model. Our key findings are: (i) import tariffs are highly contractionary, with most effects occurring in the first year after the shock; (ii) the estimated effects exceed those obtained using standard timing restriction models; and (iii) the results are robust across various alternative specifications.

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1 Introduction

In recent years, policymakers have increasingly utilized commercial policy as a tool for macroeconomic management, rekindling debates among scholars about the dynamic aggregate effects of import tariffs.

However, estimating these dynamic effects poses significant challenges due to identification issues. A primary concern is the simultaneity between tariffs and economic activity: governments often raise tariffs during economic downturns as a way to generate revenue, a behavior known as countercyclical protectionism. This endogeneity implies that observed changes in tariffs are frequently responses to the same economic conditions that affect macroeconomic aggregates, making it difficult to isolate the causal impact of tariffs on the economy.

To address this issue, we develop a novel instrument that allows us to identify exogenous import tariff shocks by decomposing aggregate tariffs into their retaliatory and protectionist components. Retaliatory tariffs, driven by strategic motivations rather than economic conditions, serve as the exogenous variation in our analysis. By focusing on these tariffs, we can isolate the impact of tariff changes that are uncorrelated with domestic economic activity, thus overcoming the simultaneity bias introduced by countercyclical protectionism.

The instrument's validity rests on two conditions. First, retaliatory tariff rates are restricted by the World Trade Organization (WTO), which requires these rates to match those imposed by the trade partner. Second, we assume that the tariffs imposed by trade partners are orthogonal to the country's own economic activity shocks. Together, these conditions establish the exogeneity of the instrument.

Intuitively, the WTO regulations prevent the retaliatory rates from varying with domestic economic conditions. Furthermore, foreign tariffs are imposed for reasons that are unrelated to the country's own economic activity. Since retaliation is an action taken against a trade partner's defection, and after controlling for global shocks, retaliatory tariffs are less likely to be correlated with the country's economic fluctuations. Evidence for this is provided in the theoretical framework section of this paper.

To carry out the estimation, we focus on a small open economy, specifically Canada. Canada, being the largest small open developed economy and a leading user of protective tariffs,[1] provides a unique and insightful context for our study. Employing an SVAR-IV model, we use our instrument to compute the impulse responses of an import tariff shock on several key macroeconomic aggregates.

[1] A large economy can improve its terms of trade following tariff imposition, creating general equilibrium effects that complicate the estimation of tariff impacts. By focusing on a small open economy where terms of trade are exogenous and foreign prices remain unaffected, we achieve a cleaner estimation of tariff effects.

The importance of this paper is highlighted by the ongoing debates in both theoretical and empirical domains, where conclusive evidence remains elusive. Much of the existing literature concentrates on theoretical models or industry-level effects, with a noticeable scarcity of applications at the macroeconomic level. Notably, only a few recent studies—such as Barattieri et al. (2021) and Furceri et al. (2018, 2021)—have addressed this issue at the aggregate level. However, their methodologies face challenges related to identification and measurement, which our instrument addresses more effectively.

The limited number of empirical studies at the macroeconomic level partly reflects the difficulty of identifying real effects due to simultaneity, which biases standard estimations toward zero. The well-documented countercyclical relationship, highlighted by Bown and Crowley (2013, 2014), complicates the disentanglement of import tariff shocks that are uncorrelated with macroeconomic fluctuations.

Recent literature has addressed the identification problem by employing timing restrictions in Cholesky-identified models. For instance, Barattieri et al. (2021) estimates the effect on real GDP under the assumption that tariffs do not respond contemporaneously to changes in GDP, effectively assuming that the immediate feedback effect is zero. However, many of the impulse response functions (IRFs) in their analysis display muted effects.

The contribution of this paper to the literature is the construction of a novel instrument for identifying structural shocks. This approach accounts for the feedback effect between tariffs and economic activity, which timing restrictions may overlook. Utilizing this instrument and a unique dataset of Canadian tariffs that we construct, we find that the effects of import tariffs on macroeconomic aggregates are significantly larger than those reported in previous studies.

Historically, tariffs have been employed for various purposes: (i) to increase government revenue, (ii) to protect domestic industries from foreign competition, and (iii) for populist or ideological reasons. The first two motives often result in countercyclical policies, as governments raise taxes during recessions to compensate for revenue losses, and firms demand more protection during economic downturns.

To limit the use of tariffs, the General Agreement on Tariffs and Trade (GATT) has promoted free trade agreements, leading to a decline in custom-level import tariffs over the past two decades. Additionally, the World Trade Organization (WTO) has established a framework for temporary trade remedies in cases of dumping. However, the lack of stringent regulation has made temporary tariffs the preferred tool for policymakers to implement protectionism. Indeed, the majority of tariffs imposed since 2018 fall into this category. Appendix C.1 illustrates a clear trend: lower custom duties have been overtaken by higher temporary tariffs.

Temporary Trade Barriers (TTBs) involve substantial duties on a small selection of goods. In Canada, the affected products account for 2.2% of the quantity imported, representing 1.5% of the import share and approximately 0.4% of annual GDP. Despite their limited scope, they have significant propagation effects. As Handley and Limão (2017) points out, TTBs create high policy uncertainty that can dampen investment. Furthermore, a large share of these tariffs is imposed on essential intermediate inputs.

The process of imposing a new tariff requires the local industry to prepare an antidumping petition to local authorities. The government then initiates an investigation and imposes import duties if material injury to the domestic industry is found and estimated dumping margins are significant. An investigation typically takes around ninety days to complete.

The identification assumption made in Barattieri et al. (2021) relies on the premise that the time required for the domestic industry to gather information and prepare a formal petition typically exceeds ninety days. Therefore, they assume that tariffs do not respond contemporaneously to changes in GDP, effectively assuming that the immediate feedback effect is zero. However, this assumption is debatable, as it overlooks the possibility that protective tariffs can also be government-driven policies, and firms may expedite case preparations during economic turmoil.

Another concern is the metric used to proxy for temporary import tariffs. Following Bown and Crowley (2013), it is standard in the TTB literature to use the number of products involved in new antidumping investigations. This approach can be problematic when used as a proxy for tariffs in estimations, as the behavior between the two is dissimilar. In Barattieri et al. (2021), the product metric is employed to estimate the effect of temporary tariffs on Canada, finding that real GDP decreases by a small amount. This outcome could be attributed to a combination of feedback bias and the use of a metric different from actual tariffs.

Our paper directly addresses these issues by constructing a measure of temporary tariffs to analyze their aggregate effect. To the best of our knowledge, this is the first attempt to develop such a metric within the TTB framework. By employing the instrument in the SVAR-IV framework, we find that the identified impulse responses are larger, sharper, and more persistent than those found in the related literature. Thus, our study opens a new avenue in the literature by providing a methodology to identify exogenous effects more accurately.

The use of instrumental variables (IV) to address identification concerns is not new in the literature. For example, Furceri et al. (2021) concentrate on customs duties data, which are available only at annual frequencies. Using a panel of countries, they estimate the effect of these longer-term tariffs through the local projections method of Jordà (2005). Their instrument—the weighted average of tariff changes by the closest trading partners—yields IV results that are significantly larger (in absolute terms) than their baseline estimation.

However, a primary concern with their instrument relates to the exogeneity condition. During recessions, countries are more likely to engage in protective tariffs. In a global crisis, if every country is simultaneously increasing tariffs, their instrument could capture endogenous interactions rather than exogenous variation. In contrast, our instrument, based on retaliatory tariffs, involves responses taken against past actions of trade partners. Therefore, it avoids contemporaneous responses and is less likely to violate the exogeneity condition.

Our findings indicate that temporary tariffs can have more immediate and pronounced contractionary effects on GDP than previously documented in the literature. While studies like Furceri et al. (2021) have found significant negative impacts of tariffs occurring over longer horizons, our results suggest that these effects materialize more rapidly, within the first year after the shock. This implies that temporary tariffs may be more harmful in the short run compared to longer-term customs duties, highlighting the importance of considering the timing and nature of tariff policies in macroeconomic analysis.

Finally, some considerations must be taken into account when analyzing our results. Our study focuses exclusively on the effects of temporary trade barriers, as this is how modern protectionism is typically implemented. However, we have excluded non-tariff barriers from the analysis due to the difficulty of quantifying them in practice, given the scarcity of data. Therefore, our results should be interpreted with caution and considered a lower bound for the impact of protectionism, as non-tariff barriers can be more detrimental than traditional trade barriers.

This paper is structured as follows. Section 2 describes the empirical evidence and details the sources of information. Section 3 explains the theoretical framework, the identification strategy and instrument properties. Sections 4 and 5 present the results and their robustness, respectively. Section 6 concludes.

2 Empirical Evidence

Data

The main source of information is the Temporary Trade Barriers Database compiled by Bown (2016). This is a panel dataset of WTO member countries covering the period from 1980 to 2015. For each country, it details the newly opened antidumping, countervailing, and safeguards investigations.[2] This dataset includes details such as the date when investigations are opened, the products involved, the named (accused) country, the resolution, and any tariffs imposed. It also includes information about Dispute Settlement Unit (DSU) cases—legal complaints taken to the WTO to challenge tariffs imposed by member countries. These are useful for classifying retaliation events.

For Canada, the information is available from 1985, and of the 479 cases, 86% are antidumping investigations, 13% countervailing, and 1% safeguard investigations. The predominance of antidumping cases is consistent across countries (85%, 11%, and 4%, respectively). The data structure allows us to construct average tariffs at different frequencies.

The second source is standard macroeconomic data taken primarily from the Organization for Economic Co-operation and Development (OECD). This comprises series of real GDP, trade balance data, and core CPI at quarterly frequencies, used in the baseline estimation. The details for each of them are described in Appendix A. When merged with trade information, we obtain a database that runs from the first quarter of 1985 to the last quarter of 2015.

Investigation Process

Initiating an investigation involves a three-stage procedure. First, the local industry files a formal petition to the government. This is not public and requires the firms to gather evidence of dumping margins before presenting the case.

In the second stage, if the government decides to open an investigation, the process then becomes public. If so, government agencies have to assess the material injury to the local industry and the dumping margins of the foreign products. The average duration to reach an outcome is ninety days, but the government is entitled to impose preliminary duties in the early stages of the investigation.

Finally, if the investigation concludes that there is material injury and non-negligible dumping margins, final duties are imposed. These reflect the estimated dumping margins and are therefore forecastable. To control for anticipation effects, we use the date at which the investigation is opened. Lastly, if the imposed duty is significantly higher than the actual dumping margin, the counterpart can retaliate by applying countermeasure tariffs and start

[2] Antidumping investigations originate when a trading partner is dumping their exports, meaning that it is selling at prices that are "less than fair value." If so, the country is entitled by the WTO to start an investigation that eventually can end up with the imposition of antidumping tariffs. Countervailing cases are normally tied to antidumping investigations and involve duties applied on top of the antidumping ones when the foreign firm is being subsidized by its government. Finally, safeguards are temporary measures, such as tariffs or quotas, imposed to protect a domestic industry from an unforeseen surge in imports that is causing or threatening to cause serious injury.

a DSU complaint.[3] A short summary of the three stages is shown in Appendix C.3.

Import Tariffs

To construct an aggregate level of tariffs, we consider those that are expressed in ad valorem terms, as this allows for a normalized metric across different types of goods. We use constant import share weights to aggregate these at quarterly frequencies (see Appendix A for methodology). A key feature of these temporary tariffs is that they entail strong propagation effects, either through policy uncertainty or through the goods on which they are placed. Table 1 describes the first of these channels.

Table 1: Temporary Tariffs Statistics

Variable	Obs.	Mean	Median	Std. Dev.	Min	Max
Average Tariff (%)	413	33	32	22	2	162
Periods in Place (quarters)	413	20	21	20	0	120

The average tariff is 33.4%, and the standard deviation is 22.3%, implying that large duties are imposed on these types of goods. Moreover, they remain in place for a long time, as the average duration is 20 quarters. The standard deviation, being the same as the mean, implies that some tariffs can remain in place for up to 10 years. As highlighted by Handley and Limão (2017), trade uncertainty can delay investment and ultimately affect GDP.

