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The Employment Consequences of Anti-Dumping Tariffs: Lessons from Brazil*

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Abstract

How do import tariffs affect employment? We develop an empirical strategy to identify the effects of tariffs using difference-in-differences, comparing anti-dumping (AD) investigations resulting in dumping tariffs to those not resulting in dumping tariffs. We find that an AD tariff decreases imports and increases employment in the protected sector. Moreover, downstream firms decrease employment, while upstream ones are unaffected because the protected sector sources inputs abroad. Using a model to quantify the aggregate effects, we find that the Brazilian AD policy increased employment by 0.06% at a welfare loss of 2.4%.

Keywords: employment, tariffs, anti-dumping, international trade

JEL Codes: F13, F16

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1 Introduction

With the promise to 'bring jobs back', tariffs are usually advocated as a tool to increase domestic employment. However, despite the relevance of tariffs to policy and their prominence in the political arena, their effects on employment are still a source of debate among economists. Some argue that tariff liberalizations have led to job losses in exposed sectors (Pierce and Schott 2016, Pierce et al. 2023), while others contend that any employment gains in sectors protected by tariffs are offset by adverse downstream effects (Flaaen and Pierce 2019, Huang et al. 2019, Bown et al. 2021) or by other countries' retaliatory tariffs (Handley et al. 2020).

On the one hand, tariffs shift demand for foreign products to products manufactured in the home market. Consequently, the protected sector and the sectors upstream from it (i.e., those that provide inputs to the protected sector) can increase production and employment. On the other hand, downstream sectors (those that use the tariffed good as an input) face higher costs, which could lead to lower employment among them. Therefore, the aggregate effect of tariffs on employment will depend on the employment elasticity of the protected sector, the upstream sectors, and the downstream sectors.

In this paper, we ask the following: What is the effect of tariffs on aggregate employment and how does it propagate through the value chain? To answer these questions, we implement a difference-in-differences approach exploiting WTO anti-dumping (AD) regulation. The effects of tariffs are identified by comparing the growth rate in employment between sectors with AD investigations resulting in dumping tariffs to those with AD investigations not resulting in dumping tariffs. We find that tariffs increase employment in the protected sector but negatively affect downstream firms. Using a model to aggregate these elasticities, we find that the Brazilian AD policy increased employment by 0.06%.

Identifying the effects of tariffs is challenging because they usually correlate with other policies, aggregate shocks, or retaliation from other countries. In many countries, tariffs and other favorable policies target politically relevant sectors, making it difficult to disentangle the effects of these other policies from the effect of tariffs. Moreover, protection from international competition usually targets sectors in decline (Staiger and Wolak 1994, Prusa

1997, Steinbach and Khederlarian 2022) or is followed by retaliation from the foreign country (Flaaen and Pierce 2019), once again creating a confounding effect.

We isolate the effect of tariffs by comparing sectors and products with AD investigations resulting in dumping tariffs to those not resulting in dumping tariffs in Brazil, which is a small open economy. According to the World Trade Organization (WTO) regulations, firms harmed by foreign competition can apply to the federal government for protection by AD tariffs. If the application satisfies certain conditions, the government opens an investigation. Subsequently, an AD tariff is triggered if and only if the price of the investigated product is greater in its home market than in the foreign market before the beginning of the investigation. Therefore, conditional on a product being investigated, the decision to impose a tariff and its size is made based on pre-determined variables, which can be teased out with fixed effects because, empirically, we find that prices affect the level of trade and employment but not their trends. Importantly, conditional on an investigation, AD tariffs should not depend on labor market trends, other policies, or political connections. Moreover, because Brazil is a small open economy, foreign prices are not affected by labor market shocks in Brazil.[1]

To implement our identification strategy, we collect information on all AD investigations initiated in Brazil.[2] Next, we link each investigation to a national producer, an upstream sector, and a downstream sector. This information is then matched to an employer-employee dataset that contains details on wages and employment at the firm level.

We implement a difference-in-differences strategy comparing the growth rate of trade and employment between investigations resulting in AD tariffs to those not resulting in AD tariffs. The treatment group is the set of products whose AD investigations led to a tariff increase. The control group is the set of products whose AD investigations did not result in a tariff change. The identifying assumption is that the treatment and control groups have parallel trends.

To validate our identification strategy, we implement a battery of exercises and robustness

[1] In practice, we are also exploiting variation on the size of the tariff within the treatment group. That is valid because the level of AD tariffs - not only the decision to implement it - are based on fixed pre-determined characteristics that can be teased out by fixed effects.

[2] Among global economies, Brazil ranks the sixth in terms of the number of anti-dumping (AD) investigations launched, only after the United States, India, European Union, Canada, and Argentina (Bown 2005). Also see Soto (2016).

checks. First, we show that pre-period parallel trends hold for all the considered variables. Second, we show that our results cannot be explained by other major shocks hitting the Brazilian economy, such as the Brazilian trade liberalization or fluctuations in the exchange rate. Third, we implement two placebo tests to show that our results are not driven by sectoral or labor market trends. Fourth, we find that adding or removing controls from our main specification does not change the results. Fifth, we show that running our main regressions at the region level, instead of the firm level, delivers similar results. Finally, we also find the same results using an instrumented difference-in-differences strategy with pre-period international prices as the instrument.

To further validate the identifying assumption, we show that political connections cannot predict AD tariffs but international prices can, as stipulated by WTO regulations. Treatment and control groups are equally likely to make campaign contributions or to receive procurement contracts, subsidies, tax breaks, or subsidized loans from the government; this shows that AD tariffs are not targeted at protecting politically connected sectors. We also show that AD tariffs do not correlate with preferential trade agreements or Most Favored Nation (MFN) tariffs. Moreover, using only international prices we can predict Brazilian AD tariffs with an R-squared above 0.95, which shows that the Brazilian government follows WTO regulations closely.

We find that AD tariffs decrease imports and increase employment in the protected sector. A 100% ad valorem AD tariff decreases imports by 25% without a significant effect on the imports' price, supporting the idea that Brazil is a small open economy. In contrast to Flaaen et al. (2019), we do not find any corresponding increase in imports from other locations.

Tariffs increase employment, exports, and imports of protected firms. A 100% ad valorem tariff generates a 1.8% employment increase among firms shielded from international competition. Despite the growth of national producers, firms upstream from them are not significantly affected, possibly due to the increase in imports of inputs by the national producer. Finally, downstream firms significantly decrease their employment, whereby a 100% ad valorem tariff on all inputs of a firm decreases employment by 3.8%.

The empirical results are informative about firm-level responses to AD tariffs but are silent about the aggregate effects. To make aggregate quantitative predictions, we build a small open economy model with international trade, input-output linkages, and labor force participation. We show that the model's key parameters can be identified from the estimated reduced-form elasticities. In the model, workers choose to work between different sectors or stay outside the labor force. To produce, firms use labor and input from all sectors. The sectoral input is supplied by imperfectly substitutable domestic and foreign producers. We calibrate the model to reproduce the effect of AD tariffs on employment and international trade.

From the quantitative model, we conclude that the Brazilian AD policy increased employment and GDP, but the effects of tariffs on employment depend on the position of the tariffed product along the value chain. We find that the Brazilian AD policy increased employment and GDP by 0.06% and 0.05%, respectively, with a decrease in consumption-equivalent welfare by 2.43%. Moreover, the aggregate effect of a tariff depends on the position of the product in the value chain. Imposing tariffs that protect the computer, electrical, and machinery sectors (which are further down the value chain) increases aggregate employment. However, imposing tariffs that protect agriculture and mining sectors (which are relatively upstream in the value chain) decreases aggregate employment. These results indicate that, if the goal of tariffs is to increase employment, they should protect sectors at the end of the value chain that use inputs from a wide range of sectors.

Our main contribution is twofold: first, we show that the effect of tariffs on employment can be identified by leveraging WTO regulations, and second, we quantify their aggregate impacts with a quantitative model. As such, this paper contributes to the emerging literature that investigates the supply chain effects of trade protections. Predominantly empirical in nature, this body of research has based its identification strategies on the trade policy institutions of specific countries, economic shocks occurring during distinct episodes, and tariff changes within particular sectors. They have studied the China shock (Acemoglu et al. 2014, Pierce and Schott 2016), the 2018-19 U.S. tariffs on China (Flaaen and Pierce 2019, Huang et al. 2019, Handley et al. 2020, Trimarchi 2020), the Trump administration's tariff on washing machines (Flaaen et al. 2019), the Bush administration's steel tariffs (Cox 2021), industrial subsidies in the steel sector (Blonigen 2016), voting patterns of U.S. congressmen

(Bown et al. 2021), rules of origin requirements in free trade agreements (Conconi et al. 2018), and monthly variation in temporary trade barriers (Barattieri and Cacciatore 2023).

We contribute to this body of literature by showing that the effect of tariffs on employment can be identified by leveraging WTO regulations. Because our strategy relies on the design of WTO AD regulation, it is applicable to all WTO members who have implemented AD investigations.[3]

This paper also contributes to the literature that studies AD tariffs.[4] The literature has shown that AD tariffs reduce imports, leading to trade depression.[5] However, the evidence on trade diversion—the impact of tariffs on imports of other products and countries—is mixed. Prusa (1997), Prusa (2001), Baylis and Perloff (2010), Flaaen et al. (2019), and De Souza et al. (2024) find that AD tariffs increase imports from non-targeted countries, while Konings et al. (2001) and Durling and Prusa (2006) do not find a significant third-country effect. This literature also reveals that AD tariffs influence firm performance in the protected sector (Konings and Vandenbussche 2008, Pierce 2011, Jabbour et al. 2019), as well as employment (Trimarchi 2020, Barattieri and Cacciatore 2023, Bown et al. 2021).

Closest to us, Bown et al. (2021) and Barattieri and Cacciatore (2023) also examine the impact of AD tariffs on the supply chain. Bown et al. (2021) employs a shift-share instrument based on political changes in swing states to show that politically motivated AD trade protection significantly reduces employment in downstream industries. Similarly, Barattieri and Cacciatore (2023), leveraging variation in the timing of AD tariffs, finds that these tariffs offer minimal employment benefits in protected industries while causing significant and persistent job losses in downstream industries due to higher input costs and reduced competitiveness.

Most studies in this literature compare products investigated for dumping and subject to AD tariffs with those that have never been investigated. However, this method introduces biases in estimating the effects of tariffs for two reasons. First, sectors investigated for dumping often experience different employment and trade trends compared to non-investigated

[3]For instance, building on the methods developed in this paper, De Souza et al. (2024) investigates how AD tariffs impact Russia's total exports, identifying trade elasticities in the short, medium, and long term.

[4]For a more comprehensive review of the literature, see Blonigen and Prusa (2016).

[5]See Staiger and Wolak (1994), Lloyd et al. (1998), Prusa (1997), Vandenbussche and Zanardi (2010), Irwin (2014), Besedeš and Prusa (2017), and Sandkamp (2020).

sectors. According to WTO regulations, an AD investigation can only be initiated if a sector is experiencing declining revenue or employment alongside increasing imports. As a result, these sectors are unlikely to follow similar trends or face comparable shocks. Second, the investigation process itself can influence trade and employment by creating trade policy uncertainty, further complicating the comparison.

We contribute to this literature in three ways. First, we show that we can leverage WTO's AD regulation to identify the effect of tariffs on employment and trade.[6] Second, unlike Bown et al. (2021) and Barattieri and Cacciatore (2023), we find that tariffs significantly increased employment in the protected sector. This finding is consistent with Flaaen and Pierce (2019), who studied the effects of US-China Trade War tariffs. Finally, to our knowledge, we are the first to provide a general equilibrium analysis of the aggregate employment effects of AD tariffs, accounting for midstream, upstream, and downstream impacts as well as flexible labor supply decisions.[7]

Our paper contributes to the extensive literature examining the labor market consequences of international trade. While empirical studies largely agree that import competition leads to decreased employment and wages in affected sectors (Trefler 2004, Autor et al. 2013, Dix-Carneiro and Kovak 2015, Dix-Carneiro and Kovak 2017, Devlin et al. 2021, among others) and that tariffs result in employment declines in downstream sectors (Flaaen and Pierce 2019, Handley et al. 2020, Bown et al. 2021, among others), there is disagreement regarding the impacts of tariffs on protected sectors and their propagation upstream, resulting in uncertainty about the aggregate effect of tariffs.[8] Quantitative works, including

[6] A similar identification strategy was also used by Pierce (2011) and Konings and Vandenbussche (2008). However, we are the first to show that this strategy satisfies several exogeneity requirements. We demonstrate that pre-period parallel trends holds for all our variables of interest, that the institutional setting supports our identification strategy, that international prices can predict AD tariffs, that AD tariffs are uncorrelated with other policies, and that they don't correlate with other shocks hitting the Brazilian economy or the business cycle.

[7] For example, Gallaway et al. (1999) evaluate US real income loss from AD tariffs using a computable general equilibrium model, but do not consider labor supply decisions. Egger and Nelson (2011) study the real income loss from AD tariffs using a regression approach, and therefore do not account for input-output linkages or labor supply decisions. Ruhl (2014) uses a small open economy model with firm dynamics to identify significant U.S. real income losses from AD tariffs. However, their model does not account for input-output linkages. Most of these works primarily focus on real income rather than employment or welfare.

[8] Flaaen and Pierce (2019) and Trimarchi (2020) find that US-China Trade War tariffs weakly increased employment in the protected sectors, but Barattieri and Cacciatore (2023) and Bown et al. (2021) find that AD tariffs had an insignificant employment effect in the protected sectors.

Caliendo et al. (2019) and Rodríguez-Clare et al. (2020), predict that trade protection can increase total employment, whereas Barattieri et al. (2021) predicts otherwise.

We contribute to this literature by presenting new evidence on tariff effects on employment in protected and upstream sectors. Our empirical estimates show moderate aggregate employment gains from AD tariffs and highlight the significance of input-output linkages in determining the aggregate employment effect.

The rest of the paper proceeds as follows. In Section 2 we review the WTO AD rules, the practice of AD investigations in Brazil, and the data used in this study. In Section 3 we explain our empirical strategy. In Section 4 we present the main empirical results. Next, in Section 5 we introduce the model. In Section 6 we describe the procedure to estimate the model. In Section 7 we show the quantitative results. Finally, in Section 8 we state our conclusions.

2 Institutions and Data

2.1 Anti-Dumping Investigations

The identification strategy exploits the design of WTO AD regulation to isolate the effect of tariffs from other confounders. In this section, we describe these regulations to argue that, conditional on an AD investigation being opened, the trigger for the AD tariff is predetermined variables outside of Brazil. Because these variables affect the level of trade and employment but not their trends, we can compare the growth rate in employment and imports between AD investigations resulting in dumping tariffs to those not resulting in dumping tariffs.

Dumping is defined as international price discrimination where the exporter charges a lower price in the destination market than in their home market. According to WTO regulations, the destination market harmed by dumping is allowed to set an AD tariff to exactly offset this price difference. The WTO AD regulations, which Brazil follows, define three steps for the creation of an AD tariff: (1) firms harmed by dumping file a complaint to the Ministry of Economy, (2) the government opens an investigation into whether the foreign competitor engaged in dumping, and (3) an AD tariff is imposed to exactly offset the difference in prices based on price estimates of the past.[9]

The process starts with a domestic firm or a group of domestic firms filing a complaint with the Ministry of Economy. The complaint must show that the sector was harmed by foreign dumping practices. Firms must present evidence that they experienced a decrease in profits, sales, or wages, and link this to increased import competition from an international competitor. This suggests that the sales and prices of investigated and non-investigated products may have different trends.[10]

The government, upon receiving the complaint, determines whether it should open an investigation or dismiss the case. This decision is made based on whether there is enough proof linking the national supplier's decline in economic performance to increased imports from the international competitor. In the empirical analysis below, we only consider the cases in which an investigation is opened.

After the government opens an investigation, it calculates the price of the imported product in its home market before the investigation (called the "normal value") and in Brazil. If the imported product comes from a non-market economy, the normal value is calculated using the pre-investigation price in a third market.[11]

If the government finds that the foreign competitor is charging a lower price in Brazil than its normal value, the government will create an AD tariff to equate the Brazilian post-tariff price to the normal value. Therefore, the AD tariff is set based on pre-determined price differences charged by the foreign exporter in Brazil and in the home market. The AD tariff, once imposed, lasts for five years and is then reevaluated. Most AD tariffs are reinstated after 5 years because the price differences remain.

[9]See the Agreement on Implementation of Article VI of the GATT 1994 (World Trade Organization (1994a)).

[10]We discuss this further in Section A.3.

[11]The Brazilian government considers only China and Vietnam to be non-market economies. In those cases, the third country chosen as a reference for the normal value will depend on data availability. In general, the normal value in a non-market economy can also be estimated using estimates of the production cost, but this method is not used in Brazil. See WTO's Technical Information on Anti-dumping (World Trade Organization (1994b)).

2.2 Data

To understand the effect of tariffs on employment exploiting WTO regulation, we merge four datasets. They contain information on AD tariffs, product-level imports, firm-level employment, and firm-level imports. For information on AD tariffs and investigations, we use the Global Anti-dumping Database (Bown 2005). For each AD investigation in Brazil, the Global Anti-dumping Database contains the investigated product's name and classification, the country of origin, the start and conclusion dates of each investigation, and the measures taken. Section A.1 presents a set of summary statistics of AD investigations in Brazil.

Data on imports comes from the Secretary of International Trade of the Ministry of Economy in Brazil. It provides monthly statistics on imports and exports for Brazil at the product level. This is used to understand the effect of tariffs on trade. The third database, RAIS, covers employment information of Brazilian firms. It is a yearly employer-employee matched dataset containing information on workers' wages, hours, occupations, and demographics. It also contains data on the sector and location of the firm. Using a concordance table provided by the Brazilian Secretary of International Trade, we link each AD investigation to its sector. This allows us to study how tariffs affect domestic employment.

Throughout the paper, we focus the analysis on firms with more than one worker that have been active for more than 10 years. The goal is to prevent changes in the composition of firms from driving the results.[12] Our analysis spans from 1995 to 2016. We also drop from the empirical analysis the service sector and the government sector.

3 Empirical Strategy

We use difference-in-differences to identify the effect of AD tariffs on trade and employment comparing AD investigations resulting in dumping tariffs to those not resulting in dumping tariffs. The key identifying assumption is oparallel trends between products with and without AD investigations. In this section, we first discuss how the institutional setting of AD tariffs

[12]One could be worried that this choice could lead to sample selection. Indeed, that would be the case if AD tariffs could lead firms to enter or exit the market. In section A.5.3, we show that results are the same if we keep all the firms in the sample. We also show that AD tariffs did not led to firm entry or exit.

supports the identifying assumption. Then, we lay down the empirical model. In the final part, we discuss a battery of tests supporting the identifying assumption.

3.1 Identification

Identification Challenge. To identify the effect of tariffs, one cannot simply compare products with AD investigations with products that do not have AD investigations. As discussed in Section 2, an AD investigation is open against products of growing imports in sectors of decreasing employment. Section A.3 shows that investigated products have a lower price and higher volume than non-investigated ones. They are also in a decreasing price and increasing volume trend at the time of the investigation. Therefore, naively comparing products with and without AD tariffs would not identify the effect of the tariffs.

Products with and without AD tariffs are also not comparable due to trade policy uncertainty. An AD investigation itself might affect trade and employment by creating uncertainty about future trade policy.[13] Therefore, comparing investigated to non-investigated products, one cannot tease out the effect of trade uncertainty.

Identification. According to WTO regulations, after an investigation is formed, the decision to impose an AD tariff is a function of the pre-determined characteristics of the product. Conditional on being investigated, a product on which a tariff is imposed only differs from a product on which a tariff is not imposed on the level of international prices.

If the only difference is the international price level - and not their trends - comparing the growth rate of imports between these two sectors identifies the effect of the AD tariff. Moreover, the effect of trade uncertainty is teased out because the treatment and control groups are both exposed to AD investigations.

[13] As highlighted by Staiger and Wolak (1994), Prusa (2001), Lu et al. (2013), Besedeš and Prusa (2017), among others.

3.2 Empirical Model

3.2.1 Imports

Main Empirical Model. We use the following empirical model to identify the effect of imposing an AD tariff $\tau_{p,c,q}$ on imports of product p from country c in quarter q:[14]

$$y_{p,c,q} = \theta^{imp}\tau_{p,c,q} + \beta\mathbb{I}_{p,c,q}\left\{\text{After AD}\right\} + \eta_{p,c} + \eta_{q,c} + \epsilon_{p,c,q}, \tag{1}$$

where $y_{p,c,q}$ is the log of total imports of product p from country c in quarter q. $\mathbb{I}_{p,c,q}\left\{\text{After AD}\right\}$ is a dummy taking the value of 1 after the beginning of the first investigation; it captures the effect of tariff uncertainty. $\tau_{p,c,q}$ is the ad valorem AD tariff imposed; for the control group, it takes the value of 0. If the AD tariff is later removed, $\tau_{p,c,q}$ takes the value of 0. $\eta_{p,c}$ is a product-country fixed effect removing any level differences between treatment and control. It also captures the effect of differences in international prices that ultimately led to the tariff. $\eta_{q,c}$ is a quarter-country fixed effect.[15]

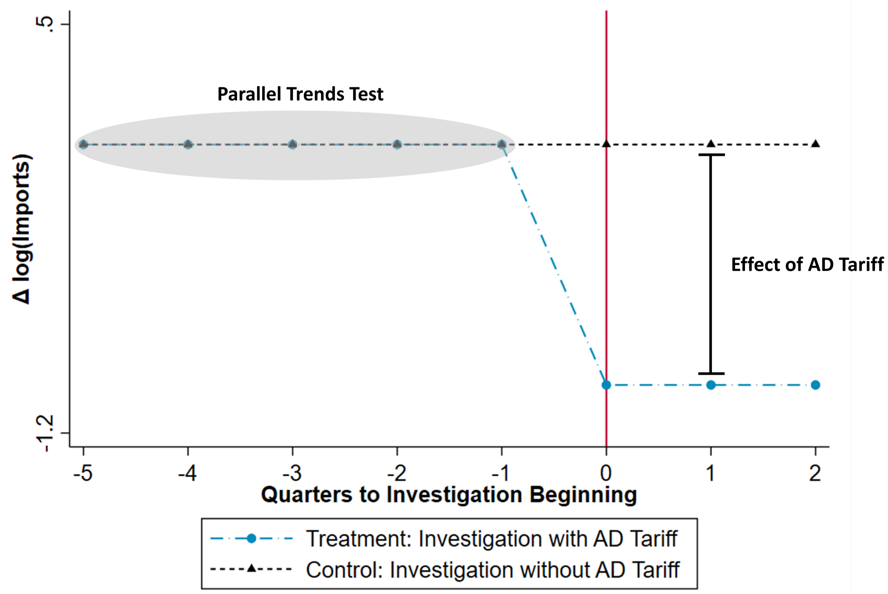
Identifying Variation. The parameter of interest, θ^{imp}, captures the effect of AD tariffs on imports. Figure 1 illustrates the main identifying variation. The y-axis plots the growth rate in imports and the x-axis the distance to the beginning of the investigation. The main source of variation informing θ^{imp} is the difference after the investigation in growth rates between investigated products without an AD tariff (the control group), and investigated ones with an AD tariff (the treatment group). If the assumption of parallel trends is valid, the control and treatment groups should have similar growth rates before the tariff was imposed.[16]

[14] In our analysis each product refers to an 8-digit Nomenclatura Comum do Mercosul (NCM) code. The first 6 digits of the NCM code are the same as those of a Harmonized System (HS) code. The Brazilian government adds two additional digits to improve granularity.