The nature of the goods subject to tariffs provides another mechanism for analysis. To explore this aspect, we examine the products affected by tariffs in each investigation case. Table 2 presents the relevant statistics:

[3] One can think of retaliatory tariffs as a reaction function of the form: $RT_t = \Lambda\left(T^*_{t-1}(Y^*_{t-1}) - DM_{t-1}\right)^{\lambda}$. Here, the foreign tariff T^*_{t-1} could depend on the cyclical condition Y^*_{t-1}. If the tariff imposed by the trading partner in the previous period is significantly different from the original dumping margin, the home country could impose retaliatory tariffs. For example, Canada could decide to protect the lumber industry by raising duties by 20% against the U.S. If they reply with countermeasure tariffs of 60%, Canada could then apply retaliatory tariffs and take the case to the WTO. Something similar occurred during the Softwood Lumber trade war between these two countries.

Table 2: Temporary Tariffs by Type of Good

Type of Good	Share of Products (%)	Tariff Rate (%)
Capital goods	2	29
Consumption goods	14	38
Intermediate goods	84	36

Intermediate inputs account for 84% of products involved under these investigation cases and have the second-highest average tariff rate. This poses an important channel through which tariffs affect GDP, as many of them are placed on key inputs of the production function. These higher costs spread to the rest of the economy, entailing a powerful propagation mechanism. These factors, together with policy uncertainty, constitute the two channels through which GDP is affected.

The remaining products are divided between consumption and capital goods, though these categories represent a smaller share of the total. Notably, consumption goods face the highest applied tariff rates, albeit only marginally higher than those imposed on intermediate inputs.

Tariffs vs. Product Measure

The literature has used the number of products (at the 6-digit level) involved in each investigation as a metric when analyzing temporary barriers. For instance, Bown and Crowley (2013) used this to depict the countercyclical relationship, and Barattieri et al. (2021) to analyze the effect on GDP. Figure 1 compares these two measures at annual frequency.

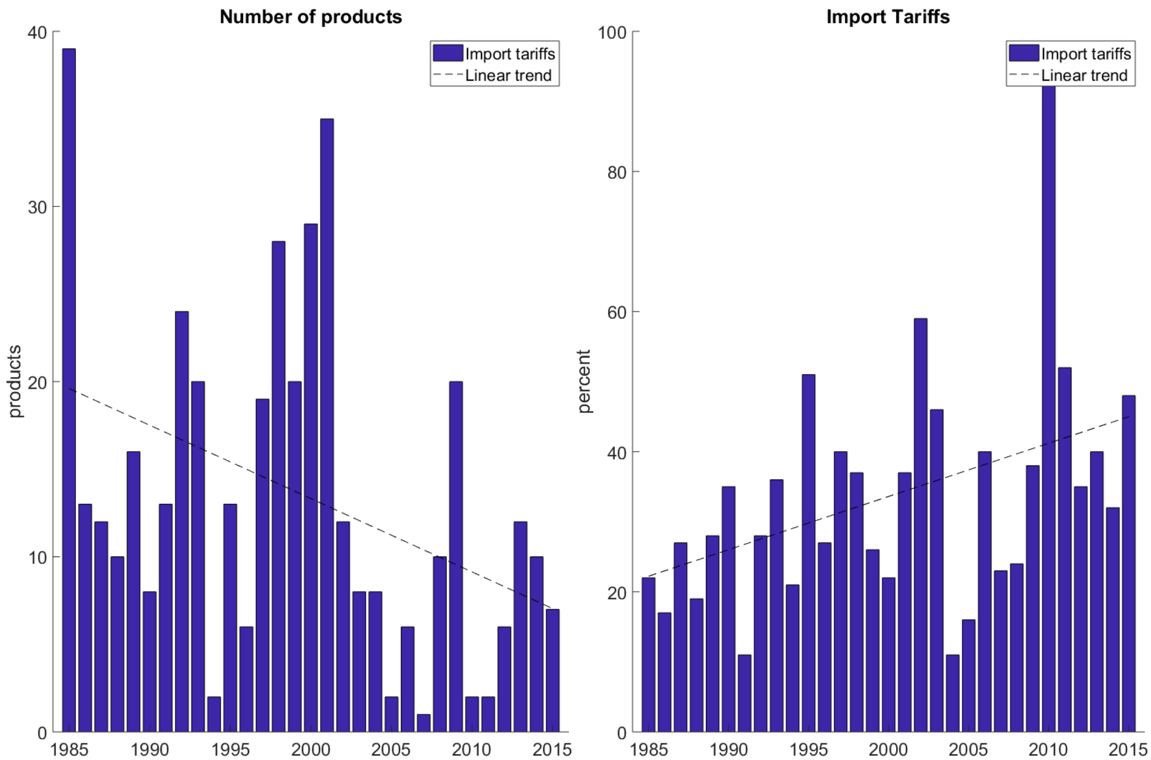

Figure 1: Product Measure vs. Import Tariffs

Both series contrast sharply; while the number of products has a significant decreasing trend over time, tariffs exhibit the opposite behavior. In effect, higher tariffs are being placed on fewer products, or in other words, the tariffs-to-product ratio has increased over time. Thus, this measure alone hides much of the tariff behavior and, consequently, is not a good proxy to use in the estimations.

Countercyclical Tariffs

To address the countercyclical relationship between tariffs and GDP, we focus on the two crises that Canada experienced during the period of analysis: the debt crisis of the early 1990s and the Great Financial Crisis. The left panel of Figure 2 shows the cyclical component of GDP (taken from the OECD), with the crisis periods highlighted in gray. The right panel analyzes the evolution of tariffs around the start of the contraction, labeled as period zero.[4] Each bar represents the average tariff in each of these quarters.

[4] The dates taken as the beginning of the contraction are the first quarter of 1990 and the third quarter of 2008.

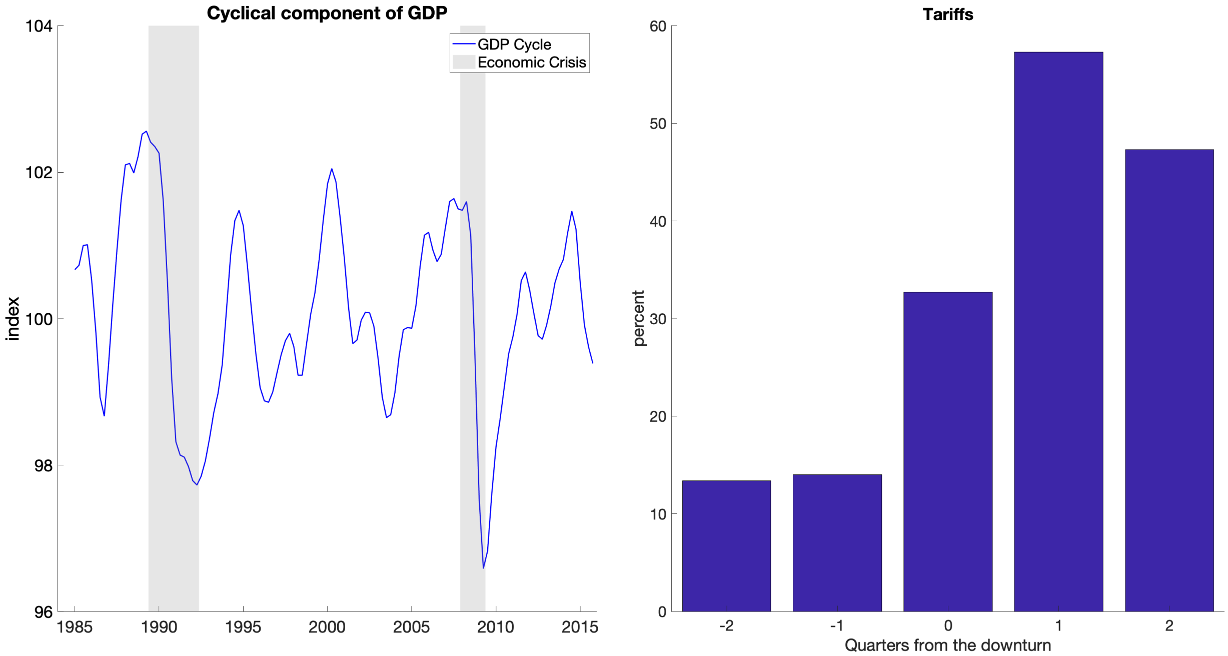

Figure 2: Endogenous Tariffs

The evolution of tariffs evidences a strong step profile from the start of the downturn. In particular, it is the 20 percentage point sharp rise at $t = 0$ that threatens the contemporaneous exogeneity assumption. This endogenous pattern of tariffs is consistent with the countercyclical behavior of the product metric that has previously been put forward in the literature.

Retaliatory Tariffs

Retaliatory tariffs are constructed by classifying each of the investigations as retaliatory or not. For this, we follow the definition outlined in the trade literature, particularly by Feinberg and Reynolds (2006, 2018). They define retaliation as an action taken no longer than a year from the original tariff rise, consistent with the view that retaliation, as punishment, has to take place shortly after the defection.

Another feature is that it is taken against a past action. As highlighted in Feinberg and Reynolds (2018), a tariff raised against another in the same period is more likely to be retaliation against a past duty than a response to the current one. This is reflected in the data, as around 80% of Canadian retaliation is carried out on a sector different from the one originally targeted (e.g., Canada retaliates in metals in response to a U.S. agricultural tariff). This suggests that retaliation is mainly a government-driven policy in which products are carefully chosen. As such, it takes time to decide where and how much to retaliate.

Examples of this are numerous. During the Canada vs. China trade war, China imposed tariffs on cellulose pulp in the first quarter of 2013. A quarter later, Canada levied duties on copper tubes imported from China. However, the bulk of the retaliation came later, when antidumping and countervailing duties were raised on solar panels, along with a formal complaint at the WTO DSU. More recently, the U.S. imposed steel tariffs in the first quarter of 2018. Canadian retaliation materialized during the next quarter on several consumption goods. Finally, a formal complaint was taken to the WTO in the third quarter of 2018.

If we allow for retaliation during the same period, this would only add 15% more observations. More importantly, these neither represent nor contribute a large share of aggregate retaliatory tariffs. Appendix C.2 shows how these change when adding the same-quarter observations. Moreover, our results remain robust to this alternative definition, suggesting that, in effect, retaliation is against past actions.

In practice, to classify these patterns in the data, we check which of the Canadian investigations are challenging a trading partner's duty levied between the previous quarter and a year ago. In addition, if there is a dispute in place, that window is expanded by an additional year. Table 3 shows how the constructed retaliatory tariffs compare to their protectionist counterparts in terms of level and periods in place.

Table 3: Retaliatory and Protectionist Tariffs Statistics

Type of Tariff	Obs.	Mean	Median	Std. Dev.	Min	Max
Protectionist Tariffs (%)	348	34	32	22	2	162
Protectionist Period (quarters)	348	23	22	22	0	85
Retaliatory Tariffs (%)	65	31	22	23	8	127
Retaliatory Period (quarters)	65	12	4	14	2	120

On average, while protectionist tariffs remain for almost six years, retaliatory ones stay in place for half that time. In terms of duties, protectionist tariffs are only 3 percentage points higher than retaliatory ones and share the same standard deviation. The latter explains 20% of the average aggregate tariff. Furthermore, Figure 3 disentangles both tariffs by type of good.