[15] There are few cases of AD investigations against the same 8-digit product. As consequence, there isn't enough power to identify θ^{imp} including product-time fixed effect. However, in the robustness section, we add sector-year and sector-country-year fixed effects obtaining similar estimates.

[16] θ^{imp} is also informed by the differences in the AD tariff among the treated product-country pairs. But most of the variation is coming from the comparison between treatment and control. To keep the graph intuitive, we remove the within-treatment variation from it.

Figure 1: **Identifying Variation of the Effect of AD Tariffs on Imports**



Description: This figure shows the identifying variation of the effect of tariffs on imports. The blue line is the fictitious growth rate for imports from a product-country that had an AD tariff. The black line is the fictitious growth rate of imports of a product-country that had an AD investigation but no AD tariff imposed. The difference between the two growth rates is the effect of the AD tariff. If the notion of parallel trends is valid, the growth rate between the two products should be the same prior to the beginning of the investigation.

Pre-Period Parallel Trends Test. To test for parallel trends in the pre-period, we use the following specification:[17]

$$y_{p,c,q} = \sum_j \theta_j \tau_{p,c,\text{first}} \mathbb{I}_{p,c,q} \{j \text{ Qrt. to AD}\} + \sum_j \beta_j \mathbb{I}_{p,c,q} \{j \text{ Qrt. to AD}\} + \eta_{p,c} + \eta_{q,c} + \epsilon_{p,c,q}, \tag{2}$$

where $\mathbb{I}_{p,c,q} \{j \text{ Qrt. to AD}\}$ is a dummy which takes the value of 1 if quarter q is j quarters to the beginning of the first AD investigation; $\tau_{p,c,\text{first}}$ is the first AD tariff imposed on product p from country c; and θ_j captures the dynamic effects of the first AD tariff. Parallel trends in the pre-period imply that $\theta_j \approx 0$ for all $j < 0$.[18]

[17]In these tests, we consider only the first AD investigation, as is standard in the literature, to ensure that there is no confounding investigation in the pre-period.

[18]We calculate event-studies relative to the beginning of the investigation. We chose that because the AD investigation itself may affect trade and the labor market. Once an investigation begins, firms familiar with WTO rules could infer the outcome of the investigation from international prices. Consequently, the effects of the investigation could appear before the AD tariff is officially imposed, shortly after the investigation starts.

3.3 Midstream Firms

We use difference-in-differences to identify the effect of AD tariffs on protected sector employment. The treatment group is the set of firms whose products faced AD investigations that led to an AD tariff. The control group is the set of firms whose products didn't receive an AD tariff despite being investigated. This is because, conditional on an investigation being opened, the decision to impose an AD tariff is made based on the level characteristics of each sector and not their trends; thus the treatment and control groups should have parallel trends, which is the identifying assumption.

Main Empirical Model. The main specification is:

$$y_{i,s,t} = \theta^{mid}\tau^{mid}_{s,t} + \beta\mathbb{I}_{s,t}\left\{\text{After AD}\right\} + X'_{i,s,t}\kappa + \eta_i + \eta_t + \epsilon_{i,t}, \tag{3}$$

where $y_{i,s,t}$ is a labor outcome of firm i in sector s in year t and $\tau^{mid}_{s,t}$ is the average of ad-valorem AD tariff imposed on products produced by sector s in year t.[19] Firms in the control group have zero tariffs, but for the treatment group the variable $\tau^{mid}_{s,t}$ increases from zero after the decision of the first investigation and keeps changing as AD tariffs are imposed or removed. The variable $\mathbb{I}_{s,t}\left\{\text{After AD}\right\}$ is a dummy that takes the value of 1 after the first AD investigation; it captures the effect of being exposed to an AD investigation. Finally, η_i is a firm fixed effect, capturing level differences between firms, including the factors that led to the AD tariff. η_t is a year fixed effect accounting for aggregate shocks, such as the business cycle.[20]

Identifying Variation. The parameter of interest, θ^{mid}, captures the effect of AD tariffs on outcome $y_{i,s,t}$ in the protected sector. It is identified from the differential in the growth rate of variable $y_{i,s,t}$ between firms in sectors with an AD investigation that led to an AD tariff (the treatment group) and firms in sectors that with an AD investigation without an AD tariff (the control group). Because we are using tariffs on the right-hand side, the parameter of interest is also informed by variations in the size of the tariff within the treatment group.

[19] Sectors are defined according to the 4-digit National Classification of Economic Activities (CNAE) codes.
[20] The controls are a set of fixed effects for the number of products investigated in the previous 5 years.

Once again, if the assumption of parallel trends is valid, firms with different exposure to tariffs should be growing at the same rate before the beginning of the investigation. The identifying variation is similar to the one plotted in Figure 1.

Pre-Period Parallel Trends Test. To test for pre-period parallel trends, we use the following model:

$$y_{i,s,t} = \sum_j \theta_j \tau^{mid}_{s,first} \times \mathbb{I}_{s,t}\{j \text{ Yrs. to AD}\} + \sum_j \beta_j \mathbb{I}_{s,t}\{j \text{ Yrs. to AD}\} + \eta_i + \eta_t + \epsilon_{i,t}, \quad (4)$$

where $\tau^{mid}_{s,first}$ is the first AD tariff imposed on products of sector s and where $\mathbb{I}_{s,t}\{j \text{ Yrs. to AD}\}$ is a dummy that takes the value of 1 if year t is j years before the beginning of the investigation that results in the first AD tariff. Parallel trends in the pre-period imply that $\theta_j \approx 0$ for all $j < 0$.

3.3.1 Downstream Firms

Main Empirical Model. The effect of an AD tariff on downstream firms depends on the factor share on the tariffed product. Firms with a larger input share of the tariffed input should be more affected by an AD tariff than those with a lower factor share. Exploiting that, we define the increase in input costs due to tariff $\tau_{s,t}$ on downstream sector d, as follows:

$$\tilde{\tau}^{down}_{d,t} = \sum_s \frac{\text{Sales from Sector } s \text{ to Sector } d}{\text{Cost Expenditure of Sector } d} \times \tau^{mid}_{s,t},$$

where $\frac{\text{Sales from Sector } s \text{ to Sector } d}{\text{Cost Expenditure of Sector } d}$ is sector d's factor share on inputs from sector s and $\tau_{s,t}$ is the average AD tariff on products of sector s in year t.[21] The main downstream specification is:

$$y_{i,d,t} = \theta^{down} \tilde{\tau}^{down}_{d,t} + \beta \mathbb{I}_{d,t}\{\text{After AD}\} + X'_{i,d,t}\kappa + \eta_i + \eta_t + \epsilon_{i,t}, \quad (5)$$

where $y_{i,d,t}$ is a labor outcome of firm i in sector d, $\tilde{\tau}_{d,t}$ is the change in input cost to a firm in sector d caused by AD tariffs in other sectors, $X'_{i,d,t}$ is a set of controls, η_i is a firm fixed

[21] Section A.2 describes how we construct the input-output table at the level of the 4-digit sector code for Brazil.

effect, and η_t is a year fixed effect.[22]

Identifying Variation. The parameter of interest is θ^{down}, which captures the effect of increasing the cost of importing inputs. θ^{down} is identified from the differential in growth rates between sectors with a large increase in the cost of their input basket compared to sectors with a lower increase. Because, according to our Input-Output table, almost all sectors buy inputs from all other sectors, all firms are at least weakly exposed to AD tariffs in their inputs.

To have a comparable and cleaner identification, we also run Equation (5) limiting the sample to firms in the main downstream sector of each investigated midstream sector.[23] In this specification, the treatment group consists of the firms in the sector whose main supplier had an AD investigation that led to a tariff increase, while the control group consists of the firms in the sector whose main supplier never received protection with an AD tariff despite being investigated.[24]

Parallel Trends Test. We test parallel trends on the specification limited to the main downstream firms. As discussed above, because almost all sectors buy inputs from all other sectors, every firm is downstream to a treatment firm and downstream to a control firm. In this case, all the firms would be both in the treatment group and in the control group as soon as the first AD tariff is imposed.

To test for parallel trends, we use the following specification:

$$y_{i,d(s),t} = \sum_j \theta_j \tilde{\tau}^{down}_{d(s)} \times \mathbb{I}_{d(s),t} \{j \text{ Yrs. to AD}\} + \sum_j \beta_j \mathbb{I}_{d(s),t} \{j \text{ Yrs. to AD}\} + \eta_i + \eta_t + \epsilon_{i,t}, \tag{6}$$

[22]The controls are a set of fixed effects for the number of inputs with AD investigation in the past 5 years. On the robustness section, we also add as controls a 2-digit sector-year fixed effects, and AD tariffs on the suppliers and on their own products.

[23]The main downstream sector is the one that buys the largest share of the reference sector's production. Section A.2 formally defines main downstream (and upstream) sectors. A similar empirical strategy is also employed by Feng et al. (2023) who examine how the impact of climate disasters propagates to main upstream and main downstream countries.

[24]It is important to note that, as is usual in difference-in-differences, we are recovering the relative effect of the tariff. All firms are affected through the input-output connections and other general equilibrium effects. Still, firms that are the main consumers of a product with a tariff hike, should be relatively more affected

where $\tilde{\tau}_{d(s)}^{down}$ is the increase in input cost in main downstream sector $d(s)$ caused by the first AD tariff imposed on a product produced by sector s, and where $\mathbb{I}_{d(s),t}\left\{j \text{ Yrs. to AD}\right\}$ is a dummy that takes the value of 1 if year t is j years to the beginning of the investigation that results in the first AD tariff.[25]

3.3.2 Main Upstream Firms

We calculate the exposure of upstream firms to tariffs on their consumers as

$$\tilde{\tau}_{u,t}^{up} = \sum_{s} \frac{\text{Sales from Sector } u \text{ to Sector } s}{\text{Production of Sector } u} \times \tau_{s,t}^{mid},$$

where $\tau_{s,t}$ is the average AD tariff on sector s in year t. The main model is

$$y_{i,u,t} = \theta^{up}\tilde{\tau}_{u,t}^{up} + \beta\mathbb{I}_{u,t}\left\{\text{After AD}\right\} + X'_{i,u,t}\kappa + \eta_i + \eta_t + \epsilon_{i,t}, \tag{7}$$

where $y_{i,u,t}$ is a labor outcome of firm i in sector u and year t. $\tilde{\tau}_{u,t}^{up}$ is the average AD tariff on customers of sector u. The other variables are as described earlier. The identifying variation and the parallel trends test are similar to the specification with downstream firms.

3.4 Validation

The identifying assumption is that, conditional on being investigated, sectors with an AD tariff are in parallel trends with sectors without an AD tariff because the decision to impose a tariff is based on pre-determined level characteristics of each sector, and not their trends. In this section, we show that parallel trends are supported by institutional facts and exogeneity tests. Moreover, AD tariffs do not correlate with other policies implemented in the period, political connections, sectoral shocks, or the business cycle.

than others. In the sections below, we use a model to match these estimated relative effects by running the same regressions in the model. In this way, we recover the aggregate effect of tariffs common to all firms. In Section A.5.2, we consider a regression that includes all midstream, weighted average upstream, and weighted average downstream tariffs.

[25] Formally, $\tilde{\tau}_{d(s)}^{down} = \frac{\text{Sales from Sector } s \text{ to Main Downstream Sector } d(s)}{\text{Cost Expenditure of Sector } d(s)} \times \tau_{s,t}^{mid}$.

AD Tariffs Can be Predicted with International Prices. In Section A.4.1, in line with the WTO regulations, we show that prices outside of Brazil can predict AD tariffs with an R-squared above 0.95.[26] These results suggest that it is very unlikely that labor trends are affecting the Brazilian government's AD policy, which supports our assumption of parallel trends.

Placebo Tests. To further guarantee that the treatment and control groups do not differ in underlying shocks or trends, we implement two placebo tests, as shown in Section A.4.2. First, we demonstrate that tariffs do not correlate with employment changes in sectors that are not subject to AD tariffs but have similar employment trends. This placebo test indicates that the results are not driven by sectoral shocks to sectors following a certain employment trend. In our second placebo test, we show that there is no correlation between AD tariffs and employment changes 5 years before the AD tariff's implementation, supporting the notion that the identifying effect is not coming from labor market trends.

Other Policies and Political Connection. In Section A.4.3, we show that, conditional on AD investigations, AD tariffs do not correlate with political connections, government subsidies, tax breaks, or other tariffs. Although the correlation between AD tariffs and public procurement is statistically significant at the 10% level, it is not economically meaningful: a 100 percentage point increase in AD tariffs increases the probability of a government contract by just 0.09 percentage points. This correlation is likely spurious, as adding controls or changing the functional form leads to statistically insignificant coefficients.

Business Cycle. If the government is more likely to impose an AD tariff during downturns, the estimates of interest could be contaminated. In Section A.4.4, we show that the AD policy does not correlate with the business cycle.

International Competition and Parallel Trends. AD tariffs are determined by the level of international prices, with firms that receive AD tariffs after an investigation being those that face lower prices. Why, then, are firms facing greater international competition

[26] As discussed in Section A.4.1, AD tariffs should be a function of the import's price in Brazil and in the

in parallel trends with those experiencing less competition? As shown in Figure A.5, despite facing lower international prices, firms in the treatment group follow the same trend in international prices as those in the control group. This indicates that, while the levels of international competition differ, the trend in international competition remains consistent between the two groups. Because these firms share the same trend in international prices, we can isolate the effect of tariffs using fixed effects.

4 Results

4.1 Effect of AD Tariffs on Imports

AD Tariffs Affect Quantity Imported but not Prices. Figure 2 shows the dynamic effects of the AD tariff on log imports in dollars. Notice that, in the quarters before the announcement of the tariff increase, the control and treatment groups had a similar trend, validating our identifying assumption. This abruptly changed when the investigation began; 10 quarters later, a 100% marginal tariff led to an approximately 50% decrease in imports.

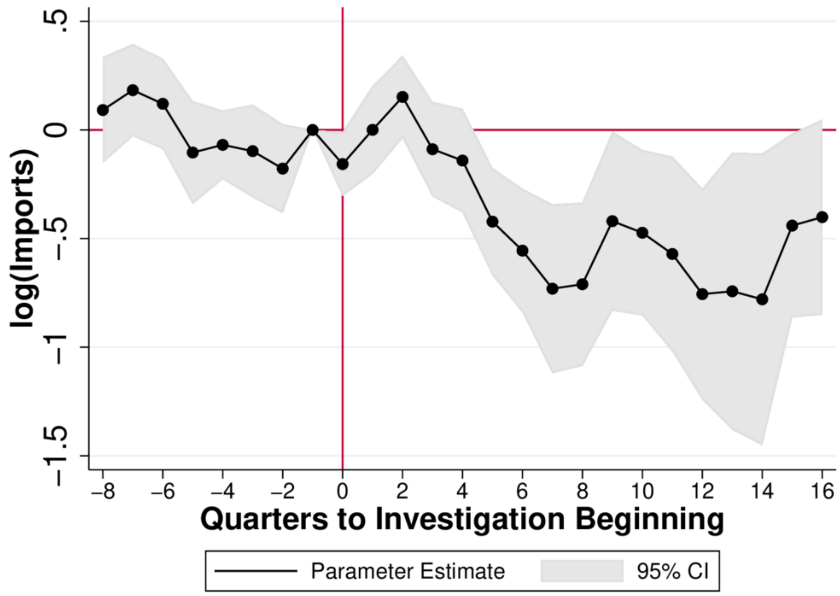
Tariffs cause a drop in the quantity imported but do not affect prices, according to Table 1, which is consistent with the idea that Brazil is a small open economy. Using variation from all AD tariffs, column 1 of Table 1 shows that a 100% increase in tariffs leads to a 25% drop in imports. For instance, moving AD tariffs from the 25th percentile to the 75th percentile would reduce imports by 11%. According to columns 2 and 3, which show the effects of tariffs on the quantity imported and the price of imported goods, the drop can be explained by the decrease in the quantity imported. The lack of a price effect, displayed in column 3 of Table 1, indicates that Brazilian demand for international goods is too small to have a significant effect on international prices.[27,28]

home country during the pre-period. But because the price in the home country is not observed, we proxy for this price with the AD tariff of other countries and the distribution of prices of the investigated product. The details of our test can be found in Section A.4.1.

[27]This indicates that we find a complete pass-through of AD tariffs in Brazil.This finding is consistent with Blonigen and Haynes (2002), Sandkamp (2020), and the recent works studying 2018-19 U.S. tariffs (Amiti et al. 2019, Amiti et al. 2020, Fajgelbaum et al. 2020, and Cavallo et al. 2021).

[28]Figure A.5 shows the dynamic effects of AD tariffs on import prices. Consistent with our identification strategy, the figure demonstrates that the treatment and control groups follow parallel trends in the pre-period, despite the treatment group facing lower average international prices.

Figure 2: **Effect of AD Tariffs on Imports**



Description: This figure contains the coefficients of the effect of AD tariff on imports using the dynamic model 2 plotted against quarters at the beginning of the investigation in the x-axis. Imports are measured in freight on board (FOB) current dollars at the NCM product code level. Import data is from the Secretary of International Trade of the Ministry of Economy, and AD data is from the Global Anti-dumping Database. The sample is composed of product-origin that had at least one AD investigation. The shaded area contains the 95% confidence interval. Standard errors are clustered at the product-origin level.

No Trade Diversion. There is no significant evidence for trade diversion; i.e., firms do not shift imports of the tariffed goods to another country. We run a regression of imports of the tariffed products from countries that did not have AD investigations on product-level AD tariffs. Table 2 shows that AD tariffs do not affect imports from other countries.[29]

We also investigate whether firms shift from importing the tariffed products to importing other products. We run a regression of imports of the products that do not face AD investigations but fall within the same 4-digit HS code impacted by the product-level AD tariff.[30] Table 2 shows that imports of similar products from the tariffed country are negatively affected by AD tariffs. This is explained by the model in Section 5: tariffs reduce the production of downstream firms by increasing their costs. Due to the production reduction, firms reduce the demand for all the inputs they use, including employment and other imported inputs associated with it.

[29]In other words, we run equation (1) with $y_{p,c,q}$ standing for imports of product p in quarter q by all countries except c.

[30]In other words, we run equation (1) with $y_{p,c,q}$ standing for imports from country c, in quarter q, of all products within the same 4-digit HS code of product p except product p.

Table 1: **Effects of AD Tariffs on International Trade**

	(1)	(2)	(3)
	log(Value Imports)	*log(Quantity Imports)*	*log(Price)*
$\tau_{p,c,t}$	-0.259***	-0.273***	0.0157
	(0.0811)	(0.0999)	(0.0428)
N	20803	20733	20732
R^2	0.635	0.652	0.787
Mean Dep. Var	12.703	11.654	1.077
Mean Ind. Var	.18	.18	.18

Description: This table presents the estimated parameters of model 1. The sample is composed of product-origin that had at least one AD investigation. *log(Value Imports)* is the log of FOB current dollar imports at the NCM level. *log(Quantity Imports)* is the log of quantity imported, and *log(Price)* is the log of price per unit. Import data is from the Secretary of International Trade of the Ministry of Economy, and AD data is from the Global Anti-dumping Database. The sample runs from 1995 to 2016. Standard errors are clustered at the product-origin level.

4.2 Midstream Firms

Protected Sector Expands. This section shows that an AD tariff increases the wage bill, employment, exports, and imports of protected sector firms. The effect of AD tariffs on the wage bill is presented in Figure 3. Before the introduction of the tariff, the treatment and control groups followed similar trends, once again validating our identification strategy. The introduction of the tariff led to a relative increase in the wage bill of firms protected by the AD tariff. Five years after its introduction, a 100% AD tariff increased the wage bill of the national producer by about 3%.

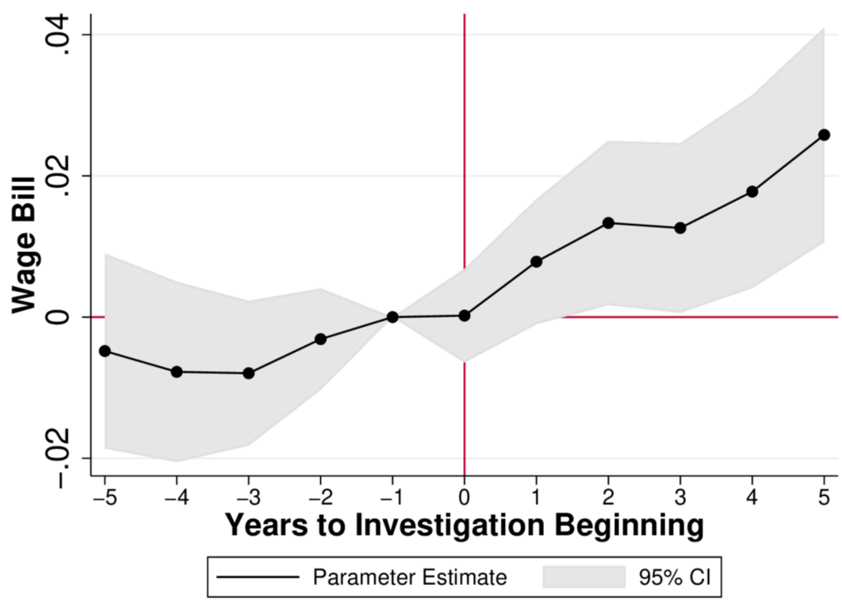
According to the results in Table 3, AD tariffs increase the employment, wage bill, exports and imports of the national producer. Columns 1 through 2 of Table 3 show the effect of tariffs on employment, and the wage bill. A 100% AD tariff increases employment by 1.8% and the wage bill by 1.9%. In terms of interquantile shift, moving AD tariffs from the 25th percentile to the 75th percentile increases employment and wage bill by 3.5% and 3.6%, respectively. Columns 3 and 4 show how the probability of becoming an exporter or importer is affected by tariffs. Column 3 shows that a 100% AD tariff would increase the probability of the national producer of becoming an exporter by 0.4%, while column 4 shows that the same tariff would increase the probability that the same domestic firm would become an

Table 2: **Effects of AD Tariffs on Trade Diversion**

	(1)	(2)	(3)	(4)
	log(Value Imports)	*log(Quantity Imports)*	*log(Value Imports)*	*log(Quantity Imports)*
AD Tariff	-0.0269	-0.0575	-0.0871**	-0.0926*
	(0.0357)	(0.0489)	(0.0443)	(0.0536)
N	60327	59792	120603	118222
R^2	0.659	0.707	0.694	0.746
Mean Dep. Var	10.832	8.661	10.993	8.952
Mean Ind. Var	.32	.32	.09	.09
Product X Orig. FE	Yes	Yes	Yes	Yes
Time X Country FE	Yes	Yes	Yes	Yes
Specification	Same Product, Other Countries		Same Country, Other Products	

Description: This table shows the effect of the AD tariff on imports from other countries and other products. In columns 1 and 2 we show the coefficient of a regression of average AD tariff at the product level on imports of countries not exposed to AD investigations. In columns 3 and 4 we show the coefficient of a regression of AD tariffs on the imports of other products at the same 4-digit HS code from the same country. Import data is from the Secretary of International Trade of the Ministry of Economy, and AD data is from the Global Anti-dumping Database. Standard errors are clustered at the product-origin level.