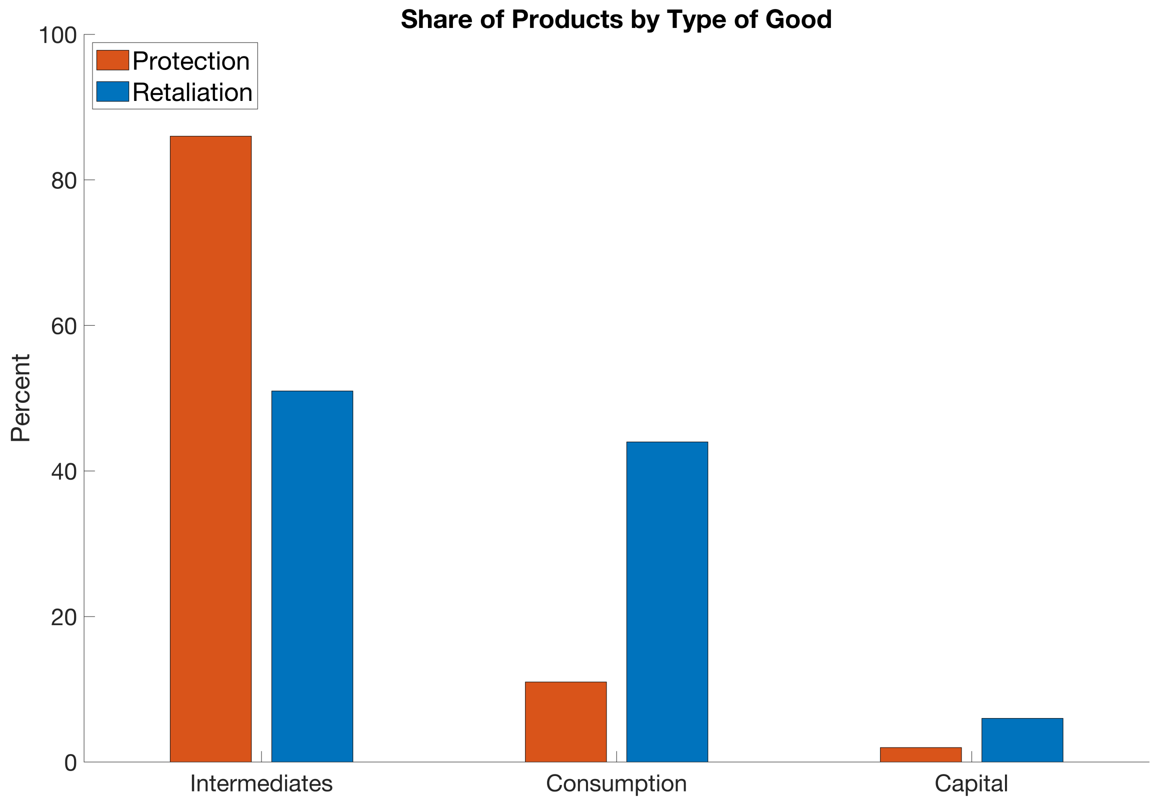

Figure 3: Retaliatory vs Protectionist Tariffs

The two profiles contrast sharply depending on whether tariffs are imposed for retaliatory purposes or not. The share of consumption goods subject to retaliation is 44% of the products involved in these cases. This represents an increase of 30 percentage points with respect to the protectionist case. This substitution is explained by a drop in the share of intermediate inputs, which changed from 86% to 51% of the cases. This implies that when countries retaliate, they choose to do so on a larger share of consumption goods relative to protection.

Finally, using retaliatory tariffs as an exogenous variation requires both types of tariffs to be similar in terms of tariff rates. As shown in the tables, average duties are close between these two groups. The null hypothesis for a test that both means are equal is not rejected. This is explained by the standard deviation of each of the protectionist and retaliatory components. This means that the average tariff rate is not heterogeneous depending on whether the country is carrying out protectionism or not.

3 Theoretical Framework

Consider the following structural VAR (SVAR) of the form:

$$A_0 Y_t = A(L) Y_t + \varepsilon_t, \tag{1}$$

where Y_t is an $n \times 1$ vector of observables, A_0 is a nonsingular $n \times n$ matrix of structural parameters governing the simultaneous relationships between the variables, and ε_t is an $n \times 1$ vector of structural (latent) shocks with $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_t') = I_n$, $E(\varepsilon_t \varepsilon_s') = 0$ for $t \neq s$, where I_n is the identity matrix of dimension n. The matrix polynomial $A(L)$ represents the lag structure of order p. The identification of a column of A_0^{-1} requires further assumptions, which are relevant for the analysis of impulse response functions (IRFs) and the forecast error variance decomposition (FEVD).

To identify the effect of a particular shock, one can impose additional sets of restrictions using proxies for the latent shock of interest. Following Mertens and Ravn (2013) and Stock and Watson (2012, 2018), suppose that we have a single instrument Z_t satisfying the following conditions:

$$E(Z_t \varepsilon_{1t}) = \gamma \neq 0, \tag{2}$$

$$E(Z_t \varepsilon_{2:n,t}) = 0, \tag{3}$$

Where ε_{1t} is the shock of interest (assumed to be the first element of ε_t), and $\varepsilon_{2:n,t}$ contains the remaining structural shocks. Equation (2) is the *relevance condition*, which requires that the instrument is correlated with the shock of interest, while equation (3) is the *exogeneity condition*, which requires that the instrument is not correlated with the other structural shocks. This condition requires two further assumptions:

$$Z_t = \lambda T_t^*(Y_t^*),$$
$$0 = E(T_t^*(Y_t^*) \times \varepsilon_{2:n,t})$$

The first assumption is that the retaliatory response is regulated by the WTO. Therefore, tariffs are required to be proportional to those imposed by the trade partner, T_t^*. In the context of the WTO, reciprocal retaliation implies $\lambda = 1$.

The second assumption is that $T_t^*(Y_t^*)$, which depends on the foreign country's GDP, is orthogonal to Canada's economic activity shocks. That is, the reasons motivating the imposition of tariffs in the foreign country are unrelated to Canada's business cycle. In other words, after controlling for global shocks, the business cycle correlation between the two countries is assumed to be zero. If these conditions are satisfied, the instrument identifies the effect of an exogenous shock, ε_{1t}.

Simultaneity

Consider the SVAR model in equation (1). For illustrative purposes, assume a bivariate VAR to estimate the effect of import tariffs (T_t) on GDP (y_t). It is important to note that our interest lies in the effect that Canadian tariffs have on their own economy. While this effect depends on trading partner tariffs (T_t^*) and GDP (Y_t^*), these can be controlled for later in the VAR structure. Furthermore, and without loss of generality, assume that there are no dynamics, so the model can be represented as follows:

$$Y_t = A_0^{-1}\varepsilon_t \quad \Leftrightarrow \quad \begin{pmatrix} T_t \\ y_t \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} \varepsilon_{T,t} \\ \varepsilon_{y,t} \end{pmatrix}. \tag{4}$$

In this example, coefficient c captures the effect of a structural shock to tariffs on GDP. The direction of this effect is *a priori* uncertain and is the focus of this paper. Theory does not provide a clear prediction: on one hand, tariffs induce *expenditure switching* towards local production, which could stimulate GDP. On the other hand, *expenditure changing* implies that a larger share of expenditure is spent on foreign goods, lowering real income and ultimately decreasing GDP. Thus, the short-run effect is uncertain and depends on the relative strength of these two forces. Since theory is inconclusive, we rely on empirical evidence to determine the direction of this parameter.

The estimation requires dealing with intrinsic simultaneity bias. The effect of a shock to GDP on tariffs is captured by coefficient b. Unless $b = 0$, any standard OLS regression would be biased due to this contemporaneous relationship. There is ample evidence in the trade literature that this parameter is negative: protective tariffs are raised in periods of economic contraction. This has been documented by Bown and Crowley (2013, 2014) and previously by Prusa and Skeath (2008). This negative relationship implies that the estimation of c is biased towards zero and, consequently, the IRF's impact effect of a tariff shock is underestimated.

Traditionally, the SVAR literature has addressed the identification problem by imposing timing restrictions. For example, Barattieri et al. (2021) employs a recursive Cholesky-identified VAR in which GDP does not affect tariffs contemporaneously. This is equivalent to imposing that $b = 0$, and consequently ignores the negative relationship.

A less restrictive approach is to find an external instrument for the import tariff shock. In practice, the exogeneity condition requires that the instrument is not driven by economic motivations and is therefore unrelated to the stage of the business cycle. On the other hand, the relevance condition can be tested through the first-stage F-statistic of the IV estimation. Typically, values higher than 10 are evidence of a strong instrument,[5] indicating that the instrument is sufficiently correlated with the endogenous variable.

The estimation follows from equation (1), which applied to this example, it reduces to two equations:

$$
\begin{aligned}
E(Z_t u_{T,t}) &= a\, E(Z_t \varepsilon_{T,t}) + b\, E(Z_t \varepsilon_{y,t}), && (5)\\
E(Z_t u_{y,t}) &= c\, E(Z_t \varepsilon_{T,t}) + d\, E(Z_t \varepsilon_{y,t}). && (6)
\end{aligned}
$$

Normalizing $a = 1$, dividing equation (6) by equation (5), and noting that the last terms in both equations are zero, given the exogeneity condition, $E(Z_t \varepsilon_{y,t}) = 0$, yields an unbiased estimator of:

$$\hat{c} = \frac{E(Z_t u_{y,t})}{E(Z_t u_{T,t})}. \tag{7}$$

Retaliation Instrument

Early contributions in the trade literature, particularly Prusa and Skeath (2002) and Prusa and Skeath (2008), have established the idea that motivations for temporary trade barriers can be classified into two groups: economic or strategic. The former includes the endogenous filing pattern described so far: protective duties imposed as a consequence of poor economic performance or trade imbalances.[6]

Strategic motivations, on the other hand, exhibit a profile closely related to deterrence purposes. A key concept embodied by these is retaliatory behavior, defined as the action of challenging a tariff that was imposed by a trading partner in the recent past. The idea, bolstered by Blonigen and Bown (2003), is that countries punish a trading partner's deviation to achieve reductions in trade protection, constituting a mechanism towards the restitution of a free trade equilibrium. This punishment takes the form of countermeasure tariffs or a legal complaint to the WTO. These studies have also shown that such actions have a strong Tit-for-Tat component, meaning that the punishment remains until the protective duty is removed.

These patterns can help classify each tariff in the data as retaliatory or not, a methodology explained in the next section. Then, aggregate tariffs can be decomposed as a weighted average between retaliatory and protectionist tariffs:

$$T_t = \alpha\, RT_t + (1 - \alpha)\, PT_t, \tag{8}$$

[5] Traditionally known as the Staiger and Stock (1997) "rule of thumb."

[6] For instance, an import surge that abruptly decreases the trade balance.

where RT_t are the aggregate retaliatory tariffs, PT_t are protectionist tariffs, and α represents the share of retaliatory tariffs. Further, following Stock and Watson (2018) and Caldara and Herbst (2019), the series of retaliatory tariffs can be expressed as a function of present and past shocks:

$$RT_t = \alpha\varepsilon_{T,t} + \sigma_\eta \eta_t + f(\varepsilon_{t-1}, \varepsilon_{t-2}, \ldots), \tag{9}$$

where η_t is an i.i.d. measurement error, and $f(\cdot)$ denotes a linear combination of past structural shocks. Essentially, the instrument is related to the structural shock by an amount proportional to its share of total tariffs, α, in this case, equal to 20%. Nevertheless, the structural shock is observed with random noise, η.[7] The vector of past shocks, ε_{t-1}, includes variables such as T_{t-1}, Y_{t-1}, and could also include T^*_{t-1}, the challenged tariff.

In this definition, the exogeneity condition is implicit, as $\varepsilon_{y,t}$ does not appear inside the function $f(\cdot)$. Thus, we assume that the instrument is not a function of the contemporaneous business cycle shock. For the relevance condition, the first-stage F-statistic is a function of what Mertens and Ravn (2013) calls the *reliability indicator* (or *relevance* in Caldara and Herbst, 2019). This is the squared correlation between the instrument and the import tariff shock, which can be written as:

$$\rho \equiv \text{corr}^2(\varepsilon_{T,t}, RT_t) = \frac{1}{1 + \left(\frac{\alpha\sigma_{\varepsilon_{T,t}}}{\sigma_\eta}\right)^{-2}}, \tag{10}$$

where $\left(\frac{\alpha\sigma_{\varepsilon_{T,t}}}{\sigma_\eta}\right)$ is the signal-to-noise ratio. Intuitively, the first stage aims to isolate the measurement error from the estimation. The ability to do so rests on the strength of the signal-to-noise ratio. If the measurement error is low (high) compared to the signal, the first-stage F-statistic would be high (low), and consequently, the instrument would be strong (weak).

Instrument Conditions

The exogeneity condition requires the instrument to be uncorrelated with structural shocks other than the import tariff shock. While this assumption is not directly testable—since shocks are latent variables—we can motivate it by showing that the instrument is uncorrelated with the stage of the business cycle. Figure 4 replicates the right panel of Figure 2, but disentangles between retaliatory and protectionist tariffs.

[7] This is a key feature of the SVAR-IV literature, as it assumes that in practice, one does not observe structural shocks directly. This contrasts with the narrative approach proposed by Romer and Romer (2010), where the instrument is treated as the true shock, a stronger assumption.

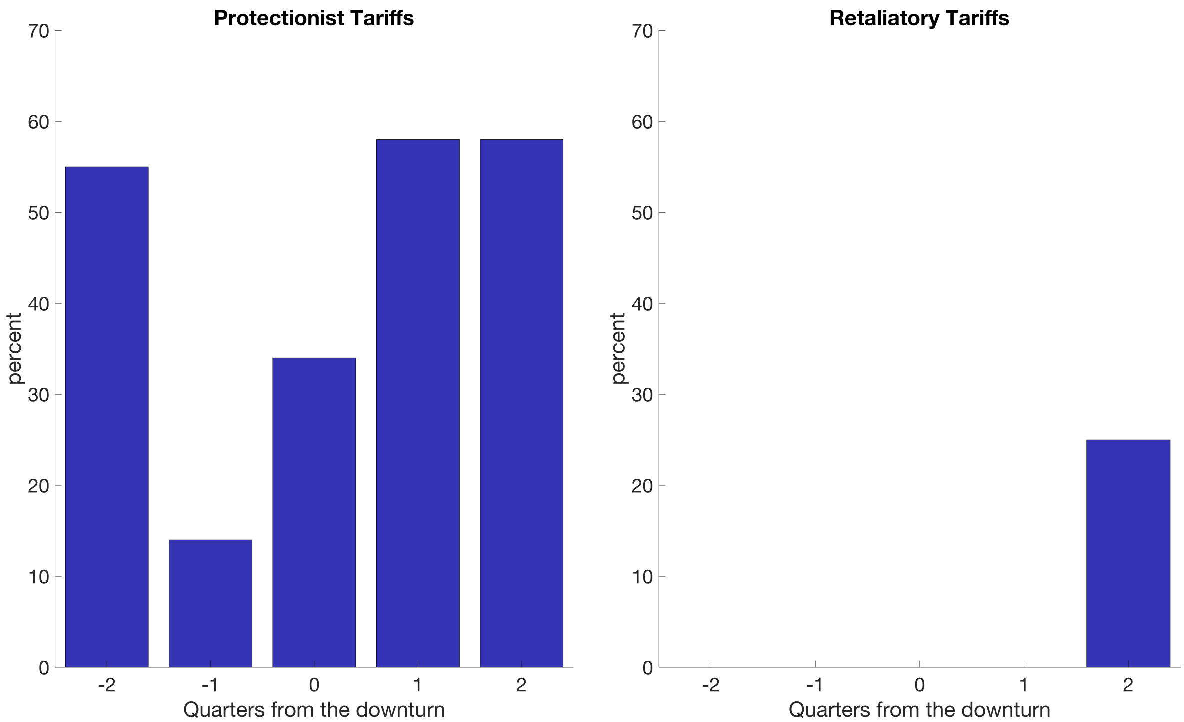

Figure 4: Retaliatory vs Protectionist Tariffs Cyclical Behavior

The two profiles contrast sharply. While protectionist tariffs exhibit the same step profile as the aggregate tariffs, retaliatory tariffs do not follow any particular pattern. This suggests that the endogenous countercyclical profile is inherited by the protectionist component only, as retaliatory actions do not react to adverse economic shocks.

This result is partly explained by the fact that during the Great Financial Crisis, Canada engaged in protective measures, but all of them were protectionist. This could be because retaliating might have triggered a trade war, a scenario with costly consequences, especially during a period of crisis.

Although these periods of crisis were chosen for illustrative purposes, we can also analyze tariff behavior beyond these two episodes. For this, we use a dummy indicator from the OECD that identifies Canadian-dated recessions. In this definition, a contraction covers the period from the peak to the trough, dividing the business cycle into expansions and recessions.

To further explore this relationship, we run a simple regression of import tariffs on this dummy indicator. Two versions are reported: an OLS regression with the tariff level and a Probit model with the dependent variable being an indicator of whether a tariff is imposed in a given quarter. These provide an overview of the intensive and extensive margins, respectively. Table 4 reports these results.

Table 4: Retaliatory vs. Protectionist Tariffs

Series	Indicator	Coefficient	SE
Tariffs	Contraction (level difference)	6.1 (*)	3.49
	Contraction (marginal effect)	0.09	0.08
Protectionist Tariffs	Contraction (level difference)	9.7 (***)	3.72
	Contraction (marginal effect)	0.18 (**)	0.08
Retaliatory Tariffs	Contraction (level difference)	-2.6	2.66
	Contraction (marginal effect)	-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 in the top 5% upper tail. Results remain robust to their inclusion.

These results reinforce the hypothesis that protectionist tariffs are responsible for the countercyclical profile. On average, tariffs are 6 percentage points higher in contractions relative to expansions, representing a third of the expansion reference level. Regarding the extensive margin, there is no evidence that more tariffs are placed during recessions. This is entirely explained by the protectionist component, as they increase by almost 10 percentage points during contractions, representing 70% of the expansion level. Additionally, it is 18% more likely to impose duties during these periods; both margins are statistically significant.

In contrast, retaliatory tariffs do not respond to the stage of the business cycle. In fact, they are almost 3 percentage points lower in recessions, although this difference is not statistically significant. A similar conclusion is reached when analyzing the extensive margin.

These results remain robust when including the controls used in the baseline SVAR. In addition, we assess predictability concerns using Granger causality tests, something common in the SVAR literature, although it does not address contemporaneous exogeneity.[8] These results, shown in Appendix B, reveal that the protectionist tariff level is predicted by GDP lags, while retaliatory tariffs are not. All this evidence suggests that retaliatory tariffs do not respond systematically to changes in economic conditions, supporting the exogeneity condition of the instrument.

Finally, and importantly, retaliation—as defined against a past tariff rise—means that it does not respond contemporaneously to foreign tariff shocks. If a trading partner imposes

[8] For instance, this is common in the tax shocks literature. Examples are found in Romer and Romer (2010) and Cloyne (2013).

protective measures due to slow economic conditions, and if the business cycles are correlated, the differences in timing prevent the exogeneity condition from being violated.

To test the relevance condition, we assess the F-statistic of the first stage. This involves a regression of the reduced-form tariff residuals on the instrument. Table 5 reports different methods of computing the F-statistic and compares them to critical values to test the hypothesis of weak instruments.

Table 5: First-Stage F-Statistics

Methodology	F-Statistic
Kleibergen-Paap	44.23
HAC SE	20.86
Montiel Olea-Pflueger	20.99

The first is the Lagrange Multiplier Kleibergen and Paap (2006) *rk* statistic, robust to non-i.i.d. errors, with a value of 44.23. The second is the F-statistic from the first stage computed using Newey-West HAC standard errors, with a value of 20.86. Finally, the Olea and Pflueger (2013) statistic shows a value of 20.99.

All of these statistics are above the suggested rule-of-thumb threshold of 10 and also exceed the Stock and Yogo (2005) weak IV test critical value of 16, indicating that the instrument satisfies the relevance condition. [9]

4 Results

The baseline model is a four-dimensional SVAR-IV with $Y_t = [T_t, \ln(y_t), tby_t, \ln(P_t)]'$. Here, T_t represents newly imposed temporary tariffs, while the remaining variables are detrended series: the logarithm of real GDP, $\ln(y_t)$; the real trade balance to GDP ratio, tby_t; and the logarithm of core CPI, $\ln(P_t)$.[10] This specification is similar to the VAR used by Barattieri et al. (2021), which allows us to compare our results. The sample comprises quarterly data from 1985 to 2015, and $A(L)$ is a second-order lag polynomial chosen based on the Akaike Information Criterion (AIC).[11]

[9] This value is calculated using a significance level of 5% and a maximal relative bias of 10% between IV and OLS, which is standard in the literature.

[10] The decision to use core CPI over CPI follows Barattieri et al. (2021). They argue that the former is more appropriate as there are no tariffs placed on energy goods.

[11] Other information criteria, such as BIC and HQ, also suggest the use of two lags. Although for quarterly data it is standard to use four lags, we follow the information criteria to prioritize efficiency. Nevertheless, we run the model with four lags in the robustness section.

The impulse responses are obtained by simulating a one standard deviation import tariff shock over a forecast horizon of 12 quarters.[12] We report 68% and 90% confidence intervals, which, as in Mertens and Ravn (2013), are computed using a recursive wild bootstrap with 10,000 replications. Figure 5 shows the responses for each of the variables.

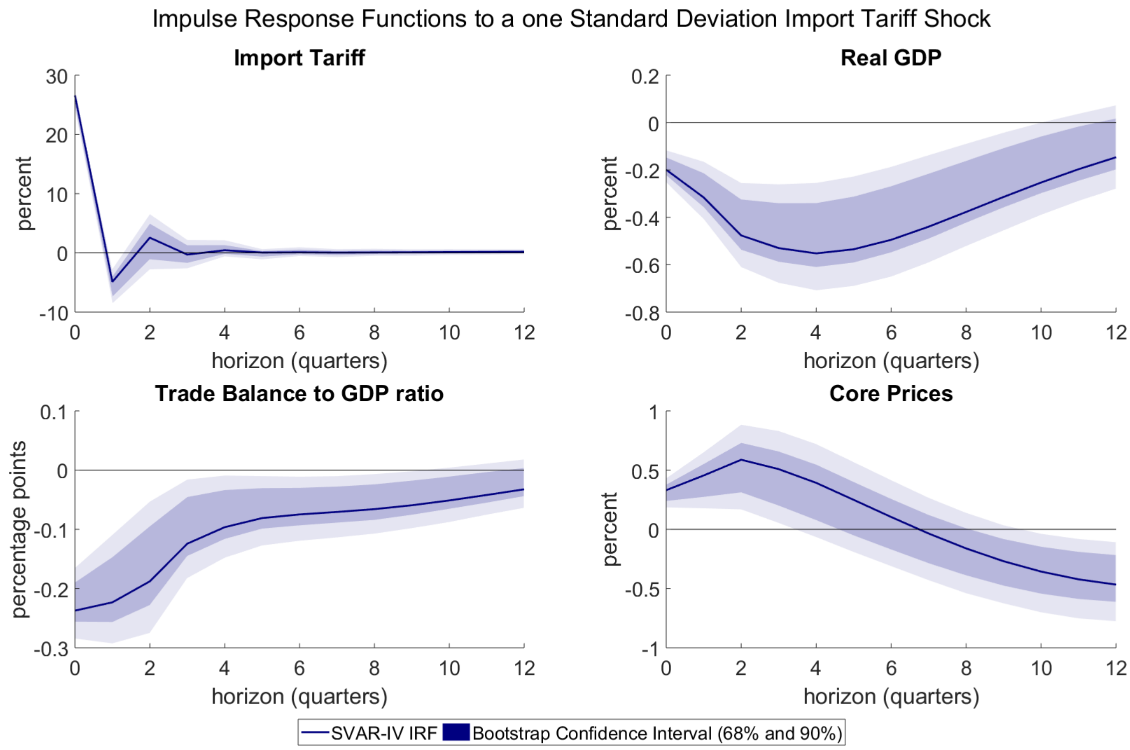

Figure 5: Import Tariff Shock Impulse Responses

A transitory one standard deviation shock, equivalent to a tariff rise of 28%, produces an immediate real GDP drop of 0.2%, indicating that the *expenditure-changing* effect dominates. The response is persistent, with the peak level reached in the fourth quarter after the shock, declining to -0.55%, and slowly returning to its original level in subsequent periods. The trade balance experiences a significant drop of -0.24 percentage points (pp) on impact, which is slowly reversed in the following quarters. This is consistent with anticipation behavior, as agents internalize the opening of an investigation as a future tariff rise and therefore import more today. Finally, annual inflation rises to 0.33% on impact, peaks at 0.59% in the second quarter, and decays rapidly afterward. This result stems from the fact that a share of the tariffs are placed on final goods.

[12] The standard deviation normalization implies re-scaling the identified column of the A_0^{-1} inverse matrix by the standard deviation of the identified shock.