Figure 3: **Midstream Wage-Bill**



Description: This figure contains the coefficients of the effect of an AD tariff on the log wage bill using the dynamic model 4. The x-axis contains the number of years to the first AD investigation. Wage bill data is from RAIS, and AD data is from the Global Anti-dumping Database. The sample is composed of firms in sectors producing the product under AD investigation. We constrain the sample to the set of firms observed 5 years around the AD investigation. These sample restrictions are made to avoid compositional change. The shaded area contains the 95% confidence interval. Standard errors are clustered at the firm level.

importer by 0.3%. Columns 5 and 6 show the effects of AD tariffs on the intensive margin of exporting and importing. Therefore, tariffs affect employment at the national producer, as well as its international trade.

We find a larger effect of tariffs on midstream firms than Bown et al. (2021), who find an elasticity close to zero. Our estimate is comparable to Flaaen and Pierce (2019) after adjusting for different regressors.[31]

Table 3: **Effect of AD Tariffs on the National Producer**

	(1)	(2)	(3)	(4)	(5)	(6)
	log(# Workers)	*log(Wage Bill)*	$\mathbb{I}$*(Exporter)*	$\mathbb{I}$*(Importer)*	*log(Exports)*	*log(Imports)*
$\tau^{mid}_{s,t}$	0.0184***	0.0186***	0.00421***	0.00330***	0.0133	0.0286***
	(0.00359)	(0.00390)	(0.00114)	(0.00119)	(0.0107)	(0.00937)
N	119368	119368	132816	132816	17057	24052
R^2	0.829	0.863	0.613	0.635	0.832	0.798
# Firms	6277	6277	6277	6277	1635	2087
Mean Dep. Var	2.68	10.069	.165	.189	12.988	12.806
Mean Ind. Var	1.19	1.19	1.07	1.07	1.07	1.07

Description: This table presents the estimated parameters of model 3. The sample is composed of firms in sectors that produce the product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of the firm's total labor expenditure. $\mathbb{I}$*(Exporter)* is a dummy that takes the value of 1 if the protected firm exports any product that year. $\mathbb{I}$*(Importer)* is a dummy that takes the value of 1 if the protected firm imports any product that year. *log(Exports)* is the log of expected exports of the firm. *log(Imports)* is the log of expected imports of the firm. Expected exports and imports are calculated following de Souza (2021), who describes how expected export and imports are calculated at the firm level. $\tau^{mid}_{s,t}$ is the average AD tariff imposed on products produced by the sector of each firm. Standard errors are clustered at the firm level.

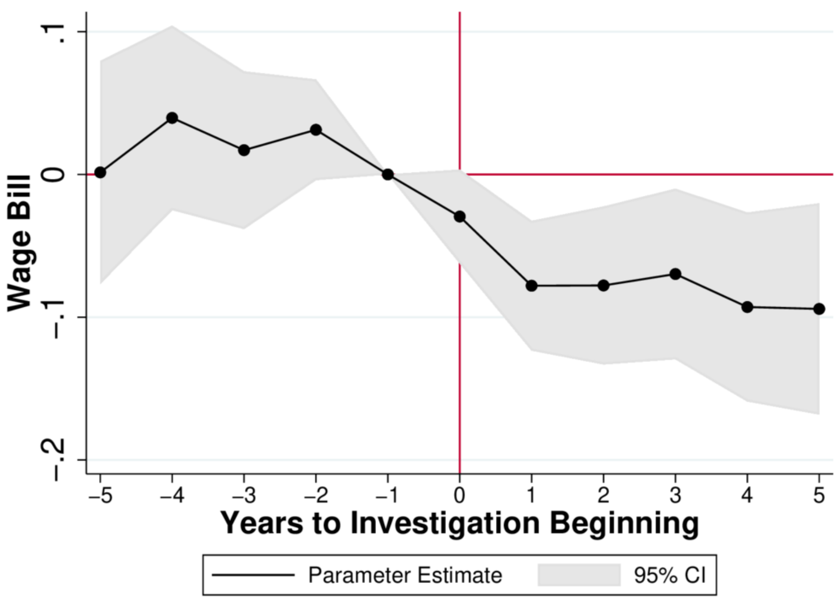
4.3 Downstream Firms

Downstream Firms Shrink. Tariffs propagate downstream, decreasing employment and the wage bill. Figure 4 traces the dynamic effects of AD tariffs on downstream firms. Once

[31]Using the model presented in this paper, along with many other canonical trade models, the partial elasticity of employment with respect to tariffs can be expressed as follows: $\Delta\log(L^s) = \beta\frac{IM^s}{X^s - IM^s + EX^s} s^s_{IM}\Delta\log(t^s)|_{\{P^s\},\{X^s\}}$, in which β is a structural parameter that summarizes the economy's fundamentals. $\frac{IM^s}{X^s - IM^s + EX^s}$ denotes the ratio of sector s import to the sector's output. s^s_{IM} denotes the share of import exposed to the tariff. Flaaen and Pierce (2019) estimate $\frac{\partial\log(L^s)}{\partial\frac{IM^s}{X^s - IM^s + EX^s}} = \beta\Delta\log(t^s) = 0.08$, which implies $\beta = 0.4$ if the average tariffs during the 2018 US-China trade war were 20% (Bown 2021). In

again, treatment and control firms show similar trends prior to the introduction of the AD tariff, diverging only after the beginning of the investigation, which supports our identification strategy. When tariffs are imposed on the inputs of these firms, employment decreases. A 100% AD tariff on all the inputs of a firm would lead to a 10% drop in the wage bill 5 years after the beginning of the investigation.

Figure 4: **Downstream Wage-Bill**



Description: This figure contains the coefficients of the effect of an AD tariff on the log wage bill of firms downstream to the AD tariff using the dynamic model 6. The x-axis contains the number of years to the first AD investigation. Wage bill data is from RAIS, and AD data is from the Global Anti-dumping Database. The sample is composed of firms whose main input is under AD investigation. We constrain the sample to the set of firms observed 5 years around the AD investigation. These sample restrictions are imposed to avoid compositional change. The shaded area contains the 95% confidence interval. Standard errors are clustered at the firm level.

Columns 1 and 2 of Table 4 show the average effect of AD tariffs on the main downstream firms.[32] A 100% AD tariff on all the inputs of these firms would lead to a 3.8% drop in employment and an 8.5% drop in the wage bill. For instance, moving input-weighted AD tariffs from the 25th percentile to the 75th percentile would decrease employment by 0.3% and wage bill by 0.8%.

The downstream effects of AD tariffs are not limited to the main buyer of an input,

contrast, we estimate $\frac{\partial \log(L^s)}{\partial \log(t^s)} = \beta \frac{IM^s}{X^s - IM^s + EX^s} s^s_{IM} = 0.0184$. Given an import-to-output ratio of 14.3% and a share of imports subject to AD of 18.44% in Brazil, we derive the structural parameter ($\beta = 0.7$). The partial elasticity requires holding aggregate prices and expenditures constant. Deriving this elasticity in general equilibrium requires a production network approach, which we will leave to future research.

[32]As Figure 4 demonstrates, these firms follow the same trend before the introduction of the tariff.

according to results in Table 4. Columns 3 and 4 show the effect of tariffs on all downstream firms. AD tariffs have no significant effect on employment downstream, although they do have an impact on the wage bill.

We identify a smaller effect of tariffs on downstream firms than many other papers in the literature. The elasticity of employment downstream from tariffs estimated by the literature ranges from -0.08 to -0.3.[33] There could be several reasons for this difference. Among them is our new identification strategy which allows us to reduce the influence of confounding effects.[34]

Table 4: **Effect of AD Tariffs on Downstream Firms**

	(1)	(2)	(3)	(4)
	log(# Workers)	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*
$\tilde{\tau}^{down}_{d,t}$	-0.0383*	-0.0857***	0.000765	-0.0430**
	(0.0221)	(0.0244)	(0.0173)	(0.0191)
Sample	*Main Downstream*	*Main Downstream*	*All Downstream*	*All Downstream*
N	182790	182790	969619	969619
R^2	0.812	0.833	0.806	0.834
# Firms	8686	8686	55505	55505
Mean Dep. Var	2.412	9.599	2.147	9.313
Mean Ind. Var	.07	.07	.05	.05

Description: This table presents the estimated parameters of model 5. The sample is composed of firms in sectors downstream to the product under AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. Columns 1 and 2 limit the sample to the main downstream firms. Columns 3 and 4 contain all downstream firms. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of total labor expenditure of the firm. $\tilde{\tau}^{down}_{d,t}$ is the average AD tariff imposed on the inputs used by downstream firms. Standard errors are clustered at the firm level.

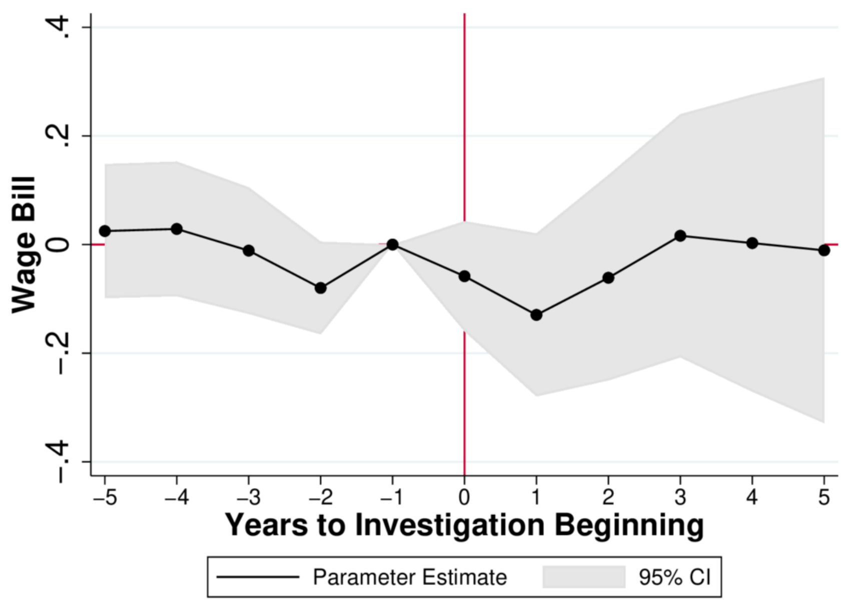
[33] Bown et al. (2021) find a downstream employment elasticity of approximately -0.3 for all sectors and roughly -0.15 for manufacturing sectors with respect to average input tariffs. The findings in Cox (2021) imply a downstream employment elasticity of -0.08 due to average steel tariffs.

[34] Our estimates are comparable to Flaaen and Pierce (2019) after a model-based calculation. In many trade models, the partial elasticity of downstream employment to midstream tariffs equals the following: $\Delta \log(L^s) = -\beta \Gamma^{ss'} \frac{IM^{s'}}{X^{s'}} s^{s'}_{IM} \Delta \log(t^{s'})|_{\{P^s\},\{X^s\}}$. $\Gamma^{ss'}$ denotes the share of midstream sector s' in downstream sector s total cost. $\frac{IM^{s'}}{X^{s'}}$ denotes the share of imports in sector s' total expenditure and $s^{s'}_{IM}$ denotes the share of imports exposed to tariffs. β is a structural parameter summarizing the economic fundamentals. Flaaen and Pierce (2019) estimate $\frac{\partial \log(L^s)}{\partial \left[\Gamma^{ss'} \frac{IM^{s'}}{X^{s'}} s^{s'}_{IM}\right]}|_{\{P^s\},\{X^s\}} = -\beta \Delta \log(t^{s'}) = -0.463$, which implies $\beta = 2.3$, if the average tariffs during the 2018 US-China trade war were 20%. In contrast, we estimate $\frac{\partial \log(L^s)}{\partial \left[\Gamma^{ss'} \log(t^{s'})\right]} = -\beta \frac{IM^{s'}}{X^{s'}} s^{s'}_{IM} = -0.038$. Given an import-to-expenditure ratio of 12.5% and a share of imports subject to AD of 18.44%, we derive the structural parameter ($\beta = 1.67$).

4.4 Upstream Firms

Upstream Firms are not Significantly Affected. Despite increasing employment in the protected sector and propagating downstream, this section shows that AD tariffs do not affect firms upstream, i.e., firms that sell inputs to the midstream firms. A potential explanation is that, as shown in Table 3, midstream firms purchase their inputs internationally instead of buying locally.

Figure 5: **Upstream Wage-Bill**



Description: This figure contains the coefficients of the effect of an AD tariff on the log wage bill of firms upstream to the AD tariff using the dynamic model. The x-axis contains the number of years to the first AD investigation. Wage bill data is from RAIS, and AD data is from the Global Anti-dumping Database. The sample is composed of firms whose main input is under AD investigation. We constrain the sample to the set of firms observed 5 years around the AD investigation. These sample restrictions are made to avoid compositional change. The shaded area contains the 95% confidence interval. Standard errors are clustered at the firm level.

Figure 5, which traces the dynamic effects of an AD tariff on the wage bill of the main input provider of the national supplier, indicates that there is no difference between the treatment and control groups before and after the AD tariff is implemented. Table 5 shows that even using variation from all the AD investigations, there is no significant effect of AD tariffs on employment or the wage bill. Columns 1 and 2 of Table 5 show the effect of AD tariffs on the numbers of workers and the wage bill in the main suppliers of sectors protected by the AD tariff. The estimates identified are neither statistically nor economically significant. Columns 3 and 4 show the effect of AD tariffs on all upstream sectors. We do not find any significant effect.

Table 5: **Effect of AD Tariffs on Upstream Firms**

	(1)	(2)	(3)	(4)
	log(# Workers)	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*
$\tilde{\tau}^{up}_{u,t}$	0.00321	-0.000384	0.00680*	0.00637
	(0.00792)	(0.00809)	(0.00379)	(0.00401)
Sample	*Main Upstream*	*Main Upstream*	*All Upstream*	*All Upstream*
N	74735	74735	3238468	3238468
R^2	0.816	0.840	0.807	0.835
# Firms	3694	3694	185354	185354
Mean Dep. Var	2.55	9.8	2.144	9.313
Mean Ind. Var	.29	.29	.05	.05

Description: This table presents the estimated parameters of model 7. The sample is composed of firms in sectors upstream to the product under AD investigation. We limit the sample to the set of firms observed 5 years around the AD investigation. Columns 1 and 2 limit the sample to the main upstream firm. Columns 3 and 4 contain all upstream firms. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of total labor expenditure of the firm. $\tilde{\tau}^{up}_{u,t}$ is the average AD tariff imposed on the sectors that upstream firms sell to. Standard errors are clustered at the firm level.

4.5 Robustness

We find that AD tariffs increase employment by protected sector firms. The effects of these tariffs propagate to downstream firms, thereby lowering their employment, but they do not significantly affect upstream firms. In this section we show that these results are robust to the addition of controls, to different specifications, and to the use of alternative identification strategies exploiting WTO regulation.

Controls. Tables A.10 through A.13 in Section A.5.1 show that the effect of AD tariffs on trade and on the wage bill is stable across specifications. Neither adding a 1-digit sector-year fixed effect, a 2-digit sector-year fixed effect, dummies for the number of products investigated, dummies for the number of products with AD tariffs as a control nor controlling for AD tariffs upstream and downstream change the main conclusion that AD tariffs increase the wage bill midstream, decrease it downstream, and have no effect upstream. While adding

2-digit sector-year fixed effects renders some coefficients insignificant, the point estimates remain consistent with our main narrative.[35]

All Sectors. Following Acemoglu et al. (2014) and Bown et al. (2021), in Section A.5.2 we run a specification with the exposure of each firm to midstream, downstream, and upstream tariffs. Under this specification, the results are still the same, i.e., AD tariffs increase employment midstream, their effects propagate downstream, and they do not affect upstream firms.

Sectoral Regressions. In Section A.5.3, we study the effect of AD tariffs on sectoral aggregates. We show that the results remain the same: AD tariffs boost employment midstream, their effects propagate to downstream firms, and they do not affect upstream firms.

Instrumental Variable. In Section A.4.1, we show that AD tariffs can be predicted with high accuracy using international prices and the AD policy of other countries. Exploiting this result, we use the AD policy of other countries as an instrument for AD tariffs in Brazil. In Section A.5.4 we show that tariffs increase employment midstream, propagate downstream, and have no effect upstream.

Regional Variation. In Section A.5.5, we also identify the effect of AD tariffs on local labor markets. Leveraging heterogeneous exposure to the tariffs' effects on account of the heterogeneous sectoral composition of regional labor markets, we find that tariffs increase employment midstream, decrease employment downstream (in particular, by educational attainment group), and have no impact upstream.

Other Shocks. In Section A.5.6, we show that heterogeneous exposure to aggregate shocks cannot explain our results. We add as controls to our main specifications terms capturing heterogeneous exposure to exchange rate fluctuation and the Brazilian trade liberalization.

[35] It is worth noting that including a 2-digit sector-year fixed effect limits the identification of the parameter of interest to variation within 2-digit sectors. However, only 25% of 2-digit sectors contain both a treatment and a control sector, resulting in high variance and low variation in specifications that include a 2-digit sector-year fixed effect.

We still find that tariffs midstream increase employment, decrease employment downstream, and have no effect upstream.

5 Model

To study the aggregate employment consequence, we build a quantitative model of the Brazilian economy. The model translates the relative employment effects that we identified into aggregate effects, taking into account the general equilibrium forces.

5.1 Environment

The model is static. There are $i \in \{0, 1, ...N\}$ countries; $i = 0$ denotes Brazil. Brazil has S production sectors and a population with measure L. Households optimally choose to work in one of the S sectors and supply labor to the sector in which they work, or stay out of the labor force ($s = 0$). If they work, they earn a sector-specific wage, decide how much labor to supply, and receive a dis-utility from working.

If households do not work, they receive social insurance from the government. To finance the social insurance, the government generates revenue from three sources: it imposes an income tax on all households, borrows from the rest of the world, and collects tariff revenues.

The firm's problem builds on Caliendo and Parro (2015) – it produces tradable output with labor and non-tradeable input from all sectors according to a constant-return-to-scale technology. The output market is competitive.[36] Each production sector has a representative firm. To make the non-tradable input, the firm sources tradable output from all sectors and countries. Brazilian tradable output is used domestically and exported.

We assume that Brazil is a small open economy in the sense that Brazilian AD tariffs do not affect the ex-tariff foreign price faced by Brazilian importers, an assumption supported by the empirical results (see Table 1).

[36] As long as mark-ups are not affected by tariffs, a model with monopolistic competition would deliver identical results.

5.2 Workers

Brazil is endowed with a population of fixed measure L. A representative household ω chooses which sector to work in and the amount of labor to supply in this sector, receives income, and chooses their consumption bundle. The labor force in all sectors and those that do not work add up to the total population. Households differ in their dis-utility to work in each sector.

Consumption. Household ω in sector s chooses final goods consumption of sector r, $c_r^s(\omega)$. The preference of households across different sectoral goods is given by

$$C^s(\omega) = \left(\sum_{r=1}^{S} (d_r)^{\frac{1}{\theta}} \left(c_r^s(\omega)\right)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}, \tag{8}$$

where d_r is a taste parameter and θ is the elasticity of substitution across sectors.

Income. Households working $l^s(\omega)$ in sector s receive wage w^s. If the household chooses to stay out of the labor force, ω receives income transfer b from the government. In any case, households pay a fraction δ of their income in taxes.[37] The budget constraint is

$$\sum_{r=1}^{s} P^r c_r^s(\omega) = \begin{cases} (1-\delta) w^s l^s(\omega) & , \ s > 0 \\ (1-\delta) b & , \ s = 0 \end{cases}. \tag{9}$$

Labor Supply. Conditional on working in sector s, households decide how much labor to supply. The utility of worker ω, supplying $l^s(\omega)$ to sector s and consuming $C^s(\omega)$, is given by

$$U^s(\omega) = \begin{cases} C^s(\omega) - \frac{\psi^s}{\psi^s+1} l^s(\omega)^{\frac{\psi^s+1}{\psi^s}} & , \ s > 0 \\ C^s(\omega) & , \ s = 0 \end{cases}, \tag{10}$$

where ψ^s, the Frisch labor supply elasticity within sector s, governs the elasticity of substitution between labor and leisure. In some sectors, ψ^s is low and it is costly for workers to

[37] This assumption ensures that fiscal policies do not distort the impact of trade shocks on a household's

adjust their labor supply. There is no dis-utility from working for those who do not work.[38]

Households choose between the different sectors. They receive a idiosyncratic preference shock $z^s(\omega)$ for working in sector s. $z^s(\omega)$ follows a Fréchet distribution with shape parameter μ.[39] Households also have an exogenous taste for working in sector s given by a^s.

Households' Problem. Households maximize utility subject to the consumption bundle (8), the budget constraint (9), and the endogenous utility (10):

$$\max_{s,\{c_s^r(\omega)\}_{r=1}^S,\{l_s(\omega)\}_{s=1}^S} U^s(\omega)a^s z^s(\omega) \tag{11}$$
$$\text{s.t. } (8),\ (9),\ \text{and } (10)$$

Heterogeneous Labor Supply Elasticity. The implied sectoral labor supply elasticity is heterogeneous across sectors. Notice that the labor supplied to sector s equals:[40]

$$L^s = \begin{cases} \frac{\tilde{a}^s\left(\frac{w^s}{P}\right)^{\lambda^s}}{\sum_{s=1}^S \tilde{a}^s\left(\frac{w^s}{P}\right)^{\lambda^s}+\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}L & , s>0 \\ \\ \frac{\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}{\sum_{s=1}^S \tilde{a}^s\left(\frac{w^s}{P}\right)^{\lambda^s}+\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}L & , s=0 \end{cases}, \tag{12}$$

where $\lambda^s = \mu(1+\psi^s)+\psi^s$ denotes the Frisch elasticity. An increase in a sector's wage causes an increase in its labor supply through two channels. First, more households choose this sector (governed by μ). Second, each household in this sector supplies more labor (governed by ψ^s). The second channel creates heterogeneous sectoral labor supply elasticities.[41]

sector choice.