Comparison with the Literature

The direct sources for comparison are Barattieri et al. (2021) and Furceri et al. (2021). The focus will be on real GDP and the trade balance, as they are part of their baseline specifications as well.[13] Our results are larger and more persistent than those of Barattieri et al. (2021), and closer to the IV estimation of Furceri et al. (2021), but occurring in the short run. Table 6 reports the impact effects, the peak levels, and the quarters in which they occur for both series under each methodology. For comparison, we consider up to the third year of the forecast horizon of Furceri et al. (2021) results.

Table 6: Comparison with the related literature

	Panel A: GDP			Panel B:Trade balance		
Methodology	Impact	Peak	Quarter	Impact	Peak	Quarter
Baseline results	-0.20 (*)	-0.55 (*)	4	-0.24 (*)	-0.24 (*)	**0**
Baratieri et al.	0.02	-0.12 (*)	2	0.03	0.08	4
Furceri et al. OLS	0.05	-0.24	12	-0.10	-0.10	0
Furceri et al. IV	0.39 (*)	-0.59	12	-0.27	-0.27	0

Notes: (*): $p < 0.01$. This is the only significance level available in the literature.

Our GDP results are larger and more persistent than those reported in Barattieri et al. (2021). Their impact effect is 0.02%, and the peak level of -0.12% occurs in the second quarter, quickly dying out thereafter. Compared to Furceri et al. (2021), our results are similar in magnitude to their IV estimation but with peaks occurring in the short run, during the first year after the shock. Their impact effect is positive, and the peak levels are experienced in the third year after the shock, being -0.24% and -0.59% for the OLS and IV IRFs, respectively. It is important to note that at these forecast horizons, the IRFs are not significant, but this changes from the fourth year onward (not considered here). It is also important to highlight the sharp difference in the impact effect: while in both papers these are positive, ours is negative and significant.

The trade balance effect in both papers is insignificant. In Barattieri et al. (2021), the impact effect is positive and remains at a relatively flat level of 0.05 pp for the remaining periods. For Furceri et al. (2021), however, the impact effect (and also the peak levels) of both OLS and IV estimations are negative, -0.10 and -0.27 pp, respectively. The deterioration

[13] In terms of the sample, Barattieri et al. (2021) use the same database and country as we do, but they do not have tariff data, so their IRFs are based on a one standard deviation shock to the number of products involved in a new investigation. Furceri et al. (2021), on the other hand, focus on a panel of countries and consider tariff data; however, these are of lower frequency (annual data) and of longer term. Their IRFs are simulated as a standard deviation shock with a forecast horizon of up to five years.

of the trade balance in the short run is consistent with our results, though they do not identify the strong anticipation pattern that we find in the data. This can be attributed to differences in the tariffs used in the analysis.

Finally, two concerns arise for each of these papers. The first involves the robustness of Barattieri et al. (2021)'s results. We have shown that the product measure is not a good proxy for import tariffs. This is reflected when replicating their results using that variable in our framework, as the IRFs are no longer significant.[14] The result remains unchanged to variations in the lag structure.

Second is the possibility that the instrument employed in Furceri et al. (2021) violates the exogeneity condition. Using the weighted average of tariff changes of the closest trading partners implies that during periods of economic crisis, the instrument would capture endogenous interactions. As countries are more likely to engage in protective policies, the exogeneity between tariffs and GDP is broken. This is exemplified by the Great Financial Crisis, where only protective tariffs were raised. In contrast, our instrument only considers the exogenous component of tariffs and therefore does not account for these episodes. Even if that is not the case, since retaliation is defined against past actions, the contemporaneous exogeneity assumption is still not violated.

Transmission Mechanisms

We can also explore the responses of other macroeconomic variables that can explain the dynamics of the previous results. For example, Barattieri et al. (2021) stress that real exchange rate (RER) appreciation prevents the trade balance from improving. They also argue that short-term interest rates reflect the central bank's reaction to higher inflation. On the other hand, Furceri et al. (2021) explore the labor market, particularly the roles of productivity and unemployment. Additionally, we examine the responses of two macroeconomic aggregates: investment, given that a share of tariffs are placed on capital goods, and private consumption.

Figure 6 plots the impulse responses of a tariff shock on detrended series of the logarithm of the RER (an increase indicates a local currency appreciation), labor productivity (real GDP per employed worker), investment, and private consumption. In addition, we use the overnight market rates to analyze the short-run interest rate, and the unemployment rate to assess the labor market.

[14] The specification used is a Cholesky SVAR with the product measure ordered first, followed by the remaining variables in our baseline VAR: detrended series of real GDP, trade balance to GDP ratio, and core CPI. Two lags are used, and the sample size is quarterly data from 1985 to 2015.

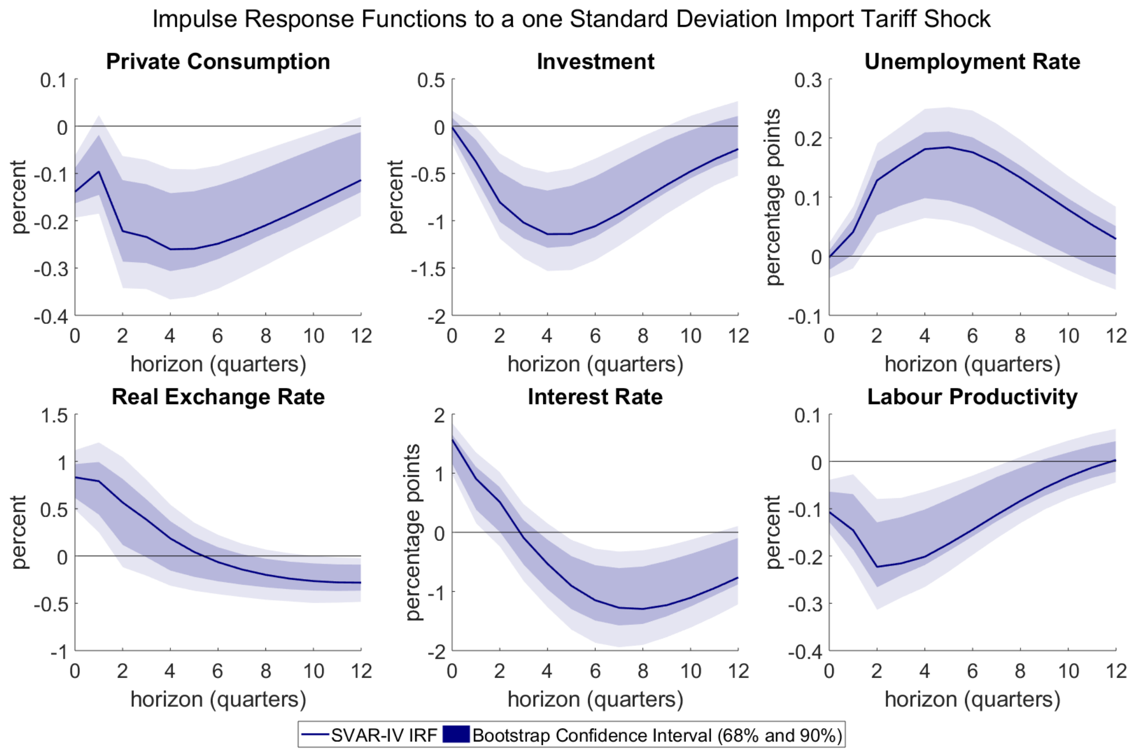

Figure 6: Transmission Mechanism Impulse Responses

The import tariff shock induces an immediate appreciation of the local currency by 0.8%, which quickly dissipates. This is consistent with the adjustment of the nominal exchange rate to partly offset the tariff in the short run, affecting the level of exports. Another key variable is the short-run real interest rate. This is determined by the central bank as it follows a Taylor rule.[15] The annual interest rate rises by 1.5 percentage points (pp) on impact, consistent with a reaction to inflation. Then, the output gap starts to dominate, leading to a drop in the interest rate, which is also consistent with the results of Barattieri et al. (2021).

In terms of the labor market response, the tariff produces an immediate drop of 0.1% in productivity, with a peak level of -0.2% in the second quarter after the shock. The unemployment rate response takes time to build, peaking at almost 20 basis points during the first year. These results are similar in direction to those of Furceri et al. (2021) but differ in magnitude and peak timing. For instance, in their results, the unemployment rate response peaks in the fifth year, although it is not statistically significant. As for productivity, the peak is achieved after the third year, with magnitudes higher than those reported here.

Finally, private consumption drops by 0.12% on impact and peaks at -0.26% in the first year. Investment does not react on impact but peaks during the first year at a magnitude

[15] Canada has followed an inflation-targeting regime since 1991.

of -1.2%. All of these results are statistically significant.

IV vs. Timing Identification

A natural estimator of A_0^{-1} for comparison is one employing timing restrictions. Barattieri et al. (2021) impose that import tariffs do not respond contemporaneously to the other economic variables, implying that tariffs are ordered first in the VAR. When this is the case, the first column of A_0^{-1} coefficients can be estimated by regressing the reduced-form residuals on the tariff residuals, effectively performing the first-stage estimation of the SVAR-IV using OLS. Hence, we can compare $\hat{A}_0^{-1,\text{IV}}$ against $\hat{A}_0^{-1,\text{OLS}}$, with the latter ignoring the countercyclical profile of tariffs. Table 7 reports these two estimates of the impact effect.

Table 7: SVAR-IV vs. Cholesky Impact Effects

IRF	SVAR-IV	Cholesky-SVAR
GDP	-0.20 (***)	0.02
Trade Balance	-0.24 (***)	-0.04
Inflation	0.33 (***)	0.19 (**)

Note: Bootstrapped standard errors using 10,000 repetitions.
(*): $p < 0.01$, (**): $p < 0.05$, (***): $p < 0.1$

The results show that when the estimation is carried out with timing restrictions (Cholesky-SVAR), the impact effects are biased towards zero. This is more pronounced in variables that are highly procyclical. The IRFs of the SVAR-IV are significant at the 99% level, while for the Cholesky-SVAR, only the core inflation IRF is significant, but at the 95% level.

These differences are particularly important in the estimation of the GDP and trade balance IRFs. For GDP, the IV estimate is ten times larger (in absolute value) than the Cholesky counterpart, while for the trade balance it is six times larger, differences that are significant at the 99% level. In terms of core inflation, the difference is much smaller and statistically insignificant. Figure 7 shows that these differences also affect the dynamics of the variables' IRFs.

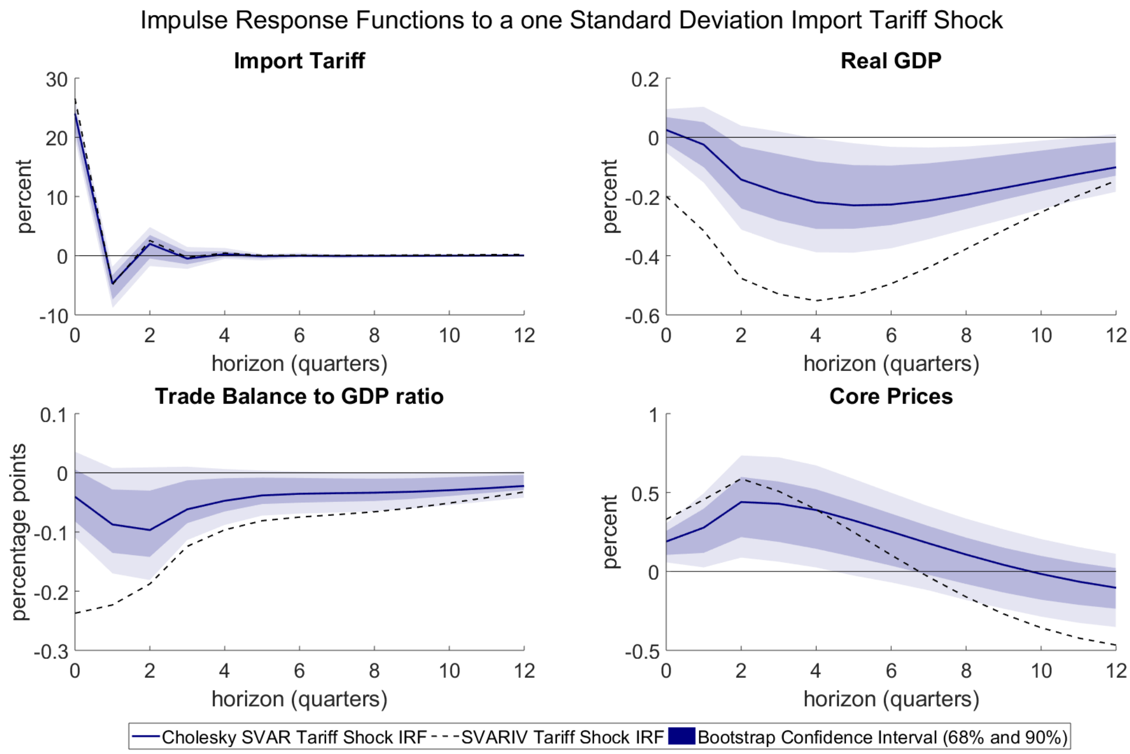

Figure 7: Cholesky-Identified SVAR Impulse Responses

The large differences in the impact effect on GDP are also reflected in the dynamics of some variables. The results show that the gap reaches its maximum level in the fourth quarter, but it is not until the third year that the two IRFs start to converge. This indicates a divergence between the two estimation methods. In terms of the trade balance, the differences are mainly in the impact effect, while for inflation, these are minor.

Forecast Error Variance Decomposition

Another structure of interest is the forecast error variance decomposition (FEVD). This quantifies the contribution of the import tariff shock to the forecast error variance of the other variables and measures the explanatory power of the identified shock. Figure 8 plots the FEVD for each of the four variables in the VAR and compares them to the Cholesky-identified model.

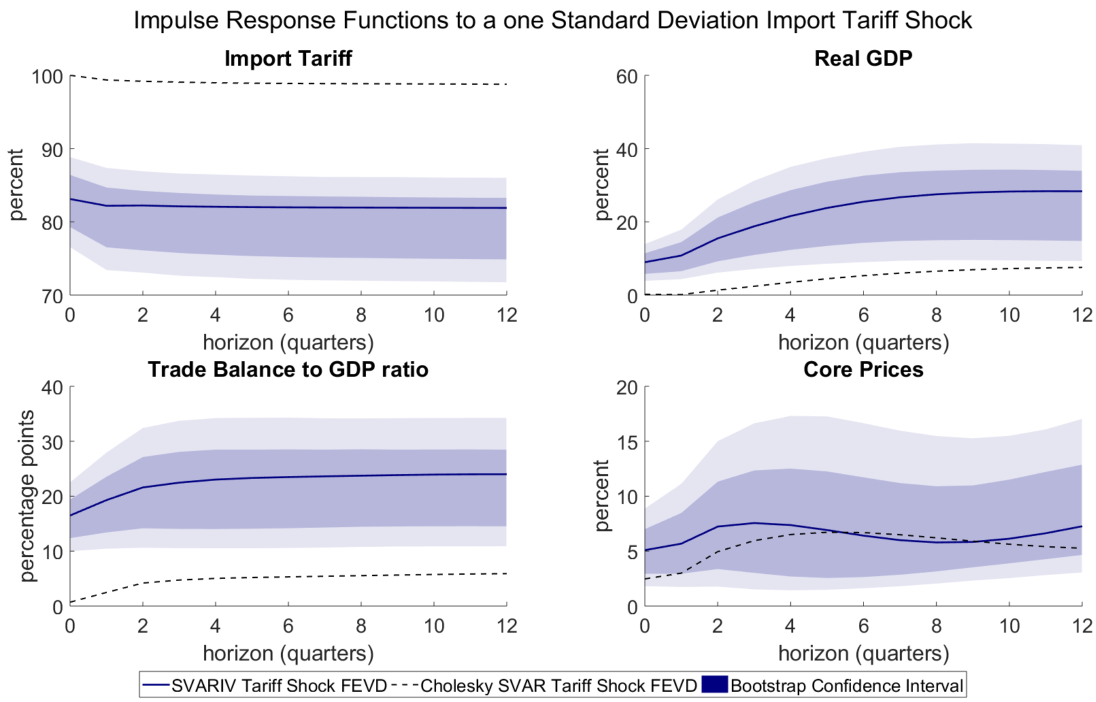

Figure 8: Tariff Shock Forecast Error Variance Decomposition

The Cholesky model explains 100% of the instant effect compared to 83% in the SVAR-IV, consistent with the contemporaneous feedback effect captured by the latter model. For the rest, the tariff shock explains a larger portion of the forecast error variance in the Proxy model than with timing restrictions. Averaging across forecast horizons, the amount of GDP variation explained is 22% compared to 5% in the Cholesky-identified model. Similarly, the shock explains 23% of the variation in the trade balance but drops to 5% when ignoring the countercyclical pattern. Finally, consistent with previous results, the differences for core inflation are minor, as the IV model explains 6%, while the Cholesky explains 5%. Nevertheless, in all cases, the FEVD is significant and higher than in the timing-identified model.

The related literature has not reported FEVD results, making it difficult to assess the magnitude of our findings. Compared to other shocks outside this field, the contribution to GDP is sizable. Our results are similar to those of Caldara and Herbst (2019) for a monetary policy shock, which explains up to 20% of industrial production (used as a GDP proxy). However, one should be cautious when drawing conclusions, as ours is a small-scale model, and these contributions might vary in a larger one.

5 Robustness

Controlling for Foreign Tariffs and GDP

As noted in Section 3, the variables in the SVAR depend on the actions of trading partners, that is, the foreign level of tariffs, T_t^*, and GDP, Y_t^*. Foreign duties are constructed using the tariffs targeting Canada and are aggregated at quarterly frequencies using constant weights. For foreign GDP, we use the level of OECD real GDP. Alternatively, since a large share of Canada's trade is with the countries of the North American Free Trade Agreement (NAFTA), we also use the real GDP of the trade union (excluding Canada). Figure 9 shows that the results remain robust when controlling for foreign tariffs and GDP shocks.

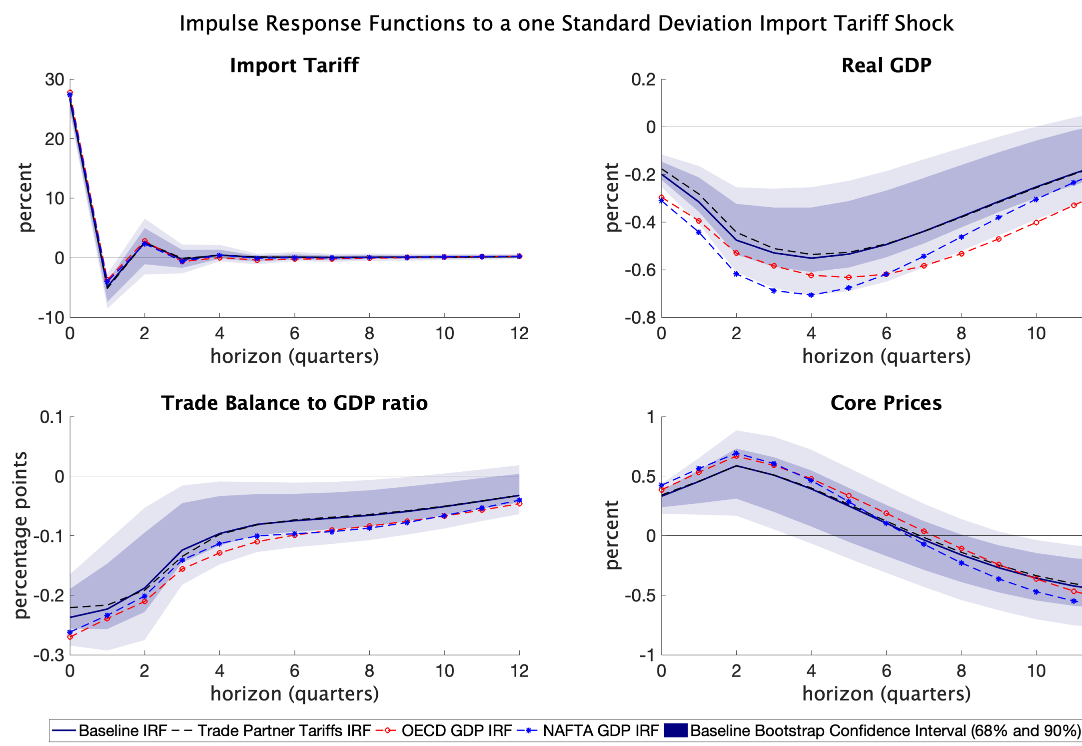

Figure 9: Controlling for Foreign Tariffs and GDP Impulse Responses

The results are comparable to those obtained in the baseline model. When adding foreign tariffs to the model, the IRFs remain almost at the same level as the originals. A similar outcome occurs when considering global shocks. However, both OECD and NAFTA GDP show slightly larger effects when analyzing the response on GDP. In particular, the IRF using NAFTA GDP is the highest during the first year after the shock. Regardless of these minor differences, the conclusions remain unchanged in any of the scenarios.

Controlling for Other Shocks

One concern, documented in both Barattieri et al. (2021) and Furceri et al. (2021), is that import tariffs are imposed following expectations about future economic conditions not captured in the SVAR. To address this, we use forward-looking variables that can capture this information. Two leading indicators are used: Canadian stock prices and an index measuring global economic activity through industrial commodity markets. This index, built by **?**, is used to forecast global economic activity that is otherwise not captured by current levels of GDP. Figure 10 shows the IRFs controlling for these variables.

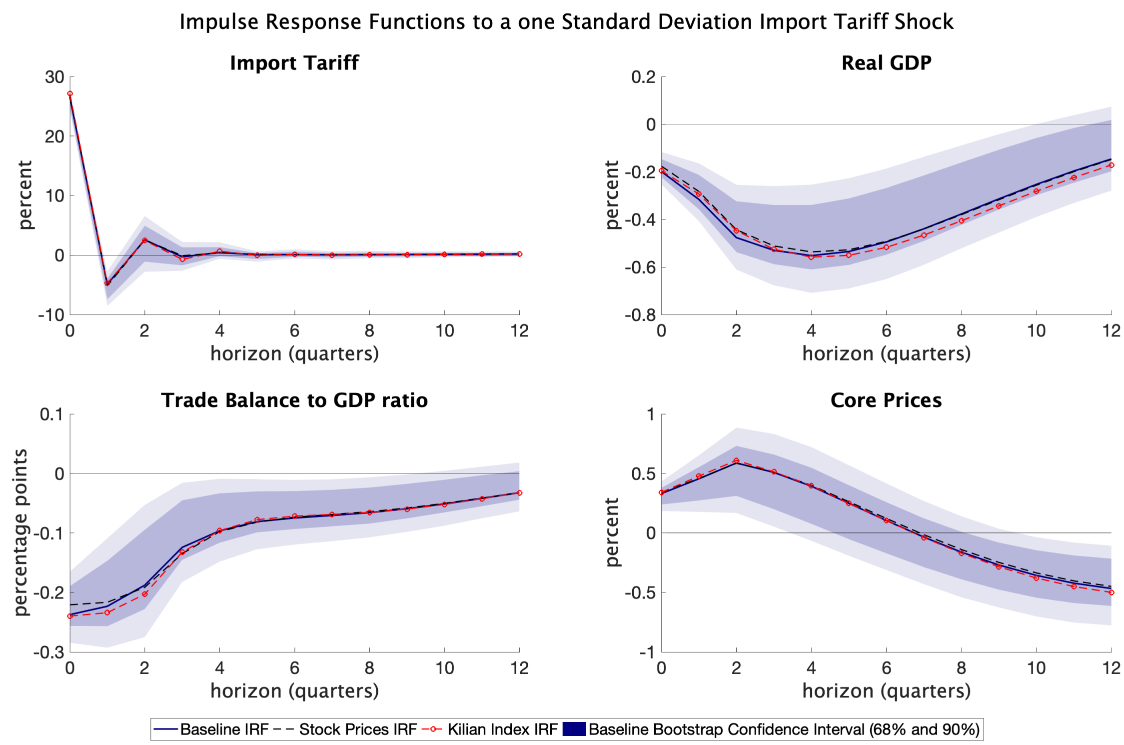

Figure 10: Controlling for Other Shocks Impulse Responses

Using either stock prices or the index of future economic conditions does not change the main conclusions of the baseline results. In effect, the IRFs remain relatively at the same level as the original, meaning the leading indicator variables do not fundamentally change our conclusions. This is also reflected in the two papers cited above.