[38]We assume that a household's labor supply problem is governed by the Greenwood et al. (1988) (GHH) preference for tractability. The GHH preference focuses on the substitution between leisure and consumption as it mutes the income effect. Cravino and Levchenko (2017) and Bonadio et al. (2021) also assume that a representative household supplies labor to each sector following GHH preferences. However, they abstract from the household's sector choice problem and their self-selection into the non-working sector.

[39]$z^s(\omega)$ has c.d.f.: $F(z^s(\omega)) = \exp(-(z^s(\omega))^{-\mu})$.

[40]See Section B.1 for the proof.

[41]If $\psi^s = 0, \forall s$, the labor supply problem will be reduced to a discrete choice problem where households only choose sectors, and the labor supply elasticity will be the same (and equal to the Fréchet shape parameter μ) for all sectors.

5.3 Government

The social insurance system is financed by three sources of government revenue. The first is the income tax, δ. The second is borrowing from the rest of the world through a Trade Deficit (TD).[42] The third is the Tariff Revenue (TR).[43] With the fiscal revenues, the government pays each non-working household a fixed social insurance income b:

$$bL^0 = \delta \left(\sum_{s=1}^{S} w^s L^s + bL^0 \right) + TD + TR. \tag{13}$$

5.4 Firms

Intermediate Goods. Each sector s contains a representative competitive firm. Firms use labor and a composite bundle from each sector to produce:

$$Y^s = A^s \left((e^s)^{\frac{1}{\rho}} (L^s)^{\frac{\rho-1}{\rho}} + \sum_{s'=1}^{S} (f^{ss'})^{\frac{1}{\rho}} (M^{ss'})^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}},$$

where A^s is the total factor productivity (TFP), L^s is the labor demand by sector s and $M^{ss'}$ is the quantity of sector s' output used by sector s. ρ denotes the elasticity of substitution across inputs. e^s and $f^{ss'}$ are labor- and input-augmenting technology parameters.[44]

A firm's profit maximization problem implies that Brazilian firms set prices, P_0^s, that are equal to the marginal cost.[45]

Composite Intermediate Goods. Firms acquire inputs from different countries. Inputs are aggregated at the sector level using a CES production function:

$$Q^s = \left(\sum_{i=0}^{N} (g_i^s)^{\frac{1}{\sigma^s}} (Y_i^s)^{\frac{\sigma^s-1}{\sigma^s}} \right)^{\frac{\sigma^s}{\sigma^s-1}},$$

[42] This is a common property of static models of international trade: the value of foreign borrowing equals the trade deficit.

[43] The tariff revenue is a function of import values and the tariffs imposed on these imports, which we specify below.

[44] These parameters allow us to match the factor shares observed in the data.

[45] These prices are a CES-aggregate of sectoral wages and composite goods prices (see Equation (B.3)). Denote sector s producer's expenditure share on input from sector s' with $s_M^{ss'}$, whose formula is reported in

where Q^s denotes the quantity of the non-tradable input bundle, g_i^s is a preference shifter for inputs from sector s and country i, and σ^s is the trade elasticity (the elasticity of substitution across countries).[46] Y_i^s denotes the quantity of sector s tradable goods imported from foreign country i. Y_0^s is the quantity of Brazilian tradable output used in Brazil.[47]

Brazilian exporters face the same trade elasticity σ^s. Foreign demand for Brazilian sector s output can be written as:

$$Y_{F0}^s = (P_0^s)^{-\sigma^s} E_F^s,$$

where E_F^s is a function of foreign income and price. Because Brazil is a small open economy, E_F^s can be treated as being exogenous to Brazilian AD tariffs.

Products. Sector-origin-level import, Y_i^s, is produced by combining different products:[48]

$$Y_i^s = \left(\sum_{l \in \Omega_i^s} (h_{il}^s)^{\frac{1}{\zeta^s}} (y_{il}^s)^{\frac{\zeta^s - 1}{\zeta^s}} \right)^{\frac{\zeta^s}{\zeta^s - 1}},$$

where Ω_i^s denotes the set of products that Brazil imports from country i in sector s, y_{il}^s denotes the quantity of imports in product l of sector s from country i, h_{il}^s is a preference parameter for products, and ζ^s is the elasticity of substitution across products. We allow the product-level elasticity of substitution to be heterogeneous across sectors and to differ from country-level substitution.

We present the market clearing conditions and equilibrium definition in Section B.2. To compute counterfactuals, we rewrite the model in changes, which we present in Section B.3.[49] We also present in Section B.3 the equilibrium definition for the model in changes.

Equation (B.4) in Section B.2.

[46] Like many works in the trade literature, including Broda and Weinstein (2006) and Caliendo and Parro (2015), we let the trade elasticity differ across sectors.

[47] Therefore, the rest of Brazilian sector s output, $Y^s - Y_0^s$, is exported. Equation (B.5) presents Brazilian sector s expenditure on country i.

[48] Fajgelbaum et al. (2020) uses a similar technology that aggregates products to sectors.

[49] By doing so we eliminate the economic fundamentals that are exogenous to tariff changes and are difficult to calibrate or estimate.

Comparing the Model to Literature. Our model and estimation strategy differ from those of Caliendo and Parro (2015) and Caliendo et al. (2019) in three important ways. First, we account for the substitutability across final products and complementarity across inputs. Second, we introduce flexible labor supply decisions, which help us understand aggregate employment consequences. Third, we estimate trade and labor supply elasticities credibly with the difference-in-differences method. We discuss these details in Section B.5.

6 Identification of Model Parameters

In this section we summarize how we identify the model parameters. In Section C, we describe each of these steps in detail.

Calibration. We calibrate a set of parameters based on Brazilian economic statistics in 1995. They include input-output coefficients, sectoral exports, sector population shares, consumption expenditure shares, and the social insurance tax rate. Each model sector refers to a Classificação Nacional de Atividades Econômicas (CNAE) 2.0 4-digit sector.

Elasticity of Substitution across Product Lines. To estimate the elasticity of substitution across product lines, ζ^s, we study the effect of AD tariffs on the import of products from a particular destination. ζ^s captures how easily the importer can switch product lines within sector-origin-level imports, and it governs the impact of AD tariffs on sector-origin-level prices. In Section calibration, we show that the elasticity of substitution across product lines, ζ^s, can be identified with a closed form-solution from the effect of AD tariffs on imports.

Elasticity of Substitution across Countries. The Armington trade elasticity, σ^s, which captures how easily sector-level imports can be substituted across different countries, is identified with a closed form-solution from the effect of AD tariffs on imports at the country level.

Labor Supply Elasticity. The labor supply elasticity, λ^s, governs the effects of tariffs on employment. In Section C, we show that λ^s can be identified with closed form-solution from the effects of AD tariffs on wages and mployment.

Indirect Inference. We estimate ρ, the elasticity of substitution across labor and materials, and θ, the demand elasticity across sectoral products, by indirect inference. ρ governs how much demand for workers increases out of an increase in the demand for the final product. Because of that, we choose a value for ρ to approximate the effect of AD tariffs on midstream employment. θ governs how much the demand of the final consumer changes from a change in prices. Because of that, we choose a value for θ to approximate the effect of AD tariffs downstream.

We guess a set of parameters, $\{\rho, \theta\}$, and we provide actual annual tariffs, $\left\{\tau_{i,t}^{s}\right\}$, to the model. For each year, we solve the counterfactual equilibrium with the model in changes (see Section B.3). Then we run the same panel regression in the model as in the data. We target the effects of anti-dumping tariffs on employment at midstream firms and at the main downstream firms. We present the detailed procedures in Section C.3.

Table 6: **Estimated Elasticities and Targeted Moments**

Parameters	**Targeted moments**	**Parameter Value**
Elasticity of substitution	Elasticity of midstream employment	0.6694
across inputs ρ	with respect to midstream tariffs	(0.6594,0.6796)
Elasticity of	Elasticity of main downstream employment	4.4082
final demand θ	with respect to midstream tariffs	(4.3658,4.4506)

Description: This table presents the elasticities that are estimated in the model–i.e., the of substitution between labor and inputs ρ and the elasticity of final demand θ. The values presented in parentheses are the lower and upper bounds of the 95% confidence interval of the estimated parameters. Standard errors are calculated by bootstrapping.

Table 6 shows the estimated parameters and their confidence intervals. Labor and materials are complements, with an elasticity of substitution equal to 0.67. Final goods are substitutes, with an elasticity of substitution of 4.41. These values fall within the estimated range in Oberfield and Raval (2021), who find that across different specifications and industries, the elasticity of substitution across inputs falls between 0.6 and 1.0 and the final demand elasticity varies between 3.0 and 5.0.[50]

[50] Additionally, Imbs and Mejean (2015) estimates an output elasticity of 4.1. Foster et al. (2008) estimates an input elasticity of 0.52. Su (2017) also finds that inputs are complements, while outputs are substitutes.

Table 7: **Targeted and non-targeted moments, data and model**

	Data	**Model**
Targeted Moments		
Midstream employment	0.0184	0.0184
Main downstream employment	-0.0383	-0.0383
Non-targeted Moments		
Main upstream employment	0.0032	0.0029
Midstream wage bill	0.0186	0.0218
Main downstream wage bill	-0.0857	-0.0769
Main upstream wage bill	-0.0003	0.0037
Exports by midstream firms	0.0133	-0.0061
Imports by midstream firms	0.0286	0.0224
Employment Elasticity with Respect to Average Tariffs		
Midstream tariffs	0.009	0.0117
Upstream tariffs	-0.0158	-0.0276
Downstream tariffs	-0.009	-0.0021

Description: This table presents the targeted and non-targeted moments in the data and in the model. Moments 1-8 refer to the elasticity of midstream, main downstream, and main upstream employment and the wage bill, as well as exports and imports with respect to midstream tariffs. Moments 9-11 refer to the joint impact of midstream, average downstream, and average upstream tariffs (see Section A.5.2). The data moments refer to the corresponding estimated coefficients that are presented in the empirical section. The model moments refer to those estimated with model-simulated data and Equations (C.1) and (C.2). The employment elasticity with respect to average tariffs refers to the joint impact of own sector, average upstream, and average downstream tariffs that we document in Table A.14.

Non-targeted Moments. The model can well approximate both targeted and non-targeted moments. Table 7 shows a series of elasticities that we identified with data in Section 3 alongside their model-generated counterparts. The model exactly matches the targeted moments, i.e., the effects of tariffs on midstream employment and on downstream employment at main downstream firms. The second panel shows the model performance on a set of non-targeted moments.[51] In particular, we do not find any upstream effects in the model, as indeed we have not found them in the data. Protected firms substitute domestically produced upstream products with imports, an empirical pattern that the model is able to accurately replicate.

All these papers use US data.

[51]The model predicts a small negative effect of tariffs on midstream exports, while the data in Table 3 shows a positive effect; that said, the positive effect documented in the data is insignificant.

7 Quantitative Results

7.1 Brazilian Anti-Dumping Policy

Table 8 shows the aggregate effects of Brazil's AD policy.[52] The Brazilian AD policy increased employment by 0.06%. Tariffs shift the demand for protected goods from overseas to the national market, which increases employment in protected firms and decreases it in downstream firms. The downstream effect is almost large enough to offset the employment and output gains in the protected sectors.

The Brazilian AD policy decreased real income by 1.3%. Tariffs increase producers' marginal cost and final prices to consumers. As a consequence, the real income of workers decreases, even though there are more workers.

Welfare decreased by 2.4%. Since the model considers the labor supply decision, we should measure welfare in consumption-equivalent terms; that is, we hold the labor-leisure choice fixed at the baseline level and we determine the percent change in consumption that makes households indifferent between a world with and without an AD policy.[53] As AD policy increases employment, the combined effects of decreased consumption and increased labor supply lead to a greater reduction in welfare than the decrease in real income.

Table 8: **Aggregate Effect of Brazilian AD Policy**

Variable	**Baseline Model**	**No Input-output**
Employment	0.06%	0.15%
GDP	0.05%	0.14%
Real income	-1.32%	-0.75%
Welfare	-2.43%	-1.53%

Description: This table shows the effect of Brazilian AD policy on aggregate employment, GDP, real income, and welfare. For each of the variables of interest, we calculate the percentage change between the equilibrium with the Brazilian AD policy and the benchmark equilibrium in which no AD tariff is imposed. These aggregate variables are defined in Section B.4. The Brazilian AD policy refers to each sector's maximum AD tariff for all years. We show the effect predicted by the baseline model and a model that does not have input-output linkages.

[52]We call the Brazilian AD policy the cumulative AD tariffs implemented by the Brazilian government. We present formulas used to compute these aggregate statistics in Section B.4. In Section C.6, instead of looking at the overall AD policy, we study the impact of AD tariffs that Brazil imposed each year.

[53]Since Lucas (1987), consumption-equivalent terms often have been used to measure the welfare change. Our equation transforms non-consumption terms that enter the utility, e.g., leisure, into consumption, such

It is important to consider the input-output relationship of firms. Table 8 shows that without this connection, the predicted effect on employment is almost twice as large, while the welfare cost is lower. The model without input-output connections fails to take into account the fact that AD tariffs decrease employment downstream; consequently, it overstates the positive impact on overall employment from AD tariffs.

Understanding the Greater Welfare Effects of AD Policy than Previous Works. We find a greater welfare loss from AD policies compared to Egger and Nelson (2011) because we measure welfare in consumption-equivalent terms and account for input-output linkages. We also find a greater real income loss from tariffs than Gallaway et al. (1999) and Fajgelbaum et al. (2020) because we account for the endogenous decrease in foreign transfers (trade deficit) due to tariffs.[54] We discuss these points in detail in Section C.6.1.

7.2 Propagation Through Input-Output Linkages

Figure 6 shows that the aggregate effect of AD tariffs depends on the protected sector's position in the value chain. On the y-axis, we plot the impact of a 200% AD tariff placed on each 4-digit CNAE 2.0 sector, averaged across all 4-digit sectors within each broad sector. The x-axis represents the average upstreamness of each broad sector, indicating the average number of sectors passed through by one dollar of output to reach the final demand (upstreamness definition in Section C.4).

Figure 6a shows that the employment impact of sector-level tariffs is negatively correlated with sector upstreamness.[55] There are two empirically relevant channels: the direct effect on the protected sector and downstream propagation.[56] When a sector is downstream in the

that they can be compared to other real economic variables, e.g., GDP and employment (Jones and Klenow 2016).

[54]Fajgelbaum et al. (2020) studies the 2018 US-China trade war, but the scope and magnitude of the trade war tariffs are comparable to the AD policy in Brazil. The trade war tariffs affected 13% of US imports, leading to an average price increase of 14% among the targeted varieties, while the US import-to-GDP ratio was 15%. Similarly, in 1995, the AD policy in Brazil affected 6% of imports, with an average tariff increase of 14.3%, and Brazil's import-to-GDP ratio was 10.2%.

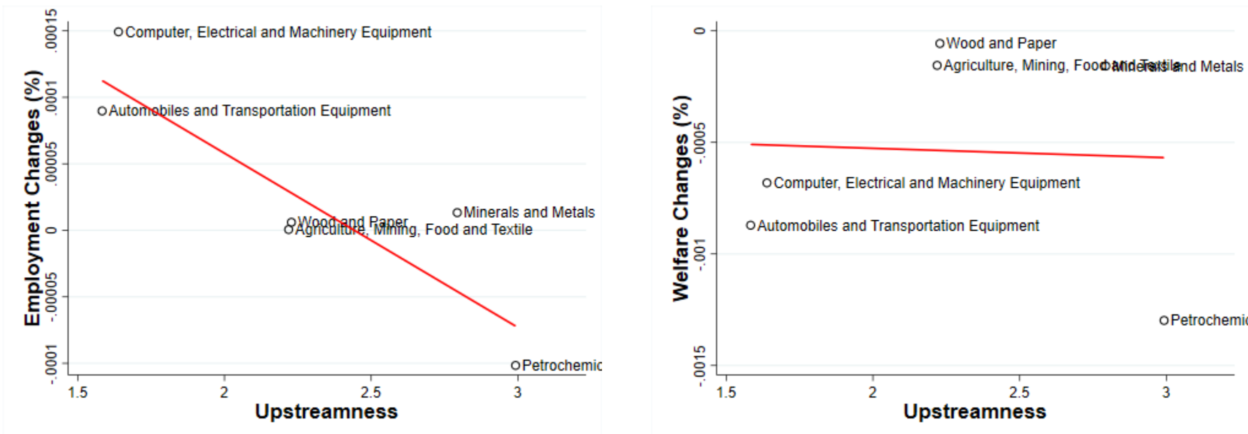
[55]This correlation persists even when controlling for sector characteristics, such as broad sector fixed effects, GDP value-added shares, employment shares, import shares, and trade elasticities (Table C.8).

[56]As discussed in the empirical section and supported by the model's predictions in Table C.5, tariffs have no significant propagation effect in upstream sectors.

value chain, few sectors are further downstream of it. The negative employment effect in downstream sectors is smaller and the positive effect in the protected sector dominates.[57]

Figure 6: **Effect of a 200% Sectoral Import Tariff on Employment and Welfare**

(a) **Employment and Sector Upstreamness** (b) **Welfare and Sector Upstreamness**



Description: These figures show the effect of a sectoral 200% AD tariff on aggregate employment and welfare. For each large sector, the x-axis plots the average upstreamness, which measures the average number of sectors that one dollar of a sector's output passes through to reach the final demand. In Section C.4, we present more details about how we measure sector upstreamness. The y-axis of Figure 6a plots the change in employment caused by a 200% AD tariff. The y-axis of Figure 6b plots the effect of a 200% tariff on welfare. To avoid cluttering the figure, we average the effect within large sectors.

Figure 6b shows that the impact of sector-level tariffs on welfare is not correlated with sector upstreamness and is negative for almost all sectors. The tariff affects economic welfare through two main channels: prices and wages. Taxing downstream sectors substitutes more imports with domestic labor, which increases domestic prices and decreases welfare. On the other hand, taxing upstream sectors decreases employment in more downstream sectors by cutting their wages, and this, too, leads to lower nominal income and welfare.[58]

7.3 Optimal Import Tariff Policy

If the goal of the government is to maximize employment, how should it choose tariffs? We study the choice of tariffs that maximize employment while keeping the government's budget

[57]In Section C.6.3 we show the aggregate consequences of imposing 200% sector-level tariffs on each 4-digit sector, without taking their means for broad sectors. The negative correlation between aggregate employment effect and sector upstreamness persists.

[58]Figure C.5 confirms this intuition, which shows that the impact of sector-level tariffs on both the nominal income and consumer price are negatively correlated with sector upstreamness.

constant.[59] We present this optimal tariff problem in Section C.5.

Figure 7a shows that the input-output linkages are an important factor in the choice of employment-maximizing tariffs.[60] Figure 7a plots on the x-axis the upstreamness of each broad sector and on the y-axis the sectoral tariffs that maximize employment. If the government's goal is to maximize employment, tariffs should be large (an average of 373%) and strongly negatively correlated with sector upstreamness. The government should minimize the negative downstream employment effect by setting higher tariffs on sectors selling directly to the final consumer.

Figure 7b shows that the optimal tariffs that maximize welfare should be low (an average of 7.8%) and positively correlated with sector upstreamness. Imposing higher tariffs on downstream sectors reallocates more production from abroad to domestic labor than imposing them on upstream sectors. That, in turn, contributes to higher consumer prices, which further reduces welfare.

According to Table 9, a government that uses tariffs can increase employment by at most 2.8%, but it causes a 15.9% decrease in welfare.[61] If, instead, the government chooses tariffs to maximize welfare, employment will increase by 0.01% but welfare should decrease only by 1.46%.[62] These findings highlight the trade-offs that policymakers face: the tariffs that increase employment are likely to harm consumer welfare.

[59] For tractability, we require tariffs to be bellow 1000%. We also experimented with setting the upper bound to 900%. Our findings are robust to the bounds.

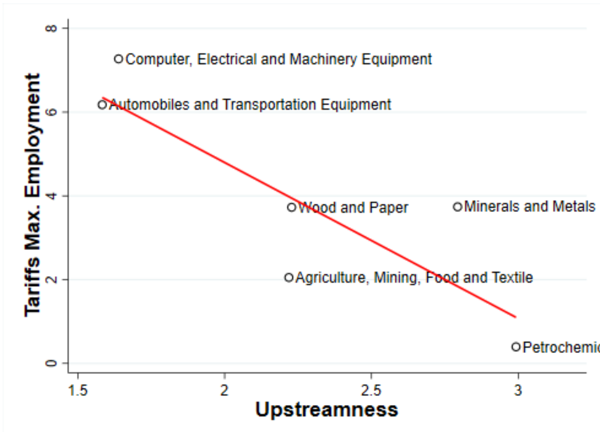
[60] In Section C.6.4 we show the optimal tariffs that maximize employment, GDP, real income and welfare on each 4-digit sector, without taking their means for broad sectors.

[61] The real income loss from optimal tariffs that maximize employment is comparable to the real income loss from autarky for Brazil that is described in the literature. Using an input-output table that has 251 sectors,Ossa (2015) shows that the Brazilian gains from trade equal 9.8%. This translates into a 8.9% real income loss from autarky.

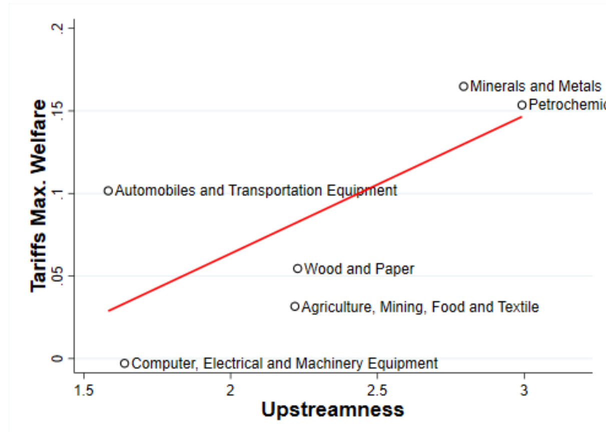
[62] Compared with the baseline equilibrium where no AD tariff is imposed, the optimal tariffs that maximize real income and welfare still reduce real income and welfare because of the fiscal constraint: the government is required to collect the same tariff revenue as it collects from the benchmark tariffs. If tariffs are set low for some sectors, they have to be high for other sectors to ensure the fiscal constraint holds. These tariffs raise welfare relative to the incumbent Brazilian AD policy.