Changing the Lag Structure

We run the model using different lag structures to check how sensitive the results are to this choice. The baseline model is a short-dimension VAR chosen based on information criteria.

However, a standard rule is to use four lags when using quarterly data. Figure 11 shows the responses for each variable using two, three, and four lags.

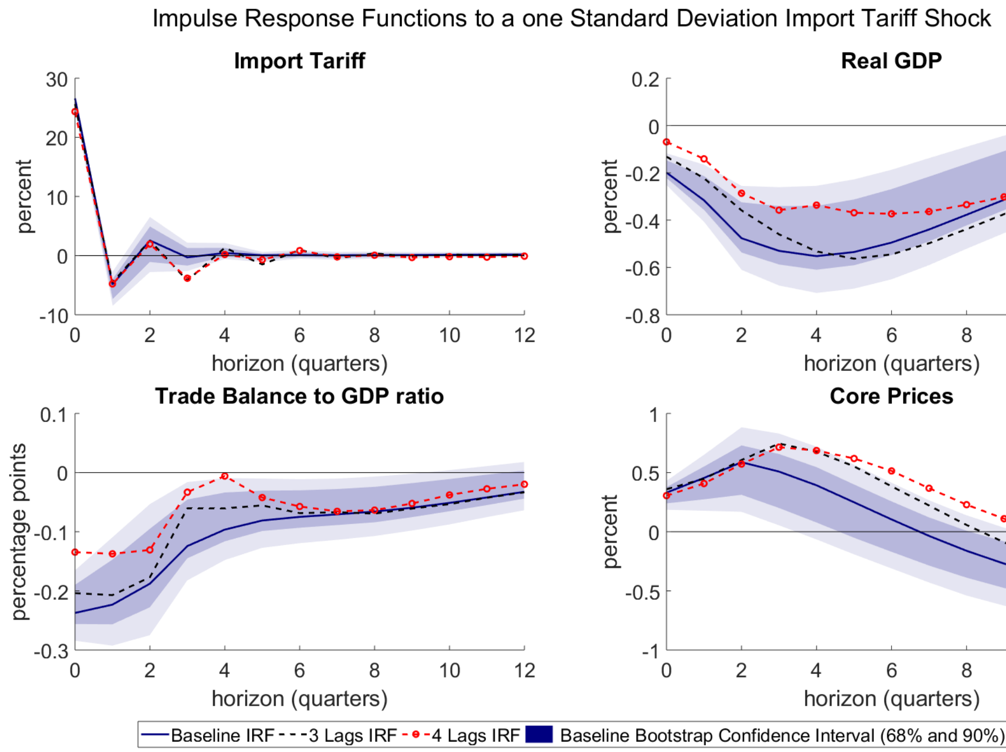

Figure 11: Impulse Responses with Different Lag Structures

The results remain robust in all cases. In each, there is a significant contraction of GDP and the trade balance, while inflation rises in the short run.

Changing the Detrending Methodology

The baseline results are computed using a higher-order polynomial, specifically of fourth order, as lower ones were not able to replicate key features of the Canadian business cycle. In this exercise, we compare different detrending methods. Figure 12 compares the baseline model with fifth and sixth-order polynomials along with the Hodrick-Prescott (HP) filter.[16]

[16]The HP filter parameter is 16,000, consistent with quarterly data.

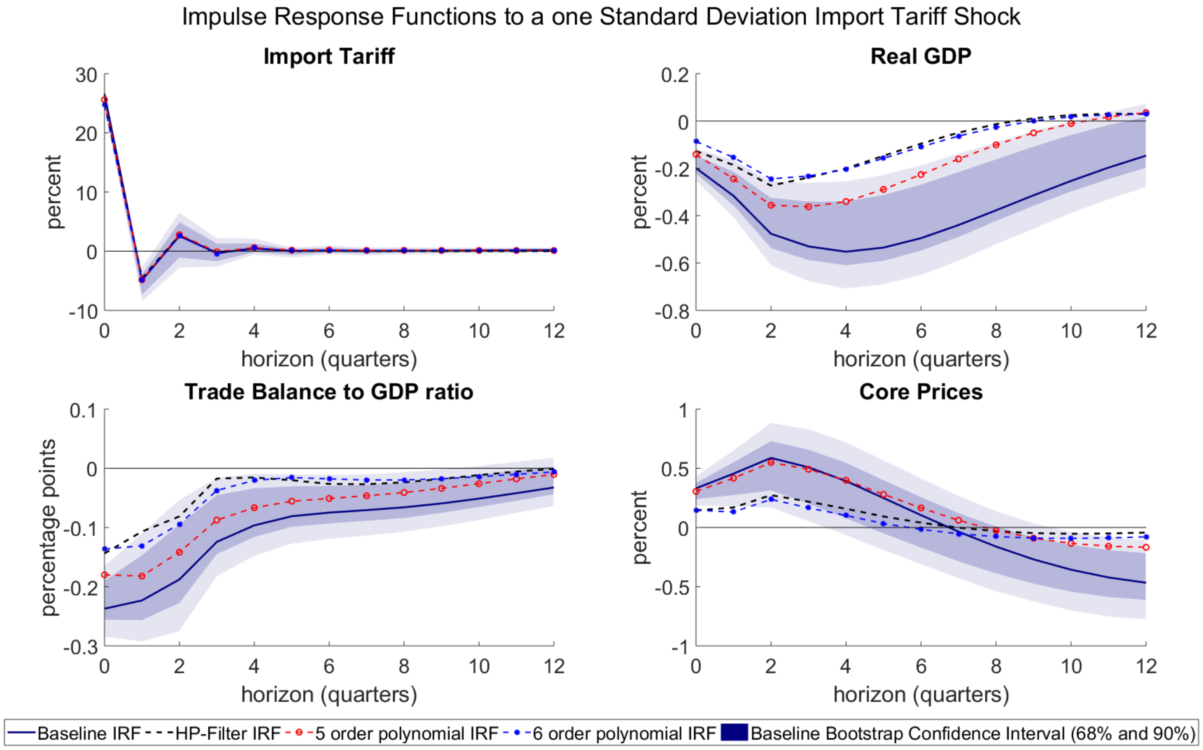

Figure 12: Impulse Responses with Different Detrending Methods

The main conclusions remain the same when using different detrending methods. Although some of the IRFs have lower impacts, all of them support the result that tariffs are contractionary.

Estimation in Differences

An alternative way to carry out the estimation is to treat the variables in differences. In this case, the model would be $A_0 \Delta Y_t = A(L)\Delta Y_t + \varepsilon_t$. The main drawback of this estimation is that any medium- or long-run relationships between the variables are lost. Indeed, the difference estimation only depicts the short-run effect of each variable and, therefore, the results are less persistent compared to the baseline model. Figure 13 shows the IRFs of the variables estimated in differences.

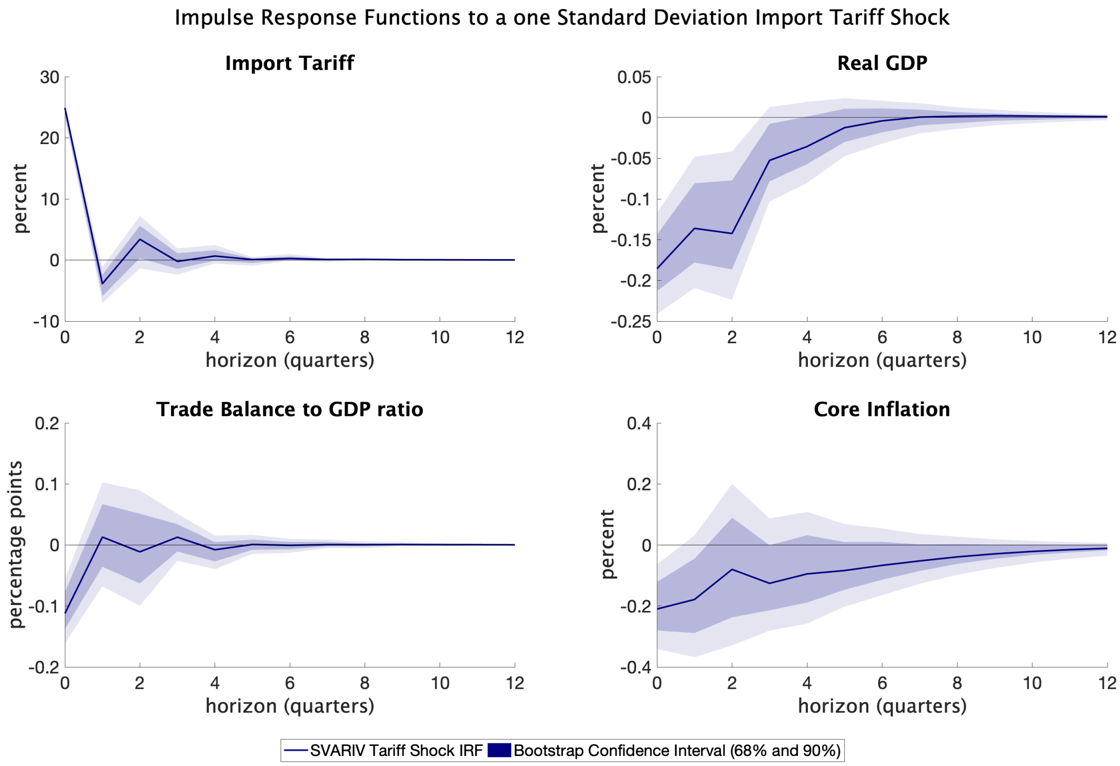

Figure 13: Impulse Responses from Difference Estimation

The IRFs of GDP and inflation, since they are in logs, are interpreted as growth rates. The results show a significant contraction in both GDP and the trade balance. The former has a similar impact effect as the detrended estimation and takes six quarters to return to its original level. The latter experiences a negative impact that is quickly reverted. In both cases, the results confirm the conclusions reached in the baseline model. The response of inflation, however, goes in the opposite direction and is not consistent with what has been reported so far. Nevertheless, as mentioned before, this result should be taken with caution as it ignores the persistence component of the original series.

6 Conclusion

The scarcity of macroeconomic empirical literature on topics related to import tariffs is associated with the challenge of identifying an exogenous shock. Econometric estimations that do not account for the simultaneous relationship between import duties and economic activity tend to be biased towards zero, given the countercyclical profile of tariffs.

This paper proposes a novel approach to address this problem. The identification is achieved through the construction of an instrument that is uncorrelated with business cycle shocks but correlated with import tariff shocks. We demonstrate that aggregate duties can be decomposed into an endogenous protectionist component and an exogenous retaliatory component.

Using retaliatory tariffs as an instrument for the import tariff shock allows us to identify an exogenous shock. The impulse responses are sharp, persistent, and peak during the first year after the shock. The effect on GDP is a 0.2% decline on impact and reaches approximately 0.6% in the fourth quarter. In terms of the trade balance, the shock generates an immediate contraction consistent with anticipation behavior and induces short-run inflation. Furthermore, the contractionary effect of import tariff shocks remains robust across various specifications.

Compared to models that do not control for the feedback effect and order tariffs first, the impulse responses in our SVAR-IV are significantly higher in absolute terms. Ignoring the feedback effect leads to estimated coefficients that are biased towards zero. This discrepancy is also evident in the forecast error variance decomposition; while the tariff shock in traditional models explains about 5% of the volatility in GDP and the trade balance, our SVAR-IV increases the explanatory power to around 22% for these variables.

Our results for GDP are larger and more persistent than those reported in previous studies that did not control for the feedback effect or used different measures for import tariffs. The differences can be attributed to our method of controlling for endogeneity and employing a direct measure of import tariffs. Additionally, compared to analyses focusing on longer-term customs duties, our findings are similar to the third-year impulse responses of instrumental variable specifications but manifest in the short run, during the first year after the shock.

There is ample room for further research in this area. While this paper employs a narrative identification strategy, alternative methods could be explored. For instance, the identification could be approached through a structural model, considering that retaliation results from strategic interactions between trading partners and follows a reaction function dependent on variables within the model. Such an approach would also facilitate counterfactual analysis.