Figure 7: **Tariffs to Maximize Employment and Welfare**

(a) **Tariffs that Maximize Employment**



(b) **Tariffs that Maximize Welfare**



Description: These figures show the sectoral optimal tariffs that maximize employment and welfare. The optimal tariffs solve a problem that maximizes the respective aggregate variable, subject to the equilibrium constraints and the additional constraint that the government collects the same tariff revenue as it collects from the benchmark tariffs (see Section 7.3). The Brazilian AD policy refers to each sector's maximum AD tariff in all years. The x-axis plots the average upstreamness of each broad sector, which measures the average number of sectors that one dollar of a sector's output passes through to reach final demand. In Section C.4, we present more details about how we measure sector upstreamness. The y-axis plots the tariff that maximizes employment (Figure 7a) and welfare (Figure 7b).

Table 9: **Optimal Import Tariff Policy**

	Optimal tariffs that maximize				Effect of
Effect on	Employment	GDP	Real income	Welfare	Brazilian AD policy
Employment	2.82%	2.46%	0.03%	0.01%	0.06%
GDP	2.32%	2.49%	0.07%	-0.10%	0.05%
Real income	-7.97%	-6.64%	-0.87%	-1.02%	-1.32%
Welfare	-15.85%	-14.63%	-1.77%	-1.46%	-2.43%

Description: This table shows the optimal tariff according to different objectives of the government and its effect on aggregate variables. The change in outcomes is made from the equilibrium without tariffs.

8 Conclusion

This paper examines how the impacts of tariffs propagate along the value chain and their aggregate consequences. The empirical method we develop to answer this question can be applied to investigate various economic outcomes resulting from tariffs across different countries, sectors, and time periods. We compile detailed data on AD investigations, trade, and the input-output table, matching them to firm-level administrative employment data in

Brazil. Using a difference-in-differences strategy, we find that AD tariffs reduce imports but do not significantly divert trade to imports of similar products from other foreign countries. AD tariffs significantly increase employment in the protected sector and strongly decrease employment in downstream sectors, but do not significantly increase employment in upstream sectors. We also demonstrate that Brazilian AD tariffs are indeed pre-dominantly determined by past foreign prices, proving the validity of the empirical strategy.

To quantify the aggregate, general equilibrium effects of these tariffs, we build a small open economy model of Brazil that takes into account international trade, input-output linkages and labor force participation. The model can reproduce the micro-elasticities identified here and it matches the aggregate moments of the Brazilian economy. We find that Brazilian AD policy weakly increases aggregate employment but decreases consumer welfare. On average, protecting downstream sectors increases aggregate employment more than it protects upstream sectors. A government whose objective is to maximize employment has strong incentives to increase tariffs, especially for downstream sectors. This moderately increases aggregate employment but substantially undermines consumer welfare.

Drawing our findings, policymakers can learn that when setting tariffs, they face an important trade-off between employment and welfare. Strong WTO rules, trade agreements, and domestic political institutions could prevent policy makers from creating jobs by raising tariffs without limits – a policy that imposes excessive harm on consumer welfare.

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A Empirical Evidence

A.1 Statistics of Anti-Dumping Investigation in Brazil

In this section we discuss the AD measures and investigations undertaken by Brazil between 1989 and 2017. Table A.1 presents the number of investigations, different products and countries. Treated refers to the product-country pair that had an AD tariff applied or price adjustment.

Table A.1: **Statistics of Brazilian AD Investigations**

	Treated	**Control**	**All**
# Investigations	393	183	576
# Products	155	108	227
# Countries	50	45	65
Avg. Tariff	0.35	0	0.24

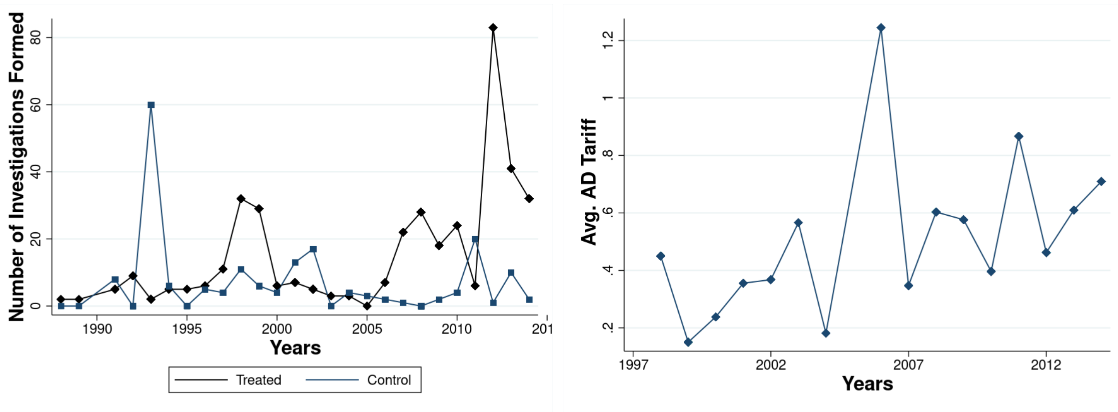
Description: This table presents the statistics on Brazilian AD investigations between 1989 and 2017. Each investigation is a product-country pair. The average tariff is calculated using the imposed ad-valorem tariff. Where the tariff is per-unit, we calculate the corresponding ad-valorem value using trade data of the preceding year.

Figure A.1a shows the AD investigations by year. In 1994 the Brazilian government filed a broad complaint that covered 124 types of artificial and synthetic fabric from South Korea. Because we count investigations on the product level and not on the complaint level, we observe a large spike in that year. The complaint was rejected for all products. With the exception of this spike, the treatment and control groups are evenly distributed over time.

Table A.2 shows the top 5 countries with the most investigations. China is the leader, and 80% of the investigations on China end with a tariff increase or price adjustment. Notably, there is a large variation in the tariffs imposed.

Figure A.1: **Brazilian Anti-Dumping Policy Over-Time**

(a) **Investigations by Year** (b) **Average AD Tariff by Year**



Description: Figure A.1a shows the average number of AD investigations per year at the product level. Figure A.1b shows the average AD tariff at the product level conditional on an AD being imposed.

Table A.2: **Statistics of Brazilian AD Investigations by Country**

Country	**# Investigations**	**% Treated**	**Avg. Tariff**
China	113	0.850	0.782
South Korea	63	0.317	0.336
United States	58	0.638	0.581
India	34	0.588	0.324
Taiwan	25	0.800	0.445
Germany	22	0.773	0.388

Description: This table presents the number of products investigated for dumping between 1989 and 2017 in Brazil against different countries. The data source is the Global Antidumping Database.

While AD tariffs target specific products and countries, they can lead to significant price changes on the sector level. Figure A.2 and Table A.3 show the average AD tariff faced by each CNAE 2.0 4-digit sector. Figure A.2a shows, for each CNAE 2.0 4-digit sector, the AD tariff faced by the average product-country pair that received an AD tariff. Figure A.2b shows, for each CNAE 2.0 4-digit sector, the AD tariff faced by the average product-country pair taking into account the product-country pairs that never faced AD tariffs.[63] Even if we

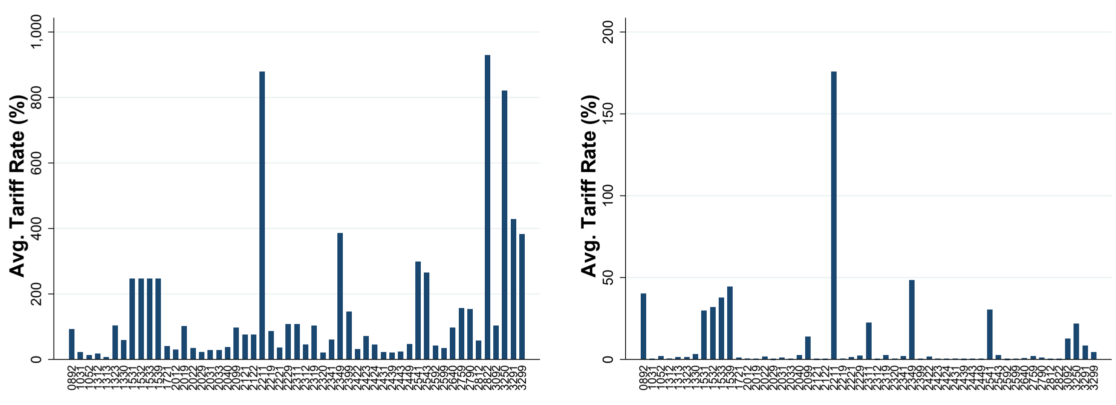
[63]In Figure A.2, we only show the 4-digit sectors that received AD tariffs. To compute the average AD tariff for each sector, first, we compute the imports in each product from each country in an average year during the sample period. Then we compute the weighted average of the maximum of product-country pair specific AD tariff during the sample period, using these product-country level imports as weights.

include in the average the product-country pairs that never had AD tariff changes, for some sectors, the average AD tariff is as high as 30%. These figures show that AD tariffs can lead to substantial price variations across sectors, even if only a subset of products and countries in each sector were hit by AD tariffs.

Table A.3 shows the summary statistics of AD tariffs by broad sectors. In Section 6, we estimate the cross-product and cross-country elasticities of substitution for the same set of broad sectors. Within each broad sector, some 4-digit sectors received an AD tariff. In the aggregate, about 20% of all 4-digit sectors (53 out of 297) were protected. Taking into account the 4-digit sectors that never received an AD tariff, the average AD tariff per 4-digit sector is 1.94%; the highest tariff is for wood and paper sector (5.4%) and the lowest tariff is for the computer, electrical and machinery equipment sector (0.1%). Among the 4-digit sectors that received AD tariffs, the average AD tariff per 4-digit sector is 10.5%, the highest is for the wood and paper sector (29.0%) and the lowest is for the computer, electrical and machinery equipment sector (0.77%). The percentiles of the tariffs also show that within each broad sector, some 4-digit sectors face large tariffs.

Figure A.2: **Anti-Dumping Tariff by Sector**

(a) **Product-countries with Positive Tariffs** (b) **All Product-countries**



Description: Figure A.2a shows, for each CNAE 4-digit sector, the average AD tariff of all product-countries that face positive AD tariffs. Figure A.2b shows, for each CNAE 4-digit sector, the average AD tariff of all product-countries that face positive AD tariffs. To compute the average AD tariff for each sector, first, we compute the imports of each product from each country in an average year during the sample period. Then we compute the weighted average of the maximum product-country pair specific AD tariff during the sample period, using these product-country level imports as weights. When computing the average tariff, Figure A.2a only includes the product-countries that had positive AD tariffs, and Figure A.2b includes all product-countries.

Table A.3: **Statistics of AD Tariff by Sector**

Sector Name	No. of 4-digit Sectors	No. with Positive AD	Uncond. Mean (%)	Cond. Mean (%)	Cond. p50	Cond. p95
Agriculture, Mining, Food and Textile	100	7	0.49	6.96	1.37	40.31
Wood and Paper	37	5	5.36	28.95	31.77	44.37
Petrochemicals	41	14	4.89	14.32	0.86	175.73
Minerals and Metals	40	18	2.82	6.27	0.39	48.34
Computer, Electrical and Machinery Equipment	47	5	0.08	0.77	0.78	1.90
Automobiles and Transportation Equipment	32	4	1.47	11.74	10.43	21.78
All Sectors	297	53	1.94	10.52	1.27	44.37

Description: This table presents summary statistics of AD tariff by broad sectors. The same set of broad sectors is used in Section 6, where we estimate the cross-product and cross-country elasticities of substitution. The *Uncond. Mean* refers to, for each sector, the AD tariff faced by an average 4-digit sector when we account for the 4-digit sectors that never received an AD tariff. *Cond. Mean* refers to, for each sector, the AD tariff faced by an average 4-digit sector that received an AD tariff. *Cond. p50* and *Cond. p95* shows the 50th percentile and 95th percentile of the AD tariffs faced by 4-digit sectors within each broad sector.

A.2 Input-Output Table

A.2.1 Estimating an Input-Output Table

We base our sectoral findings on CNAE 2.0 4-digit level (CNAE4 level) sectors.[64] There are a total of 297 goods (agriculture, mining, and manufacturing) sectors and 375 service sectors. As there is no AD tariff variation in the service sectors, we combine all service sectors into one single sector. In order to identify a sector's main upstream and downstream sectors, and to compute the weighted average upstream and downstream tariffs, we need to identify an input-output table for Brazil that has information about a sector's input expenditure on all sectors and from both domestic and foreign sources. We call such a table the **complete input-output table**. However, the most disaggregated complete input-output table for Brazil that is readily available is tabulated on a different sector classification–Niv, which has only 67 broad sectors (among the Niv sectors just 36 are goods and the rest are services).[65] To acquire complete input-output information on the CNAE4 level, we take advantage of the following datasets: a CNAE4 level imports table (details described below), CNAE4 level gross output and expenditure on input, as well as a Niv level complete input-output table. We then apply a generalized-RAS (GRAS) estimation algorithm (Temursho et al. 2021) on these databases to estimate the desirable input-output matrix.

We proceed with the following steps. We start with a unique database acquired from the Secretary of International Trade of the Ministry of Economy on sector-product level imports, showing the value of each HS 6-digit product that is imported by a domestic sector. Using a concordance table between HS 6-digit products and CNAE4 sectors from the Secretary of International Trade, we construct the input-output table for imports, i.e., CNAE4 level imports by each domestic CNAE4 sector. We call it the **imports table**. A few works in this literature, for example, Flaaen and Pierce (2019), and Handley et al. (2020), use the imports table directly to compute domestic sectors' exposure to upstream tariffs. However, due to the home bias, the IO coefficients calculated with the imports table may not equal to those calculated with the complete input-output table, which includes both domestic sales

[64]See `https://cnae.ibge.gov.br/` for the background information about this sector classification.

[65]Muendler (2002) discusses the relationship between CNAE sectors and Niv sectors. The Niv level complete input-output table is available from IBGE (the Brazilian Institute of Geography and Statistics). As the Niv level input-output table is only available for 2015, we fix all other datasets to the same year.

and imports.[66] Using only the imports table may miss the sectors in which the domestic producers are mainly upstream and downstream to the protected sectors but do not import or export extensively. Therefore, we need to update the imports table with domestic input-output information.

In the third step, we apply the GRAS estimation algorithm to these datasets to estimate a CNAE4-level complete input-output table. RAS (Leontief 1949, Stone 1961) is an estimation algorithm that has been widely used to estimate input-output tables. It minimizes the weighted distance between the unknown matrix and an initial guess of it, subject to constraints on the row- and column-sums of the unknown matrix (sectoral gross output and total input expenditure in our setting). The GRAS algorithm (Günlük-Şenesen and Bates 1988, Junius and Oosterhaven 2003) extends RAS. It imposes additional constraints such that the unknown matrix, once aggregated to a set of broad sectors, is consistent with a known input-output matrix at the same broad sector level. The GRAS algorithm is recommended by the Brazilian government to estimate the national input-output table when such a table is not available for the current year (Guilhoto et al. 2010), as well as to estimate the regional input-output table using region-sectoral gross output, total input, and the national level input-output table (Guilhoto et al. 2010). In our setting, the initial guess is the "normalized" imports table, where we multiply each entry in the imports table with the ratio of total input expenditure (the sum of all entries in the Niv level input-output table) to total imported intermediate input (the sum of all entries in the imports table).[67] Our constraints are the data on CNAE4 level gross output, input expenditure, and the Niv level input-output table. Following Temursho et al. (2021), we formulate the problem as:

[66]For example, an upstream sector's share in other sectors' domestic expenditure can be different from its share in other sectors' imports. Similarly, a downstream sector's share in the sales of other sectors' domestic producers may not equal its share in other sectors' foreign producers.

[67]Consequently, total expenditure in the "normalized" imports table, as we add up all elements in the matrix, equals total input expenditure in the Brazilian economy.

$$\min_{\{z_{ij}\}} f(\mathbf{Z}) = \sum_{i=1}^{S+F}\sum_{j=1}^{S} |x_{ij}^{O}| z_{ij}\log(z_{ij}) \tag{A.1}$$

$$\text{s.t.} \quad \sum_{j=1}^{S} x_{ij}^{O} z_{ij} = u_i, \forall i \in \{1, ..., S\} \tag{A.2}$$

$$\sum_{i=1}^{S+F} x_{ij}^{O} z_{ij} = v_j, \forall j \in \{1, ..., S\} \tag{A.3}$$

$$\sum_{i\in\Omega_I}\sum_{i\in\Omega_J} x_{ij}^{O} z_{ij} = w_{IJ}, \forall I \in \{1, ..., M\}, J \in \{1, ..., M\}. \tag{A.4}$$

$\{i\}_{i=1}^{S}$, $\{j\}_{i=1}^{S}$ denotes CNAE4 sectors. $i = F$ denotes the final sector (final demand and exports). I, J denote Niv sectors, Ω_I, Ω_J denote the CNAE4 sectors in the Niv sectors. Niv sectors do not overlap–$\Omega_I \cap \Omega_J = \emptyset, \forall I \neq J$, and $\cup_{I=1}^{M}\Omega_I = \{1, ..., S\}$. $\left\{x_{ij}^{O}\right\}_{i=1,j=1}^{i=S,j=S}$–the initial guess–represents the normalized imports table–imports of sector j output by sector i. x_{Fj}^{O} denotes sales by sector j to the final sector.[68] z_{ij} represents the distance between the normalized imports table and the unknown, complete input-output table. u_i denotes sector i total input expenditure. v_j denotes sector j supplies (imports and domestic products). w_{IJ} denotes Niv sector J total output used by Niv sector I.

The objective function minimizes the weighted distance between the imports table and the complete input-output table. The complete I-O table is consistent with the following information in the data: CNAE4 level total input expenditure according to constraint A.2, CNAE4 level gross output according to constraint A.3, and the cross-sector flows in the complete input-output table on the Niv level according to constraint A.4. Junius and Oosterhaven (2003), Miller and Blair (2009) and Temursho et al. (2021) show that the solution to this problem is unique, and Temursho et al. (2021) provides an iterative solver that can give the solution.

Armed with the solved $\{z_{ij}\}$, we recover the complete input-output table with $x_{ij} = z_{ij}x_{ij}^{O}$. We can then obtain the input-output coefficients. We define the sector expenditure share, $\gamma_{ij} = \frac{x_{ij}}{u_i}$, as the share of input that sector i spends on sector j. The numerator denotes the

[68]This initial guess is set to sector j's gross output plus this sector's imports minus $\sum_{i=1}^{J} x_{ij}^{O}$.

input demand of sector i from sector j and the denominator denotes the aggregate input demand of sector i. We define the sector output share, $S_{ij} = \frac{x_{ij}}{v_j}$, as the share of output that sector j sells to sector i. The numerator denotes the sales to sector i from sector j and the denominator denotes the production of sector j. With these two sets of market shares, we can construct the main upstream and downstream sectors as well as the average downstream and upstream tariffs.

A.2.2 Main upstream and downstream

For each sector i, we define its main upstream sector $j(i)$ as the sector that sells the largest share of output to sector i:

$$j(i) = \arg\max_{j} S_{ij}.$$

For each sector j, we define its main downstream sector $i(j)$ as the sector that spends the largest share of input on sector j:

$$i(j) = \arg\max_{i} \gamma_{ij}.$$

In the event studies we focus on non-service main upstream and downstream sectors.

A.3 Endogeneity of AD Tariffs

In this section, we show that products and sectors that are targeted by an AD investigation are not similar to the ones that are not investigated. Investigated products have higher trade volumes and lower prices. Moreover, they have an increasing trend in trade volume and a decreasing trend in prices. Investigated sectors have higher employment and wages, and have a decreasing trend in wages. These findings suggest that one cannot compare investigated products to non-investigated ones, because one cannot tease apart the effect of AD tariffs from product-level trends.

We use the following model to calculate the probability of investigation:

$$\mathbb{I}_{p,o,t}\left\{\text{Investigation}\right\} = \beta_0 \log(\text{Imports}_{p,o,t-1}) + \beta_1 \log(\text{Price}_{p,o,t-1}) + \mu_{p,o} + \mu_{t,o} + \epsilon_{p,o,t}, \tag{A.5}$$

where $\mathbb{I}_{p,o,t}\left\{\text{Investigation}\right\}$ is a dummy taking the value of 1 if there is an AD investigation against product p, from destination o, in year t; $Imports_{p,o,t-1}$ are imports of product p from origin o in year $t-1$; $\mu_{p,o}$ is a production-origin fixed effect, and $\mu_{t,o}$ is a time-origin fixed effect.

Columns 1 and 2 of Table A.4 show that AD investigations are more likely to target higher volume and lower price product-destinations. Columns 3 and 4 show that investigations are more likely to target product-destinations in an increasing volume and decreasing price trend. Columns 5 and 6 show that AD tariffs are also more likely to be implemented on higher volume and lower price product-destinations, and columns 7 and 8 show that they are also implemented on products in a decreasing price and increasing volume trend. Given that AD tariffs should be implemented on lower-price producers, it is expected that they are in an increasing volume and decreasing price trend. As the investigated products are not in the same trend as non-investigated ones, a comparison between them would deliver a biased estimate–one cannot tease apart the effect of an AD tariff from that of a pre-existing trend.

Table A.4: **Probability of Dumping Investigation and Anti-Dumping Tariff**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{AD\ Tariff\}$	$\mathbb{I}\{AD\ Tariff\}$	$\mathbb{I}\{AD\ Tariff\}$	$\mathbb{I}\{AD\ Tariff\}$
$log(Imports_{t-1})$	0.000121***	0.000120***	0.000108***	0.000111***	0.0000983***	0.0000972***	0.0000924***	0.0000941***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$log(Price_{t-1})$	-0.0000746***	-0.0000750***	-0.0000168**	-0.0000181**	-0.0000575***	-0.0000589***	-0.0000201***	-0.0000207***
	(0.000)	(0.000)	(0.033)	(0.023)	(0.000)	(0.000)	(0.003)	(0.002)
N	1542747	1542747	1509536	1508929	1542747	1542747	1509536	1508929
R^2	0.001	0.001	0.087	0.090	0.001	0.001	0.090	0.093
Year FE		X	X			X	X	
Product-Destination FE			X	X			X	X
Year-Country FE				X				X

Description: This table shows the estimated parameters of model A.5. $\mathbb{I}\{Investigation\}$ is a dummy taking the value of 1 if that product-destination has an AD investigation starting at that year. $\mathbb{I}\{AD\ Tariff\}$ is a dummy taking the value of 1 if a product had an AD investigation starting that year. $log(Imports_{t-1})$ the lagged FOB imports in dollars, and $log(Price_{t-1})$ is lagged prices. Trade data is from the Secretary of International Trade of the Ministry of Economy in Brazil and AD data is from the Global Anti-dumping Database. Standard errors, clustered at the origin-product level, are in parentheses.

Table A.5 examines the relationship between AD investigations and firm-level labor market outcomes. Columns 1 and 2 show that investigations are more likely to start in sectors that have higher wages, higher employment, and a smaller number of establishments. Column 3 shows that investigations are more likely to start in sectors that have increasing wages, an increasing number of workers, and a decreasing number of establishments trends. Columns 4-6 show that the same relationship holds between AD tariffs and firm-level labor market outcomes.

Table A.5: **Probability of Dumping Investigation and AD Tariff**

	(1)	(2)	(3)	(4)	(5)	(6)
	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{Investigation\}$	$\mathbb{I}\{AD\ Tariff\}$	$\mathbb{I}\{AD\ Tariff\}$	$\mathbb{I}\{AD\ Tariff\}$
log(Avg. Wage$_{t-1}$)	0.000102***	0.000335***	0.0000146	0.0000770***	0.000294***	0.0000130
	(0.000)	(0.000)	(0.191)	(0.000)	(0.000)	(0.236)
log(N. Workers$_{t-1}$)	0.000358***	0.000333***	-0.00000987**	0.000343***	0.000319***	-0.00000676+
	(0.000)	(0.000)	(0.027)	(0.000)	(0.000)	(0.122)
log(N. Establishments$_{t-1}$)	-0.000503***	-0.000529***	-0.0000349**	-0.000489***	-0.000516***	-0.0000363**
	(0.000)	(0.000)	(0.034)	(0.000)	(0.000)	(0.025)
N	36677266	36677266	33294706	36677266	36677266	33294706
Year FE		X	X		X	X
Sector FE			X			X

Description: This table shows the estimated parameters of a regression of AD policy and firm level characteristics. $\mathbb{I}\{Investigation\}$ is a dummy taking the value of 1 if that product-destination has an AD investigation starting at that year. $\mathbb{I}\{AD\ Tariff\}$ is a dummy taking the value of 1 if a product had an AD investigation starting that year. *log(N. Workers$_{t-1}$)* is lagged employment and *log(N. Establishments$_{t-1}$)* is lagged number of establishments. Trade data is from the Secretary of International Trade of the Ministry of Economy in Brazil and AD data is from the Global Anti-dumping Database. Standard errors, clustered at the origin-product level, are in parentheses.

A.4 Validation

A.4.1 Predicting Tariffs

According to the WTO regulation, AD tariffs should be equal to the price exporters charged in their home country minus the price they charged in Brazil. Therefore, if we had international data on prices we could test whether WTO regulations are being followed with

$$\tau_{p,c} = \beta \frac{\pi_{p,c,c} - \pi_{p,c,BR}}{\pi_{p,c,BR}} + \epsilon_{p,c},$$

where $\tau_{p,c}$ is the AD tariff imposed against product p from country c, $\pi_{p,c,c}$ is the price charged by the exporter of product p, from country c, in country c, $\pi_{p,c,BR}$ is the price of product p, from country c, in Brazil. If WTO regulations are being followed, $\beta = 1$.

However, life is not so easy. We do not observe the price charged by the exporter in their home market. Instead, we must approximate this with the distribution of prices and the AD policy of other countries. The idea is that the distribution of prices of product p from country c and the AD tariffs imposed against product p from country c contain indirect information on the price charged in country c. We use the specification:

$$\tau_{p,c} = \beta_1 \tau_{p,c}^{avg} + \beta_2 \tau_{p,c}^{median} + \beta_2 \tau_{p,c}^{p25} + \beta_2 \tau_{p,c}^{p75} + \beta_2 \tau_{p,c}^{max} + \beta_2 \tau_{p,c}^{min} + X'_{p,c}\theta + \epsilon, \tag{A.6}$$

where $\tau_{p,c}^{avg}$ is the AD tariff if the price charged in country c and product p was the average price charged for imports of product p from country c across all countries in the world except for Brazil. Similarly, $\tau_{p,c}^{median}$, $\tau_{p,c}^{p25}$, $\tau_{p,c}^{p75}$, $\tau_{p,c}^{max}$, and $\tau_{p,c}^{min}$ uses the tariff that would have been implemented if the price charged by the supplier in its home country had been the median, the 25th percentile, the 75th percentile, the maximum price, or the minimum price, respectively. $X_{p,c}$ is a set of fixed effects for the number of countries imposing AD tariff against pair (p, c) or implementing an AD investigation against (p, c).

Table A.6, which displays the coefficients of model A.6, shows that international prices are a good predictor of AD tariffs. The most relevant information is the R-squared. It shows that, with precision varying from 0.8 to 0.972, international prices alone can predict AD tariffs. It is worth mentioning that the relation between international prices and AD tariffs is non-monotonic. Therefore, a R-square of 1 would never be attainable.

Table A.6: **AD Tariffs and the Distribution of Prices**

	(1)	(2)	(3)	(4)
	AD tariff	AD tariff	AD tariff	AD tariff
$\tau^{avg}_{p,c}$	0.731***	0.550***	0.101*	-0.0400
	(0.0511)	(0.0593)	(0.0554)	(0.0992)
$\tau^{median}_{p,c}$	-0.237***	-1.095***	0.0316	0.112
	(0.0622)	(0.153)	(0.117)	(0.0931)
$\tau^{p25}_{p,c}$	3.676***	2.732***	-0.183	-0.0272
	(0.407)	(0.442)	(0.190)	(0.232)
$\tau^{p75}_{p,c}$	-0.752***	0.0735	0.0000453	0.00163
	(0.0647)	(0.164)	(0.00457)	(0.00319)
$\tau^{max}_{p,c}$	-0.000000196***	0.000000238	2.98e-08	0.00000379***
	(5.01e-08)	(0.000000241)	(5.61e-08)	(0.000000562)
$\tau^{min}_{p,c}$	-5.787***	-4.072***	-0.0230	-0.282
	(0.639)	(0.722)	(0.219)	(0.483)
Level	Product X Origin	Product X Origin	Sector	Sector
Sample	All	Positive Tariff	All	Positive Tariff
N	129	100	62	49
R^2	0.800	0.904	0.830	0.972
adj. R^2	0.680	0.828	0.390	0.853

Description: This table shows the estimated parameters of a regression of AD policy on different values of predicted tariffs. $\tau^{avg}_{p,c} = \frac{\pi_{p,avg}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,c,avg}$ is the average price charged by country c for good p to all other countries except Brazil , $\tau^{median}_{p,c} = \frac{\pi_{p,median}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,median}$ is the median price charged by country c for good p to all other countries except Brazil, $\tau^{median}_{p,c} = \frac{\pi_{p,median}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,median}$ is the median price charged by country c for good p to all other countries except Brazil, $\tau^{p25}_{p,c} = \frac{\pi_{p,p25}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,p25}$ is the 25th percentile of prices charged by country c for good p to all other countries except Brazil, $\tau^{p75}_{p,c} = \frac{\pi_{p,p75}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,p75}$ is the 75th percentile of prices charged by country c for good p to all other countries except Brazil, $\tau^{max}_{p,c} = \frac{\pi_{p,max}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,max}$ is the maximum price charged by country c for good p to all other countries except Brazil, and $\tau^{min}_{p,c} = \frac{\pi_{p,min}-\pi_{p,c,BR}}{\pi_{p,c,BR}}$ where $\pi_{p,min}$ is the minimum price charged by country c for good p to all other countries except Brazil. $ADtariff$ is the AD tariff imposed at the product level. Trade data is from the the Secretary of International Trade of the Ministry of Economy in Brazil and the United Nations Comtrade, and AD data is from the Global Anti-dumping database. Standard errors, clustered at the origin-product level, are in parenthesis.

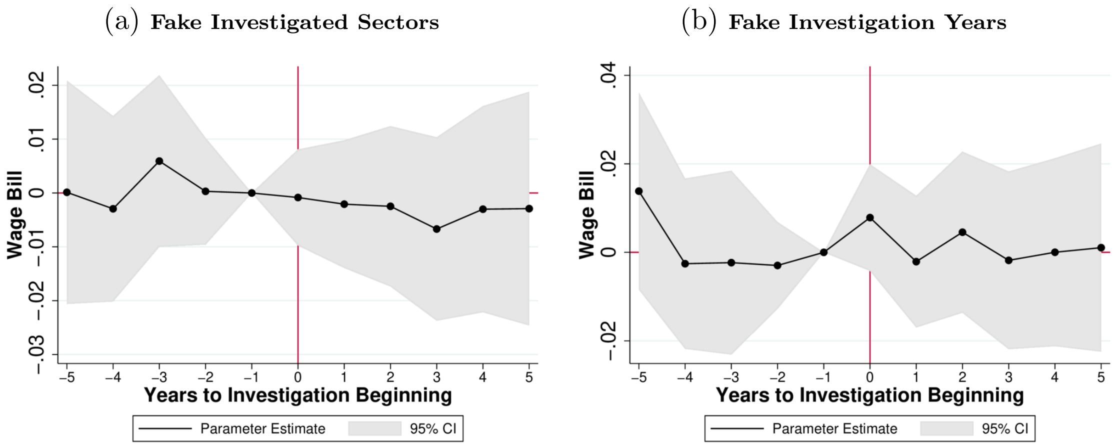
A.4.2 Placebo Tests

In this section, we discuss the results of two placebo tests. First, we evaluate if the results are driven by sectoral shocks. To do so, we match each sector that received an AD tariff, to another sector that did not receive an AD tariff but was in a similar trend before the introduction of the tariff. We take these matches as the fake treatment group and compare this group to the same control group as in the main specification. Second, we evaluate if the results are driven by sectoral trends. To do so, we implement the difference-in-differences strategy pretending that the AD tariff was implemented 5 years before its de-facto implementation. These placebo tests support that results are not driven by sectoral shocks or trends.

To test if the results are driven by sectoral shocks, we match each sector that faces an AD investigation to a sector that belongs to the same large sector group, and had similar employment and international trade trends but did not face an AD investigation. More specifically, for each 4-digit sector i that has an AD investigation, we match it to sector q which is in the same 1-digit sector and had a similar level of employment and wage bill in the three years before the AD investigation commenced. Then, we treat each firm at sector q as if they had been affected by the investigation and reproduce regression 4. If a sectoral shock that affected sectors in a particular trend is behind the results identified, the AD tariffs should also correlate with employment movements at sector q.

The results of the placebo test are presented in Figure A.3a. They indicate that there is no correlation between employment in sectors that did not receive an AD tariff but had a similar trend in employment and the wage bill, and AD tariffs. We conclude that the results are not driven by sectoral shocks affecting sectors with similar employment characteristics.

Figure A.3: **Placebo Tests with Fake Investigated Sectors and Fake Investigation Years**



Description: Figure A.3a shows the coefficients of regression 4 but using placebo firms. For each sector with an AD investigation, we match it to a sector in the same 4-digit classification that had similar employment and wage-bill in the 3 years before the investigation. Then, we treat the matched sector as if it was subjected to the AD investigation and tariff. Figure A.3b shows the coefficients of regression 4 pretending that the AD investigation started 5 years before it actually did.

We also test if the results are driven by sectoral trends. To do so we implement regression 4 but we pretend that the investigation started 5 years before its de-facto implementation. Figure A.3b shows that, as expected, we don't find any difference in the wage bill between treatment and control five years before the introduction of the tariff.

A.4.3 Political Connection and Other Policies

We show that AD tariffs are not correlated with political engagement or other policies. If firms protected by a tariff are also targeted by other policies, we will not be able to tease apart the effect of tariffs from the effect of these other policies. Table A.7 tests this for a series of prominent policies in Brazil. It shows that AD tariffs do not correlate with signing a procurement contract with the federal government (Column 2) nor with receiving a subsidized loan (Column 3).

During the 2000s, the Brazilian government implemented policies facilitating access to the stock market, reducing taxes, and privatizing state-owned firms. Columns 4 to 7 show that these policies do not correlate with AD tariffs.

There is no correlation between tariffs and campaign contributions, according to Table A.7. Therefore, it is unlikely that firms targeted by AD tariff are systematically lobbying for other benefits from the government.

AD tariffs do not correlate with other international trade policies. Columns 8 and 9 show that the treatment and control groups are equally exposed to changes in MFN tariffs and preferential tariffs.

There is a weak correlation between AD tariffs and government procurement. Specifically, a 100 percentage point increase in AD tariffs raises the probability of a government contract by only 0.09 percentage points. We present two exercises suggesting that this correlation is likely spurious.

First, Table A.8 shows the correlation between AD tariffs and government procurement under alternative functional forms, rather than the dummy variable used in the main specification in Table A.7. The results show no statistically significant correlation between AD tariffs and the number or value of government contracts across these functional forms. Second, Table A.9 shows that adding any control to the baseline specification eliminates the significance of the correlation between tariffs and government procurement. These results suggest that the correlation between AD tariffs and government procurement is spurious.

Table A.7: **AD Tariffs are not Correlated with Political Connection and Other Policies**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\mathbb{I}$\{Campaign Contribution\}	$\mathbb{I}$\{Gov. Demand\}	$\mathbb{I}$\{Subsidize Loan\}	$\mathbb{I}$\{Publicly Traded\}	$\mathbb{I}$\{Public\}	$\mathbb{I}$\{Multinational\}	$\mathbb{I}$\{Simples\}	MFN Tariff	Tariffs
$\tau_{s,t}^{mid}$	-0.000359	0.000917*	-0.000106	-0.000331	0.00000810	-0.00000934	-0.00168	0.138	0.136
	(0.00112)	(0.000531)	(0.000196)	(0.000338)	(0.000183)	(0.0000120)	(0.00132)	(0.0979)	(0.105)
N	18419	72149	132816	132770	132811	132815	96100	132816	132816
R^2	0.512	0.523	0.181	0.537	0.208	0.109	0.751	0.942	0.951
# Firms	6274	6275	6277	6277	6277	6277	6277	36	36
Mean Dep. Var	.014	.02	.001	.006	.004	0	.535	17.381	18.037
Mean Ind. Var	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Description: This table presents the estimated parameters of model 3. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. $\mathbb{I}$\{Campaign Contribution\} is a dummy taking the value of 1 if the firm has made a campaign contribution in the past election, $\mathbb{I}$\{Gov. Demand\} is a dummy taking the value of 1 if the firm has won a government procurement, $\mathbb{I}$\{Subsidize Loan\} is a dummy if the firm has collected a subsidized loan from the government, $\mathbb{I}$\{Publicly Traded\} is a dummy if the firm is publicly traded, $\mathbb{I}$\{Public\} is a dummy if the firm is owned by the government, $\mathbb{I}$\{Multinational\} is a dummy if the firm is part of a multinational corporation, $\mathbb{I}$\{Simples\} is a dummy if the firm is part of the Simples plan, which is a plan with lower taxes and simplified tax filling, MFN Tariff is the most favored nation tariff, i.e., the tariff imposed by Brazil on other WTO member, and Tariffs is the tariff imposed by Brazil excluding AD. $\tau_{s,t}^{mid}$ is the average AD tariff imposed on products produced by the sector of each firm. Standard errors are clustered at the firm level for columns 1 to 7 and at the sector level for columns 8 and 9. We cluster tariffs at the sector level because they do not vary at the firm level.

Table A.8: **AD Tariffs and Government Procurement Contracts under Different Functional Forms**

	(1)	(2)	(3)	(4)	(5)	(6)
	Value Procurement	*Number Procurement*	*log(Value Procurement)*	*log(N Procurement)*	*log(Value Procurement + 1)*	*log(Number Procurement + 1)*
$\tau_{s,t}^{mid}$	-366.1	-0.00185	-0.00432	0.00209	0.00925	0.000536
	(1796.5)	(0.00253)	(0.0419)	(0.0246)	(0.00616)	(0.000613)
N	72149	72149	1349	1349	72149	72149
R^2	0.240	0.819	0.714	0.645	0.562	0.648
# Firms	6275	6275	266	266	6275	6275
Mean Dep. Var	38943.681	0.067	11.452	0.659	0.235	0.023
Mean Ind. Var	1.07	1.07	1.07	1.07	1.07	1.07
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Description: This table presents the correlation between AD tariffs and government procurement under different functional forms, following the estimated parameters of model 3. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. *Value Procurement* is the total value (in reais) of government procurement contracts, *Number Procurement* is the total number of government procurement contracts, *log(Value Procurement)* is the logarithm of the total value of government procurement contracts, *log(N Procurement)* is the logarithm of the total number of government procurement contracts, *log(Value Procurement+1)* is the logarithm of the total value of government procurement contracts plus one, and *log(N Procurement+1)* is the natural logarithm of the total number of government procurement contracts plus one. $\tau_{s,t}^{mid}$ is the average AD tariff imposed on products produced by the sector of each firm. Standard errors are clustered at the firm level.

Table A.9: **AD Tariffs and Government Procurement Contracts with Controls**

	(1)	(2)	(3)	(4)	(5)
	$\mathbb{I}\{Gov.\ Demand\}$	$\mathbb{I}\{Gov.\ Demand\}$	$\mathbb{I}\{Gov.\ Demand\}$	$\mathbb{I}\{Gov.\ Demand\}$	$\mathbb{I}\{Gov.\ Demand\}$
$\tau^{mid}_{s,t}$	0.000917*	0.000606	0.000756	0.000210	0.000233
	(0.000531)	(0.000477)	(0.000539)	(0.000420)	(0.000474)
N	72149	72149	72149	72149	72149
R^2	0.523	0.524	0.523	0.523	0.524
# Firms	6275	6275	6275	6275	6275
Baseline Controls	X	X	X	X	X
2-digit Sector FE		X			X
# AD Products			X		X
Other Tariffs				X	X

Description: This table presents the correlation between AD tariffs and government procurement under different functional forms, following the estimated parameters of model 3. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. The first column is the baseline specification. The second column adds a 2-digit sector-year fixed effect. The third column adds a fixed effect for the number of products under AD investigation. The fourth column adds as control AD tariffs upstream or downstream. The last column adds all the controls. $\tau^{mid}_{s,t}$ is the average AD tariff imposed on products produced by the sector of each firm. Standard errors are clustered at the firm level.

A.4.4 Business Cycle

If the government is more lenient in AD investigations during a recession, this could bias the estimates and indicate that the government isn't following the WTO regulation. To investigate if this is the case, we plot the following impulse response functions:

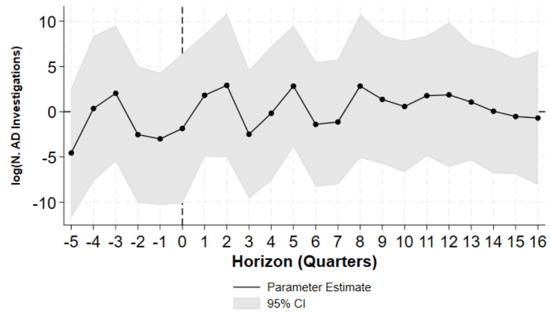
$$Y_{t+j} = \beta_j GDP\ growth\ rate_t + \theta_j + epsilon_t \tag{A.7}$$

where Y_{t+j} is an outcome of AD policy in quarter $t + j$. β_j is the correlation between AD policy in j quarters and the GDP growth rate in quarter t. If recessions lead to more AD tariffs, β_j should be a negative significant coefficient for $j > 0$.

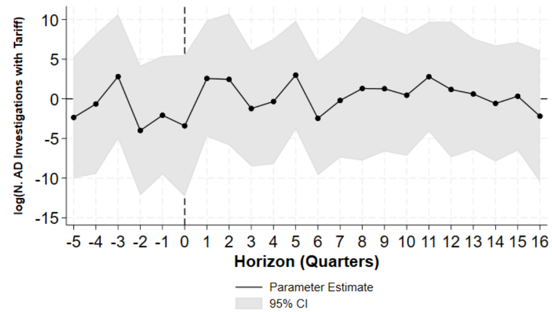
Figure A.4 shows that there is no correlation between the number of AD investigations, the number of investigations resulting in AD tariffs, and the share of investigations leading to AD tariffs and the business cycle. This is exactly what should happen if the government is following the WTO requirements, supporting our identification strategy. Furthermore, these results are consistent with our main conclusion that AD tariffs have a minimal impact on aggregate GDP, though we do not interpret the impulse response functions as causal.

Figure A.4: **Correlation Between AD Policy and Business Cycle**

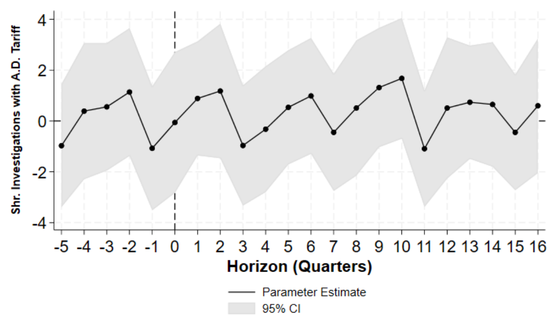
(a) **IRF: Log Number of AD Investigations**



(b) **IRF: Log Number of Positive AD Investigations**



(c) **IRF: Share of Positive AD Investigations**

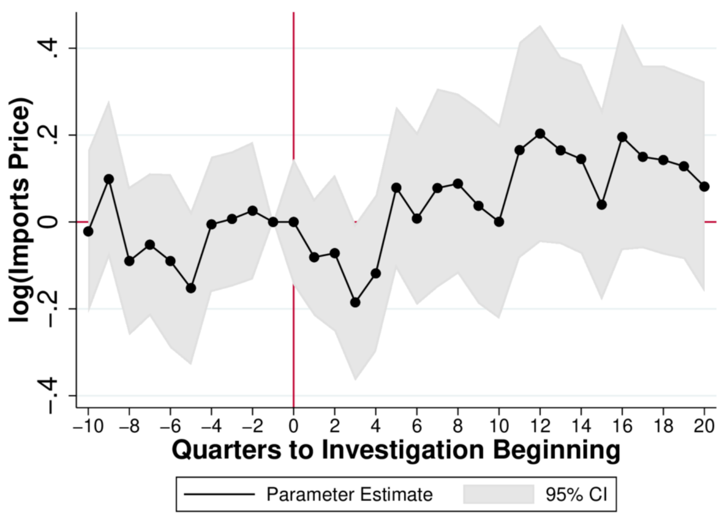


Description: This figure shows the correlation between AD policy and GDP growth according to model A.7.

A.4.5 Effect of Tariff on Import Prices

Figure A.5 shows that the treatment and control groups exhibit similar price trends. We estimate Equation (2) using the pre-tariff price as the dependent variable. The event study figure indicates that, although the treatment and control groups have different price levels, they experience similar price trends. This similarity mitigates endogeneity concerns regarding AD tariffs. The analysis also shows that AD tariffs do not significantly impact prices after their implementation, suggesting that Brazil faces an elastic export supply curve. This finding is consistent with our model's assumption that Brazil operates as a small open economy.