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A Appendix A: Data description

This section provides a brief description of the variables used in the estimation and their sources:

Real GDP: Taken from the OECD quarterly national account database. In particular, we use the VPVOBARSA measure.

Real trade balance: Taken from the OECD quarterly national account database. In particular, the measure used is VPVOBARSA.

Core CPI: Taken from the OECD prices database. It considers the price level not accounting for the energy and food sectors. Although it is not seasonally adjusted, we deseasonalized it using X-13ARIMA.

Real effective exchange rate: Taken from the Bank of International Settlements. Quarterly series are constructed using the value of the last month of each quarter.

Interest rates: Taken from the OECD main economic indicators. It corresponds to the interbank overnight interest rate and is used as a proxy for the policy rate.

Investment: We use the real Gross Fixed Capital Formation (GFCF) series taken from the OECD quarterly national accounts.

Private consumption: We use the real private consumption series taken from the OECD key economic indicators.

Unemployment rate: Taken from the OECD labor market statistics. Quarterly series are constructed taking the value of the last month of each quarter.

Labour productivity: Taken from the OECD productivity statistics. This variable measures the amount of GDP per employed worker.

Import tariffs: Tariff information is obtained from the Temporary Trade Barriers Database. To construct quarterly series, we take a weighted average of the ad-valorem duties of each of the investigations in a given quarter. Towards this end, we employ constant shares taken from the import distribution at the product level in the year 2010.

Traditionally, tariff information can be recorded in two different formats: ad-valorem or specific duties. The latter is widely used by developing countries and during early periods in developed economies. This poses a problem for constructing a normalized aggregate measure of tariffs, as they have to be expressed as a percentage of the price.

For Canada, most tariffs are expressed in ad-valorem terms, but to increase coverage, we converted some of the early specific duties into ad-valorem equivalents. To do this, we analyzed each of these cases using official Canadian records available at the Canada Border Service Agency (CBSA) and re-expressed those providing sufficient detail.

Another concern is the type of tariff used for the analysis. When a product is taxed, two tariffs can be applied: preliminary or final. The former is normally imposed near the date the investigation is opened and reflects the estimated dumping margin. The median duration of an investigation is around 90 days, during which a final duty is imposed, which mirrors the adjusted dumping margin estimation. Normally, the difference between preliminary and final tariffs is small, averaging around four percentage points.

For its construction, we use a combination of criteria based on these two types. When preliminary or final duties are the only source available, we use that amount. If both have non-zero entries, we compare them with another source of information that contains the estimated dumping margins of the foreign firms. The source of information chosen is the one closest to the dumping margin. On average, this is not a major concern as the differences are relatively small. However, when the differences are large and above a tolerance level, we check the official records to determine which is closer to the true dumping margin.

B Appendix B: Exogeneity condition tests

Controlling for the variables used in the baseline VAR does not change the main conclusions. Protectionist tariff levels are higher in recessions than in expansions, while retaliatory tariffs do not react to the stage of the business cycle.

Table 8: Tariff components business cycle behavior: with controls

Series	Indicator	Coefficient	SE
Tariffs	Contraction (level difference)	6.8	4.97
	Contractions (marginal effect)	0.09	0.11
Protectionist tariffs	Contractions (level difference)	11.8 (***)	4.53
	Contractions (marginal effect)	0.18	0.12
Retaliatory tariffs	Contractions (level difference)	-2.2	3.90
	Contractions (marginal effect)	-0.07	0.11

Note: (*):$p < 0.01$, (**): $p < 0.05$, (***): $p < 0.1$

The predictability tests are carried out following Cloyne (2013). We present a VAR Granger causality test and a Probit regression using the same variables as in the Granger test, with the dependent variable being an indicator of whether a tariff is raised in a given quarter. These tests are run on each of the tariff components to test if the parameters associated with GDP are different from zero. As in the baseline model, we use two lags of each variable.

Table 9: Tariff components business cycle behavior: with controls

Series		Test statistic	p-value
Protectionist tariffs			
	Granger Causality	7.7	0.06 (*)
	Probit Model	9.2	0.03 (**)
Retaliatory Tariffs			
	Granger Causality	0.7	0.87
	Probit Model	2.3	0.51

Note: (*):$p < 0.01$, (**): $p < 0.05$, (***): $p < 0.1$

The results show that the null hypothesis of both models is rejected for the case of protectionist tariffs. This means that past economic conditions predict the current level of these tariffs, both at the intensive and extensive margin. In terms of retaliatory tariffs, both tests show that these cannot be predicted by past levels of GDP. These results add more weight to the hypothesis that retaliatory tariffs can be used as an exogenous variation to estimate the effect of import tariffs.

C Appendix C: Other Figures

C.1 Custom Duties and Temporary Tariffs

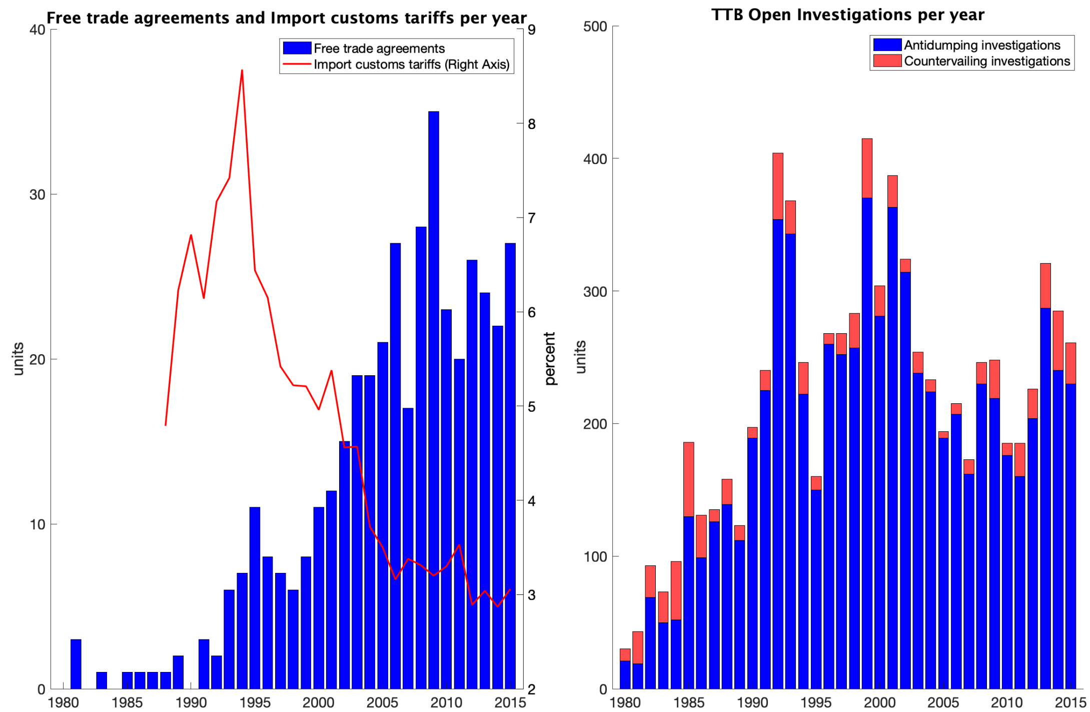

Figure 14: Custom duties vs Temporary Tariffs

C.2 Retaliatory tariffs alternative definition

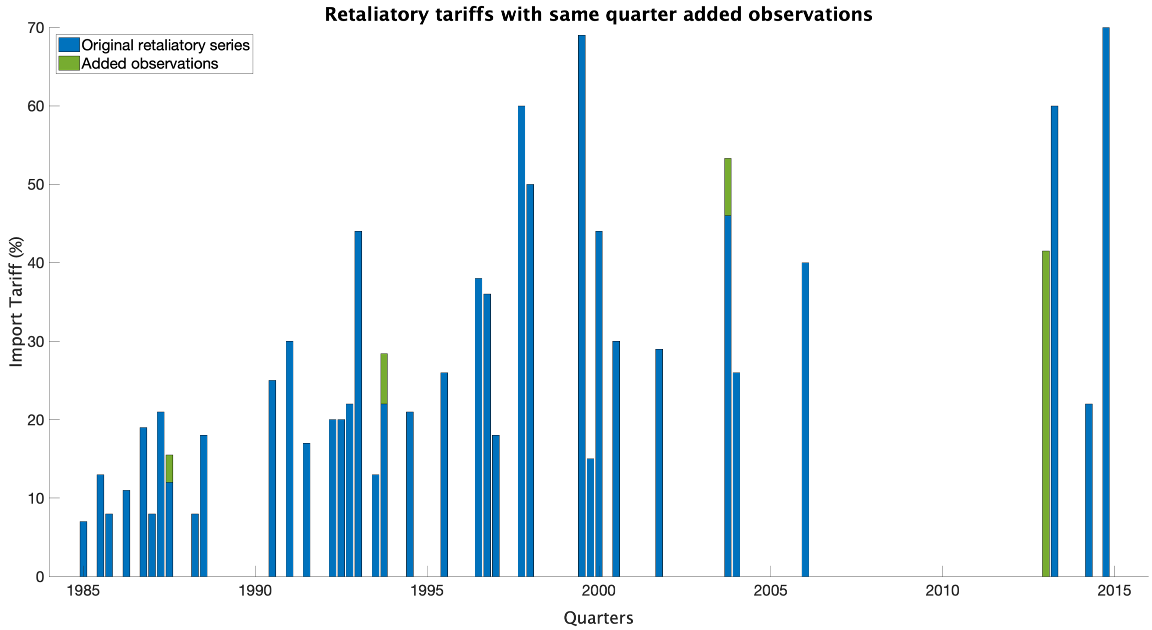

Figure 15: Same quarter retaliation

C.3 Investigation stages

Raising an investigation involves a three-stage procedure:

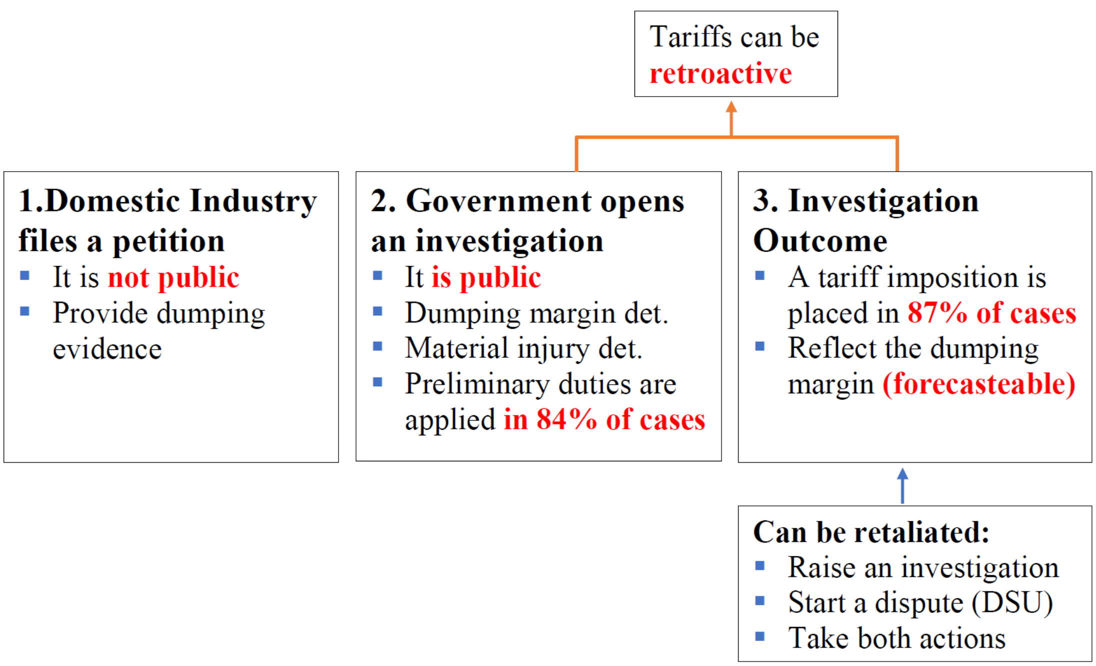

Figure 16: Investigation process