Figure A.5: **Effect of AD Tariffs on Import Prices**



Description: This figure contains the coefficients of the effect of AD tariff on import prices using the dynamic model 2 plotted against quarters to the beginning of the investigation in the x-axis. Imports are measured in freight on board (FOB) current dollars at the NCM product code level. Import data is from the Secretary of International Trade of the Ministry of Economy, and AD data is from the Global Anti-dumping Database. The sample is composed of a product-origin that had at least one AD investigation. The shaded area contains the 95% confidence interval. Standard errors are clustered at the product-origin level.

A.5 Robustness

A.5.1 Controls

Table A.10: **Effect of AD Tariffs on Imports using Different Controls**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	log(Value Imports)	*log(Value Imports)*	*log(Value Imports)*	*log(Value Imports)*	*log(Value Imports)*	*log(Value Imports)*	*log(Value Imports)*
$\tau_{p,c,t}$	-0.238***	-0.383***	-0.391***	-0.459***	-0.364***	-0.463***	-0.530***
	(0.0797)	(0.0807)	(0.0829)	(0.0983)	(0.0863)	(0.102)	(0.145)
N	21135	21134	21133	21092	20178	17941	13953
R^2	0.640	0.655	0.677	0.723	0.665	0.712	0.757
Model	Baseline	1-digit sector	2-digit sector	4-digit sector	1-digit sector x country	2-digit sector x country	4-digit sector x country

Description: This table presents the estimated parameters of model 1. The sample is composed of a product-origin that had at least one AD investigation. *log(Value Imports)* is the log of FOB current dollars imports at the NCM level. Import data is from the Secretary of International Trade of the Ministry of Economy, and AD data is from the Global Anti-dumping Database. The sample runs from 1995 to 2016. Standard errors are clustered at the product-origin level.

Table A.11: **Robustness of the Effect of AD Tariffs on the National Producers**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	log(Wage Bill)	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*
$\tau_{s,t}^{mid}$	0.0111***	0.0156***	0.0121***	0.0186***	0.0130***	0.0191***	0.0156***
	(0.00211)	(0.00358)	(0.00417)	(0.00390)	(0.00423)	(0.00397)	(0.00446)
N	119368	119368	119368	119368	119368	119368	119368
R^2	0.863	0.863	0.865	0.863	0.865	0.863	0.863
1 Digit Sector FE		X		X		X	X
2 Digit Sector FE			X		X		
# Product Invest.				X	X	X	X
# Product AD						X	
Tariffs							X

Description: This table presents the estimated parameters of model 3. The sample is composed of firms in sectors producing the product under AD investigation. We constrain the sample to the set of firms observed after and before the AD investigation, that have more than 10 observations and more than one worker. These sample restrictions are made to avoid compositional change and special firms. Column 2 adds a 1-digit sector interacted with year as control. Column 3 has a 2-digit sector interacted with year as control. Column 4 has a 1-digit sector-year FE with dummies for the number of product investigated. Column 5 has a 2-digit sector-year FE with dummies for the number of product investigated. Column 6 has as control a 1-digit sector-year FE, number of product investigated, and number of products with AD. Column 7 has as control a 1-digit sector-year FE, number of products investigated, and AD tariffs upstream and downstream. *log(Wage Bill)* is the log of the total labor expenditure of the firm. $\tau_{s,t}^{mid}$ is the average AD tariff imposed against products produced by the sector of each firm.

Table A.12: **Effect of AD Tariffs on Downstream Firms**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	log(Wage Bill)	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*
	Sample: Main Downstream						
$\tilde{\tau}^{down}_{d(s),t}$	-0.118***	-0.0957***	-0.0124	-0.0857***	-0.0142	-0.0820***	-0.0998***
	(0.0239)	(0.0247)	(0.0327)	(0.0244)	(0.0330)	(0.0250)	(0.0373)
N	182790	182790	182790	182790	182790	182790	182790
R^2	0.831	0.832	0.836	0.833	0.836	0.833	0.833
	Sample: All Downstream						
$\tilde{\tau}^{down}_{d,t}$	-0.0738***	-0.0270	-0.0217	-0.0430**	-0.0249	-0.0372*	-0.0362*
	(0.0181)	(0.0190)	(0.0220)	(0.0191)	(0.0221)	(0.0192)	(0.0208)
N	969621	969619	969611	969619	969611	969619	969619
R^2	0.833	0.834	0.835	0.834	0.835	0.834	0.834
1 Digit Sector FE		X		X		X	X
2 Digit Sector FE			X		X		
# Product Invest.				X	X	X	X
# Product AD						X	
Tariffs							X

Description: This table presents the estimated parameters of model 5. The sample is composed of firms in sectors downstream to the product under AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. *log(Wage Bill)* is the log of the firm's total labor expenditure. Column 2 adds a 1-digit sector interacted with year as control. Column 3 has a 2-digit sector interacted with year as control. Column 4 has a 1-digit sector-year FE with dummies for the number of product investigated. Column 5 has a 2-digit sector-year FE with dummies for the number of product investigated. Column 6 has as control a 1-digit sector-year FE, number of product investigated, and number of products with AD. Column 7 has as control a 1-digit sector-year FE, number of products investigated, and AD tariffs upstream and midstream. $\tilde{\tau}^{down}_{d(s),t}$ is the tariff exposure faced by main downstream sector firms. $\tilde{\tau}^{down}_{d,t}$ is the average AD tariff imposed on the inputs used by downstream firms. Standard errors are clustered at the firm level.

Table A.13: **Effect of AD Tariffs on Upstream Firms**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	log(Wage Bill)	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*	*log(Wage Bill)*
	Sample: Main Upstream						
$\tilde{\tau}^{up}_{u(s),t}$	0.00985	-0.00219	-0.0114	-0.000384	-0.0156	-0.00320	-0.00364
	(0.00602)	(0.00707)	(0.0257)	(0.00809)	(0.0244)	(0.00826)	(0.00902)
N	74735	74735	74713	74735	74713	74735	74735
R^2	0.844	0.844	0.845	0.844	0.845	0.844	0.844
	Sample: All Upstream						
$\tilde{\tau}^{up}_{u,t}$	0.0174***	0.00833**	0.0115**	0.00637	0.0114**	0.00486	0.00283**
	(0.00386)	(0.00395)	(0.00569)	(0.00401)	(0.00576)	(0.00403)	(0.00122)
N	3238468	3238468	3238468	3238468	3238468	3238468	3238468
R^2	0.834	0.835	0.835	0.835	0.835	0.835	0.835
1 Digit Sector FE		X		X		X	X
2 Digit Sector FE			X		X		
# Product Invest.				X	X	X	X
# Product AD						X	
Tariffs							X

Description: This table presents the estimated parameters of model 7. The sample is composed of firms in sectors are upstream to a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. *log(Wage Bill)* is the log of the firm's total labor expenditure. Column 2 adds a 1-digit sector interacted with year as control, column 3 has a 2-digit sector interacted with year as control, column 4 has a 1-digit sector-year FE with dummies for the number of product investigated, column 5 has a 2-digit sector-year FE with dummies for the number of product investigated. column 6 has as control a 1-digit sector-year FE, number of product investigated, and number of products with AD. Column 7 has as control a 1-digit sector-year FE, number of products investigated, and AD tariffs midstream and downstream. $\tilde{\tau}^{up}_{u(s),t}$ is the tariff exposure faced by main upstream sector firms. $\tilde{\tau}^{up}_{u,t}$ is the average AD tariff imposed on the sectors that upstream firms sell to. Standard errors are clustered at the firm level.

A.5.2 All Connected Sectors

In this section, we identify both the effects of tariffs on firms and their propagation. Following Acemoglu et al. (2014) and Bown et al. (2021), our specification is given by

$$y_{i,s,t} = \theta\tau_{s,t} + \theta^{up}\tau_{s,t}^{up} + \theta^{down}\tau_{s,t}^{down} + X'_{i,s,t}\kappa + \eta_i + \eta_t + \epsilon_{i,t}, \tag{A.8}$$

where $\tau_{s,t}$ is the average AD tariff against sector s, $\tau_{s,t}^{up}$ is the average exposure of firm i in sector s to upstream tariffs, $\tau_{s,t}^{down}$ is the average exposure of firm i in sector s to downstream tariffs. $X'_{i,s,t}$ is a set of controls, which include a 1-digit sector fixed effect interacted with year, and a dummy for the number of investigations. We run this regression on all firms–not only the ones exposed to AD investigation as we studied before.

This specification has two drawbacks. The first one is that to identify the causal effect of tariffs we have to assume that all sectors are in parallel trends. Given that we expect sectors with AD investigations to be in a declining trend due to the institutions of AD investigations discussed in Section 2, this is a strong assumption. A second drawback is that we cannot test if sectors were in similar trends before the introduction of the tariffs.

Still, despite the drawbacks, Table A.14 confirms the result that AD tariffs increase employment at midstream firms and tariffs in the downstream do not significantly affect employment.

Table A.14: **Effect of AD Tariffs through the Input-Output Connection**

	(1)	(2)	(3)	(4)
	log(# Workers)	*log(Wage Bill)*	$\mathbb{I}\{Exporter\}$	$\mathbb{I}\{Importer\}$
$\tau^{mid}_{s,t}$	0.00910***	0.00958***	0.00325***	0.00294***
	(0.00163)	(0.00184)	(0.000494)	(0.000503)
$\tau^{up}_{s,t}$	-0.00965*	-0.00588	-0.00445***	-0.00551***
	(0.00510)	(0.00550)	(0.00105)	(0.00106)
$\tau^{down}_{s,t}$	-0.0158	-0.0551***	0.0206***	0.0250***
	(0.0106)	(0.0116)	(0.00234)	(0.00234)
N	3142280	3142280	3142280	3142280
R^2	0.814	0.840	0.586	0.600
# Firms	180618	180618	180618	180618
Mean Mid. Tariff	.1	.1	.1	.1
Mean Up. Tariff	.05	.05	.05	.05
Mean Down. Tariff	.05	.05	.05	.05

Description: This table presents the estimated parameters of model 3. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of the firm's total labor expenditure. $\mathbb{I}\{Exporter\}$ is a dummy that takes the value of 1 if the protected firm exports any product that year. $\mathbb{I}\{Importer\}$ is a dummy taking the value of 1 if the protected firm imports any product that year. $\tau^{mid}_{s,t}$ is the average AD tariff imposed on products produced by the sector of each firm, $\tau^{up}_{s,t}$ is the average exposure to upstream tariffs and $\tau^{down}_{s,t}$ is the average exposure to downstream tariffs. Standard errors are clustered at the firm level.

A.5.3 Sectoral Regressions

In this section we study the effect of AD tariffs on sector-level aggregate variables. First, we show that AD tariffs do not lead to the entry or exit of firms. Second, we show that, even at the sector level (without exploiting firm-level variations as we did before), AD tariffs lead to an increase in employment midstream and decreased wages downstream.

AD tariffs do not lead to the entry or exit of firms or establishments, according to results in Table A.15. Column 1 of Table A.15 shows the effect of tariffs on the number of firms in the midstream, main downstream, and main upstream sectors. In none of these specifications do we find that tariffs lead to more or fewer firms in the sector. Column 2 of Table A.15 shows the effect of tariffs on the total number of establishments. Once again, we find that AD tariffs do not lead to more establishments midstream, downstream, or upstream.

The fact that AD tariffs do not cause the entry or exit of firms is important for two reasons – the identification of elasticities and our modeling assumptions. First, it guarantees that our estimates of the effect of AD are not biased. If AD tariffs did lead to the entry/exit of firms, our estimates would be conditional on surviving. Second, in Section 5, based on the fact that AD tariffs do not affect entry or exit, we build a model without this margin.

We also find that AD tariffs increase employment midstream and decrease wages downstream using sectoral aggregate data, as shown in Table A.15.

Table A.15: **Effect of AD Tariffs on Firms Using Sectoral Aggregates**

	(1)	(2)	(3)	(4)
	log(# Firms)	*log(# Establishments)*	*log(# Workers)*	*log(Wage Bill)*
		Midstream		
$\tau^{mid}_{s,t}$	0.0141	0.0139	0.0265***	0.0334**
	(0.00877)	(0.00918)	(0.00839)	(0.0128)
N	1079	1079	1079	1079
R^2	0.978	0.974	0.927	0.877
		Downstream		
$\tilde{\tau}^{down}_{d,t}$	0.0304	0.0735	0.0717	0.00376
	(0.100)	(0.125)	(0.111)	(0.0999)
N	1134	1134	1134	1134
R^2	0.979	0.977	0.936	0.905
		Upstream		
$\tilde{\tau}^{up}_{u,t}$	-0.00812	0.000793	-0.0136	0.0198
	(0.0121)	(0.0168)	(0.0196)	(0.0238)
N	944	944	944	944
R^2	0.988	0.981	0.970	0.964

Description: This table presents the estimated parameters of models 3, 5, and 7, aggregated at sector level. The sample is composed of sectors that produce a product under an AD investigation. *log(# Firms)* is the log of the total number of firms in the sector. *log(# Establishments)* is the log of the total number of establishments in the sector. *log(# Workers)* is the log of the total number of workers in the sector. *log(Wage Bill)* is the log of the sector's total labor expenditure. $\tau^{mid}_{s,t}$ is the average AD tariff imposed on products produced by the sector of each firm. $\tilde{\tau}^{down}_{d,t}$ is the average AD tariff imposed on the inputs used by downstream firms. $\tilde{\tau}^{up}_{u,t}$ is the average AD tariff imposed on the sectors that upstream firms sell to. Standard errors are clustered at the sector level.

A.5.4 Instrumental Variables

Exploiting the institutional setting discussed in Section A.4.1, we propose an instrument for AD tariffs. We instrument AD tariffs in Brazil with the AD tariffs imposed in other countries. The rationale for this is outlined in the following. A supplier exporting with low prices to Brazil is likely to export with low prices to other countries as well. Therefore, if a supplier meets the requirements for an AD tariff in Brazil due to its low prices, it is also likely to meet these requirements in other countries. Since the AD policy outside of Brazil is unlikely to directly affect the Brazilian labor market, the instrument is exogenous to Brazilian employment.

We instrument $\tau_{s,t}$, the average AD tariff on products of sector s, with a set of dummies for the number of investigations and tariffs imposed against products of sector s in year t in all other countries except Brazil. The first stage is

$$\begin{aligned}\tau_{s,t} = &\sum_{o} \beta_o^I \mathbb{I}_t \left\{\text{o Countries Investigated Sector } s\right\} + \\ &\sum_{o} \beta_o^T \mathbb{I}_t \left\{\text{o Countries Imposed AD Tariff on Sector } s\right\} + X'_{s,t}\kappa + \epsilon_{s,t},\end{aligned} \tag{A.9}$$

where $\mathbb{I}\left\{\text{o Countries Investigated Sector s}\right\}$ equals one if countries except Brazil conduct o AD investigations on sector s in year t. $\mathbb{I}\left\{\text{o Countries Imposed AD Tariff on Sector } s\right\}$ equals one if countries except Brazil impose o AD tariffs on sector s in year t. We instrument the exposure to tariffs downstream and upstream similarly.

The results in Table A.16 confirm the finding that AD tariffs increase employment midstream, with the effect propagating downstream, but they do not affect upstream firms. Column 1 and 2 of Table A.16 show the effect of AD tariffs on midstream firms using as an instrument the AD policy of countries outside Brazil. As in the baseline model, we limit the sample to the firms that faced AD investigations. We find that imposing a 100% AD tariff causes a 3% increase in employment. Columns 3 and 4 show the effect of tariffs downstream, presenting that a 100% AD tariff on all the inputs of a firm causes a 60% decrease in employment. This is an order of magnitude larger than what we found in the main regressions. An instrument variable regression identifies the effect of AD tariffs on compliers, i.e., on the set of sectors that were targeted by both tariffs in Brazil and those outside of Brazil. These sectors are not necessarily representative of the set of sectors targeted by tariffs in Brazil. Columns 5 and 6 show that there is no effect of tariffs upstream.

Table A.16: **Effect of AD Tariffs with Instruments**

	(1)	(2)	(3)	(4)	(5)	(6)
	log(# Workers)	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*
$\tau^{mid}_{s,t}$	0.0319***	0.0316***				
	(0.00669)	(0.00744)				
$\tilde{\tau}^{down}_{d,t}$			-0.590***	-0.819***		
			(0.194)	(0.243)		
$\tilde{\tau}^{up}_{u,t}$					0.0319	0.0685
					(0.0425)	(0.0479)
Sample	Investigated Sectors	Investigated Sectors	Main Downstream	Main Downstream	Main Upstream	Main Upstream
N	132816	132816	31748	31748	41424	41424
R^2	0.809	0.844	0.831	0.843	0.818	0.838
# Firms	6277	6277	1458	1458	2063	2063
Mean Dep. Var	2.684	10.062	2.412	9.599	2.55	9.80
Mean Ind. Var	1.07	1.07	.07	.07	.29	.29

Description: This table presents the estimated parameters of models 3, 5, and 7. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of the firm's total labor expenditure. $\tau^{mid}_{s,t}$ is the average AD tariff imposed on products produced by the sector of each firm. $\tilde{\tau}^{down}_{d,t}$ is the average AD tariff imposed on the inputs used by downstream firms. $\tilde{\tau}^{up}_{u,t}$ is the average AD tariff imposed on the sectors that upstream firms sell to. Standard errors are clustered at the firm level.

A.5.5 Regional Variation

In this section we study the effect of AD tariffs on local labor markets. We exploit heterogeneous sectoral composition across regions to create a measure of heterogeneous exposure of regions to AD tariffs. We find that midstream tariffs significantly increase employment but the propagation of tariffs through the input-output connection of firms is not significant.

Denote the AD tariff imposed against sector s in year t with $\tau_{s,t}$. The exposure of region r to tariff $\tau_{s,t}$ equals:

$$\tau_{r,t}^{reg} = \frac{\sum_s Employment_{r,s,t-1} \tau_{s,t}}{\sum_s Employment_{r,s,t-1}},$$

where $Employment_{s,t-1}$ is the previous year's employment in region r, sector s and $\tau_{r,t}^{reg}$ is the exposure of region r to midstream tariffs. Similarly, we can calculate the exposure of region r to upstream tariffs, $\tau_{r,t}^{reg,up}$, and to downstream tariffs, $\tau_{r,t}^{reg,down}$.

The regional specification is the following:

$$y_{r,t} = \theta^{mid} \tau_{r,t}^{reg} + \theta^{up} \tau_{r,t}^{reg,up} + \theta^{down} \tau_{r,t}^{reg,down} + X'_{r,t} \kappa + \epsilon_{r,t} \tag{A.10}$$

where $y_{r,t}$ is the log of a labor outcome in region r and year t and $X_{r,t}$ is a set of controls containing the weighted number of investigations, pre-period log employment interacted with year, and pre-period log wage interacted with year.

Table A.17 shows the main results of this section. Columns 1 and 2 show that midstream tariffs have a large impact on employment and the wage bill in local labor markets. We also find that exposure to upstream tariffs has a large point estimate, but it is not significant. Columns 3 to 5 show that upstream tariffs decrease the employment of workers with a completed high school education and beyond, but do not affect the employment of workers who did not complete high school. Finally, once again we find that tariffs do not propagate upstream.

Table A.17: **Effect of AD Tariffs on Regional Labor Markets**

	(1)	(2)	(3)	(4)	(5)
	log(# Workers)	*log(Wage Bill)*	*log(# HS Dropout)*	*log(# HS Complete)*	*log(# More HS)*
$\tau_{r,t}^{reg}$	0.343***	0.312**	0.244**	0.312**	0.341**
	(0.106)	(0.126)	(0.115)	(0.126)	(0.159)
$\tau_{r,t}^{reg,up}$	-0.901	-1.428	0.259	-3.476***	-6.269***
	(0.859)	(1.023)	(0.937)	(1.024)	(1.296)
$\tau_{r,t}^{reg,down}$	-0.101	-0.0998	0.155	0.269	-0.0884
	(0.141)	(0.167)	(0.153)	(0.168)	(0.212)
N	14367	14367	14364	14358	14341
R^2	0.982	0.981	0.977	0.979	0.975
# Regions	558	558	558	558	558
Mean Midstream Tariff	.01	.01	.01	.01	.01
Mean Downstream Tariff	0	0	0	0	0
Mean Upstream Tariff	.01	.01	.01	.01	.01
Mean Ind. Var	9.452	16.806	8.831	8.177	7.144

Description: This table presents the estimated parameters of model A.10. *log(# Workers)* is the log of total employment in the region, *log(Wage Bill)* is the log of total wage bill in the region, *log(# HS Dropout)* is the log of high-school dropouts in the region, *log(# HS Complete)* is the log of employment of workers who completed high school, and *log(# More HS)* is the log of employment of workers that continued education beyond high-school. $\tau_{r,t}^{reg}$, $\tau_{r,t}^{reg,up}$, and $\tau_{r,t}^{reg,down}$ denote the regional exposure to midstream, upstream, and downstream tariffs. Standard errors are clustered at the firm level.

A.5.6 Other Shocks

In this section, we show that heterogeneous exposure to aggregate shocks cannot explain our results. In particular, we focus on important shocks to the Brazilian economy in the past years – the exchange rate fluctuation and trade liberalization, as discussed by Dix-Carneiro and Kovak (2015) and Dix-Carneiro and Kovak (2017).

To control for heterogeneous exposure to exchange rate fluctuation, we use the following model:

$$y_{i,s,t} = \theta\tau_{s,t}^{mid} + \beta\mathbb{I}_{s,t}\left\{\text{After AD}\right\} + \alpha_s E_t + X_{i,s,t}'\kappa + \eta_i + \eta_t + \epsilon_{i,t} \tag{A.11}$$

where α_s is a parameter capturing the correlation of exchange rate fluctuation E_t and sector s labor outcomes. Equivalently, we write similar specification for the effect of AD tariffs upstream and downstream. Tables A.18, A.19, and A.20 shows that AD tariffs increase employment at midstream firms, decreases it downstream, and has no effect upstream, as we have found on the main specification.

One could be worried that we are capturing reminiscences of the Brazilian trade liberalization experience. To test if this is the case, we use the following functional form

$$y_{i,s,t} = \theta\tau_{s,t}^{mid} + \beta\mathbb{I}_{s,t}\left\{\text{After AD}\right\} + \alpha_t Lib_s + X_{i,s,t}'\kappa + \eta_i + \eta_t + \epsilon_{i,t} \tag{A.12}$$

where Lib_s is the tariff change between 1995 and 1990 calculated by Dix-Carneiro and Kovak 2017. α_t is an year-specific parameter. Tables A.18, A.19, and A.20 shows that AD tariffs increase employment at midstream firms, decreases it downstream, and has no effect upstream, as we have found on the main specification.

Table A.18: **Effect of AD Tariffs on Midstream Firms Controlling for Shocks**

	(1)	(2)	(3)	(4)
	log(# Workers)	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*
$\tau_{s,t}^{mid}$	0.0215***	0.0225***	0.0227***	0.0232***
	(0.00378)	(0.00412)	(0.00557)	(0.00617)
Control:	Exchange Rate	Exchange Rate	Trade Liberalization	Trade Liberalization
N	132816	132816	128745	128745
R^2	0.811	0.846	0.808	0.843
# Firms	6277	6277	6098	6098
Mean Dep. Var	2.684	10.062	2.684	10.062
Mean Ind. Var	1.07	1.07	1.07	1.07
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Description: This table presents the estimated parameters of models A.11 and A.12. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. Columns 1 and 2 control the Brazilian exchange rate. Columns 3 and 4 control Brazilian sectoral tariff changes. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of total labor expenditure of the firm. $\tau_{s,t}^{mid}$ is the average AD tariff imposed on products produced by the sector of each firm. Standard errors are clustered at the firm level.

Table A.19: **Effect of AD Tariffs on Downstream Firms Controlling for Shocks**

	(1)	(2)	(3)	(4)
	log(# Workers)	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*
$\tilde{\tau}_{d,t}^{down}$	-0.0263	-0.0336	-0.0553*	-0.1000***
	(0.0220)	(0.0242)	(0.0286)	(0.0312)
Control:	Exchange Rate	Exchange Rate	Trade Liberalization	Trade Liberalization
N	182790	182790	128745	128745
R^2	0.813	0.834	0.808	0.843
# Firms	8686	8686	6098	6098
Mean Dep. Var	2.412	9.599	2.684	10.062
Mean Ind. Var	.07	.07	1.07	1.07
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Description: This table presents the estimated effects of tariffs on downstream firms controlling for shocks. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. Columns 1 and 2 control the Brazilian exchange rate. Columns 3 and 4 control Brazilian sectoral tariff changes. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of total labor expenditure of the firm. $\tilde{\tau}_{d,t}^{down}$ is the average AD tariff imposed on the inputs used by downstream firms. Standard errors are clustered at the firm level.

Table A.20: **Effect of AD Tariffs on Upstream Firms Controlling for Shocks**

	(1)	(2)	(3)	(4)
	log(# Workers)	*log(Wage Bill)*	*log(# Workers)*	*log(Wage Bill)*
$\tilde{\tau}^{up}_{u,t}$	0.0106	0.00966	0.000974	-0.000780
	(0.00864)	(0.00849)	(0.0109)	(0.0120)
Control:	Exchange Rate	Exchange Rate	Trade Liberalization	Trade Liberalization
N	74735	74735	67536	67536
R^2	0.821	0.844	0.823	0.846
# Firms	3694	3694	3352	3352
Mean Dep. Var	2.55	9.8	2.55	9.8
Mean Ind. Var	.29	.29	.29	.29
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Description: This table presents the estimated effects of tariffs on upstream firms controlling for shocks. The sample is composed of firms in sectors that produce a product under an AD investigation. We limit the sample to the set of firms observed 5-years around the AD investigation. Columns 1 and 2 control the Brazilian exchange rate. Columns 3 and 4 control Brazilian sectoral tariff changes. *log(# Workers)* is the log of the total number of workers in the firm. *log(Wage Bill)* is the log of total labor expenditure of the firm. $\tilde{\tau}^{up}_{u,t}$ is the average AD tariff imposed on the sectors that upstream firms sell to. Standard errors are clustered at the firm level.

B Model Appendix

B.1 Model

Proof of Equation (12)*:* Conditional on choosing sector s, the household's optimal sectoral consumption $c_r^s(\omega)$ and labor supply $l^s(\omega)$ are independent of their utility shocks that govern sector choice, $z^s(\omega)$. Ignoring ω, the within-sector problem implies that the household's sectoral consumption equals the following:

$$P^r c_r^s = \begin{cases} \frac{d_r(P^r)^{1-\theta}}{(P)^{1-\theta}}(1-\delta)w^s l^s & , \ s > 0 \\ \frac{d_r(P^r)^{1-\theta}}{(P)^{1-\theta}}(1-\delta)b & , \ s = 0. \end{cases}$$

We denote the sectoral consumption shares with $\alpha^r = \frac{d_r(P^r)^{1-\theta}}{(P)^{1-\theta}}$, and the consumer price index with P:

$$P = \left(\sum_{r=1}^{S} d_r(P^r)^{1-\theta} \right)^{\frac{1}{1-\theta}}.$$

Within a production sector s, we solve the household optimal labor supply which increases in the sector's real wage. The supply elasticity equals ψ^s:

$$l^s = \left(\frac{w^s}{P} \right)^{\psi^s}. \tag{B.1}$$

Plugging Equations (9) and (B.1) into Equation (10) gives the nonrandom component of welfare associated with staying in sector s:

$$U^s = \begin{cases} \left(1-\delta-\frac{\psi^s}{1+\psi^s}\right)\left(\frac{w^s}{P}\right)^{1+\psi^s} & s > 0 \\ \frac{(1-\delta)b}{P} & s = 0. \end{cases}$$

The elasticity of a household's welfare in sector $s > 0$ with respect to the sector's real wage equals $1 + \psi^s$, and it is greater than that of the outside sector's welfare with respect to the social insurance (which is 1). A real wage increase leads to a higher labor supply for households that work in the sector and a greater-than-unity increase in the total real income and welfare of staying in the sector.

With the familiar property of the Fréchet distribution, we can solve for the probability that a household chooses each sector, π^s:

$$\pi^s = \begin{cases} \frac{\tilde{a}^s\left(\frac{w^s}{P}\right)^{\eta^s}}{\sum_{s=1}^{S}\tilde{a}^s\left(\frac{w^s}{P}\right)^{\eta^s}+\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}} & , \ s>0 \\ \\ \frac{\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}{\sum_{s=1}^{S}\tilde{a}^s\left(\frac{w^s}{P}\right)^{\eta^s}+\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}} & , \ s=0, \end{cases}$$

where $\eta^s = \mu(1+\psi^s)$, $\tilde{a}^s = \left(a^s(1-\delta-\frac{\psi^s}{1+\psi^s})\right)^{\mu}$, $s>0$ and $\tilde{a}^0 = (a^0(1-\delta))^{\mu}$ are parameters.

The population in all sectors adds up to the total population:

$$\sum_{s=0}^{S}\pi^s l^s = L. \tag{B.2}$$

This implies that the share of the population in each sector, i.e. sectoral labor supply L^s, equals the following:

$$L^s = \frac{\pi^s l^s}{\sum_{s=0}^{S}\pi^s l^s}L = \begin{cases} \frac{\tilde{a}^s\left(\frac{w^s}{P}\right)^{\lambda^s}}{\sum_{s=1}^{S}\tilde{a}^s\left(\frac{w^s}{P}\right)^{\lambda^s}+\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}L & , \ s>0 \\ \\ \frac{\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}{\sum_{s=1}^{S}\tilde{a}^s\left(\frac{w^s}{P}\right)^{\lambda^s}+\tilde{a}^0\left(\frac{b}{P}\right)^{\mu}}L & , \ s=0. \end{cases}$$

B.2 Additional Model Equations

In this section, we provide additional equations for Section 5. The Brazilian firm output price, P_0^s, equals the following:

$$P_0^s = \frac{1}{A^s}\left(e^s(w^s)^{1-\rho} + \sum_{s'=1}^{S} f^{ss'}(P^{s'})^{1-\rho}\right)^{\frac{1}{1-\rho}}, \tag{B.3}$$

where $P^{s'}$ denotes the price of input from sector s'.

Sector s producer's expenditure share on the input from sector s' with $s_M^{ss'}$ equals the following:

$$s_M^{ss'} = \frac{f^{ss'}(P^{s'})^{1-\rho}}{e^s(w^s)^{1-\rho} + \sum_{s'=1}^{S} f^{ss'}(P^{s'})^{1-\rho}}. \tag{B.4}$$

Profit maximization and competitive markets imply that Brazilian sector s has the following expenditure function for country i:

$$x_i^s = \frac{g_i^s(P_i^s)^{1-\sigma^s}}{(P^s)^{1-\sigma^s}} X^s, \tag{B.5}$$

where P_i^s is the price of a composite good of sector s from country i, $x_i^s = P_i^s Y_i^s$ denotes the expenditure by sector s on country i, and $X^s = P^s Q^s$ denotes the total expenditure by sector s. The relationship between the sectoral input price and the sector-origin-level output price can be established as follows:

$$(P^s)^{1-\sigma^s} = \sum_{i=0}^{N} g_i^s (P_i^s)^{1-\sigma^s}. \tag{B.6}$$

Brazil imposes tariffs τ_{li}^s on the products. The ex-tariff import price of product l is denoted with p_{li}^s. As mentioned before, we assume that Brazil is a small open economy. Therefore, p_{li}^s can be treated as exogenous to Brazilian AD tariffs. The competitive market and the profit maximization assumption imply the following expenditure function on product

l of sector s from country i:

$$x_{il}^s = \frac{h_{il}^s (p_{il}^s t_{il}^s)^{1-\zeta^s}}{(P_i^s)^{1-\zeta^s}} x_i^s, \tag{B.7}$$

where $t_{il}^s = 1 + \tau_{li}^s$. We denote the product l's share in the expenditure on sector s of country i: $s_{il}^s = \frac{p_{il}^s t_{il}^s y_{il}^s}{P_i^s Y_i^s}$.[69] The sector-origin-level output price, P_i^s, can be written as a function of product-level prices and tariffs:

$$(P_i^s)^{1-\zeta^s} = \sum_{l \in \Omega_i^s} h_{il}^s (p_{il}^s t_{il}^s)^{1-\zeta^s}. \tag{B.8}$$

Market Clearing. The market clearing condition for Brazilian sector s output is:

$$Y^s = (P_0^s)^{-\sigma^s} \left(\frac{1}{(P^s)^{-\sigma^s}} Q^s + E_F^s \right). \tag{B.9}$$

On the right-hand side, $\frac{(P_0^s)^{-\sigma^s}}{(P^s)^{-\sigma^s}} Q^s$ denotes the domestic demand for Brazilian output. The rest, $Y_{F0}^s = (P_0^s)^{-\sigma^s} E_F^s$, denotes the foreign demand.

The sectoral input, Q^s, is used for both the consumption and the production of tradable output. Thus, the market clearing condition is:

$$Q^s = \sum_{s'=1}^{S} M^{s's} + C^s, \tag{B.10}$$

where $M^{s's}$ is the quantity of composite goods from sector s and used by sector s', and C^s refers to the total consumption by all households of sector s composite good:

$$P^s C^s = \alpha^s (1 - \delta) \left(\sum_{s=1}^{S} w^s L^s + b L^0 \right).$$

Labor is hired to produce the tradable output. The market clearing condition for labor

[69]The demand for product l of sector s imports from country i is denoted by the following: $y_{il}^s = \frac{(p_{il}^s t_{il}^s)^{-\zeta^s}}{(P_i^s)^{-\zeta^s}} Y_i^s$.

equates the labor supply to labor demand in each production sector:

$$L^s = \frac{1}{w^s} s_L^s P_0^s Y^s. \tag{B.11}$$

We finally relate the trade deficit and tariff revenue. Trade deficit equals total imports minus total exports:

$$TD = \sum_{s=1}^{S} \sum_{i=1}^{N} \sum_{l \in \Omega_i^s} p_{il}^s y_{il}^s - \sum_{s=1}^{S} (P_0^s)^{1-\sigma^s} E_F^s. \tag{B.12}$$

And the tariff revenue equals tariff import values multiplied by tariffs:

$$TR = \sum_{s=1}^{S} \sum_{i=1}^{N} \sum_{l \in \Omega_i^s} p_{il}^s y_{il}^s \tau_{il}^s.$$

Equilibrium Given the government's fiscal and tariff policy, $\{\delta, b, \{\tau_{il}^s\}_{i,l,s}\}$ and foreign prices and demand, $\{\{p_{il}^s\}_{i,l,s}, \{E_F^s\}_s\}$, the equilibrium is defined as a set of sectoral input prices, $\{P^s\}_s$, and sectoral wages, $\{w^s\}_s$, such that the following hold:[70]

1. Firms maximize profit (Equation B.3);
2. The price index satisfies Equations (B.6) and (B.8);
3. The goods markets clear, satisfying Equations (B.9) and (B.10);
4. The labor market clears, satisfying Equation (B.11);
5. Government budget constraint (Equation 13) holds.

[70]The equilibrium also depends on fundamentals, $\{\{\tilde{a}^s\}_s, \{d^s\}_s, \{A^s\}_s, \{e^s\}_s, \{f^{ss'}\}_{s,s'}, \{g_i^s\}_{i,s}, \{h_{il}^s\}_{i,l,s}\}$.

B.3 Model in Changes

To compute counterfactuals, we rewrite the model in terms of changes. This approach eliminates the need to directly calibrate or estimate economic fundamentals, which are often challenging to determine. These fundamentals include productivity, foreign prices, country and product preferences, among others. We use V' to denote the post-tariff-shock value of a variable V, and $\hat{V} = \frac{V'}{V}$ to represent the variable in terms of changes.

First, the change in sectoral labor supply equals the following:

$$\hat{L}^s = \begin{cases} \dfrac{\left(\frac{\hat{w}^s}{\hat{P}C}\right)^{\lambda^s}}{\sum_{s=1}^{S} \kappa^s \left(\frac{\hat{w}^s}{\hat{P}C}\right)^{\lambda^s} + \kappa^0 \left(\frac{1}{\hat{P}C}\right)^{\mu}} & , \; s > 0 \\ \\ \dfrac{\left(\frac{1}{\hat{P}C}\right)^{\mu}}{\sum_{s=1}^{S} \kappa^s \left(\frac{\hat{w}^s}{\hat{P}C}\right)^{\lambda^s} + \kappa^0 \left(\frac{1}{\hat{P}C}\right)^{\mu}} & , \; s = 0, \end{cases} \tag{B.13}$$

where $\kappa^s = \frac{L^s}{L}$ denotes the population share in sector s in the baseline equilibrium. κ^0 denotes the fraction of the population that does not work.

The change in sectoral Brazilian output price is the following:

$$\hat{P}_0^s = \left(s_L^s (\hat{w}^s)^{1-\rho} + \sum_{s'=1}^{S} s_M^{ss'} (\hat{P}^{s'})^{1-\rho} \right)^{\frac{1}{1-\rho}}. \tag{B.14}$$

The change in input-output shares equals:

$$\hat{s}_M^{ss'} = \frac{(\hat{P}^{s'})^{1-\rho}}{(\hat{P}_0^s)^{1-\rho}}.$$

Therefore, the ex-post input-output shares equal: $s_M^{ss'\prime} = \hat{s}_M^{ss'} s_M^{ss'}$.

The change in sector s expenditure shares on country i equals:

$$\hat{s}_i^s = \frac{(\hat{P}_i^s)^{1-\sigma^s}}{(\hat{P}^s)^{1-\sigma^s}},$$

where the change in sectoral input price equals:

$$(\hat{P}^s)^{1-\sigma^s} = \sum_{i=0}^{N} s_i^s (\hat{P}_i^s)^{1-\sigma^s}. \tag{B.15}$$

The change in expenditure share on product l in sector s imported from country i is:

$$\hat{s}_{il}^s = \frac{(\hat{t}_{il}^s)^{1-\zeta^s}}{(\hat{P}_i^s)^{1-\zeta^s}},$$

where the change in sector-origin level output price equals:

$$(\hat{P}_i^s)^{1-\zeta^s} = \sum_{l \in \Omega_i^s} s_{il}^s (\hat{t}_{il}^s)^{1-\zeta^s}. \tag{B.16}$$

The ex-post market clearing condition for sector s labor equates labor demand with labor supply:

$$\frac{1}{w^{s\prime}} s_L^{s\prime} \left(s_0^{s\prime} X^{s\prime} + E_{F0}^s (\hat{P}_0^s)^{1-\sigma^s} \right) = L^{s\prime} = \hat{L}^s L^s. \tag{B.17}$$

Similarly, ex-post market clearing condition for sector s input is the following:

$$X^{s\prime} = P^{s\prime} C^{s\prime} + \sum_{s'=1}^{S} s_M^{s's\prime} \left(s_0^{s'\prime} X^{s'\prime} + E_{F0}^{s'} (\hat{P}_0^{s'})^{1-\sigma^{s'}} \right), \tag{B.18}$$

where ex-post consumption is:

$$P^{s\prime} C^{s\prime} = \alpha^{s\prime} (1-\delta) \left(\sum_{s=1}^{S} w^{s\prime} L^{s\prime} + b L^{0\prime} \right),$$

in which $\alpha^{s\prime} = \alpha^s \hat{\alpha}^s$ is the ex-post consumption expenditure share, and the expression for $\hat{\alpha}^s$ is the following:

$$\hat{\alpha}^s = \frac{(\hat{P}^s)^{1-\theta}}{(\hat{P})^{1-\theta}},$$

where $(P)^{1-\theta} = \sum_{s=1}^{S} \alpha^s (\hat{P}^s)^{1-\theta}$.

The ex-post budget constraint for the government is:

$$bL^{0\prime} = \delta(\sum_{s=1}^{S} w^{s\prime}L^{s\prime} + bL^{0\prime}) + TD' + TR', \tag{B.19}$$

in which the ex-post trade deficit and ex-post tariff revenue equal:

$$TR' = \sum_{s=1}^{S}\sum_{i=1}^{N}\sum_{l\in\Omega_i^s} X^{s\prime}s_i^{s\prime}s_{il}^{s\prime}\frac{\tau_{il}^{s\prime}}{t_{il}^{s\prime}}, \tag{B.20}$$

$$TD' = \sum_{s=1}^{S}\sum_{i=1}^{N}\sum_{l\in\Omega_i^s} X^{s\prime}s_i^{s\prime}s_{il}^{s\prime}\frac{1}{t_{il}^{s\prime}} - \sum_{s=1}^{S}(\hat{P}_0^s)^{1-\sigma^s}E_{F0}^s. \tag{B.21}$$

Equilibrium in changes Given the government's fiscal and tariff policy, $\{\delta, b, \{\tau_{il}^s\}_{i,l,s}\}$, baseline export, $\{E_{F0}^s\}$, market shares, $\{\kappa^s, \alpha^s, s_L^s, s_M^{ss'}, s_i^s, s_{il}^s\}$, and elasticities $\{\lambda^s, \mu, \theta, \rho, \sigma^s, \zeta^s\}$, the equilibrium is defined as a set of changes in sectoral input prices, $\{\hat{P}^s\}_s$, and changes in sectoral wages, $\{\hat{w}^s\}_s$ such that

1. Firms maximize profit (Equation (B.14));
2. The price index satisfies Equations (B.15) and (B.16);
3. The goods market clears in the counterfactual equilibrium, satisfying Equation (B.18);
4. The labor market clears in the counterfactual equilibrium, satisfying Equation (B.17);
5. The government budget constraint in the counterfactual equilibrium (Equation (B.19)) holds.

B.4 Changes in the Aggregate Variables

In this section, we present the formula used to compute the different aggregate variables.

Aggregate Employment. The change in aggregate employment equals a weighted average of changes in sectoral employment:

$$\mathrm{dlog}(L^e) = \sum_{s=1}^{S} \frac{L^s}{\sum_{s=1}^{S} L^s} \mathrm{dlog}(L^s).$$

AD tariffs that protect a sector draw additional labor from both the nonworking population and other sectors. As a result, the protected sectors experience an increase in employment. Given the interconnected nature of multiple sectors, we must solve the counterfactual equilibrium to determine the aggregate effect.

GDP. The change in real GDP can also be written as a weighted average of the changes in sectoral employment. However, different from the aggregate employment effect, the weights are sector value-added shares in nominal GDP:

$$\mathrm{dlog}(rGDP) = \sum_{s=1}^{S} \frac{w^s L^s}{\sum_{s=1}^{S} w^s L^s} \mathrm{dlog}(L^s). \tag{B.22}$$

Proof: A country's nominal GDP equals the product of real GDP and GDP deflator. Alternatively, it can be written as the difference between the country's gross output and total intermediate input used.

$$\text{GDP} = P^{\text{rGDP}}\text{rGDP} = \sum_{s=1}^{S} \left(P_0^s Y^s - \sum_{s'=1}^{S} P^{s'} M^{ss'} \right),$$

where P^{rGDP} is the price index for real GDP. Consider the first-order approximation of changes in real GDP while holding fixed the prices P^{rGDP}, P_0^s and P^s:

$$\mathrm{dlog}(rGDP) = \sum_{s=1}^{S} \frac{P_0^s Y^s}{GDP} \mathrm{dlog}(Y^s) - \sum_{s'=1}^{S} \frac{P^{s'} M^{ss'}}{GDP} \mathrm{dlog}(M^{ss'}).$$

Note that the first-order approximation of the production function equals:

$$\text{dlog}(Y^s) = \text{dlog}(A^s) + s_L^s \, \text{dlog}(L^s) + \sum_{s'=1}^{S} s_M^{ss'} \, \text{dlog}(M^{ss'}).$$

As tariffs are the only exogenous shock to the model, we set $d\log(A^s) = 0$. Further note that $P^{s'}M^{ss'} = s_M^{ss'}P_0^sY^s$ and $w^sL^s = s_L^sP_0^sY^s$. These imply:

$$\text{dlog}(rGDP) = \sum_{s=1}^{S} \frac{w^sL^s}{GDP} \, \text{dlog}(L^s).$$

Real Income. We measure real income (real GNI) with the ratio of nominal income (the sum of labor income, foreign transfer and tariff revenue) to the consumer price index:

$$rGNI = \frac{\sum_{s=1}^{S} w^sL^s + TD + TR}{P}.$$

Decomposition 1. Extending Caliendo and Parro (2015) by considering varying aggregate labor supply, the first order approximation of changes in real GNI equals the following:

$$\text{dlog}(rGNI) = \underbrace{\sum_{s=1}^{S} \frac{w^sL^s}{GNI} \, \text{dlog}(L^s)}_{\text{Labor Supply}} + \underbrace{\frac{1}{GNI}\left(\sum_{s=1}^{S} \sum_{i \in \Xi_F} \sum_{l \in \Omega_i^s} T_{il}^s t_{il}^s \, \text{dlog}(T_{il}^s) - \sum_{s=1}^{S} E_{F0}^s \, \text{dlog}(Y_{F0}^s)\right)}_{\text{Terms of Trade}}. \tag{B.23}$$

On the right hand side, the employment effect summarizes changes in real income associated with sector employment changes. This term is identical to changes in real GDP. The only difference is that the denominator for changes in real GNI is nominal GNI, whereas the denominator for changes in real GDP is nominal GDP.

While sectoral employment changes are sufficient to summarize changes in real GDP (and aggregate employment), the terms of trade effect indicates that tariffs contribute to real GNI through not only the employment effect but also changes in foreign and domestic prices. In this term $T_{il}^s = p_{il}^s y_{il}^s$ denotes product-country level import value before tariffs, $t_{il}^s = 1 + \tau_{il}^s$ where τ_{il}^s denotes tariffs, E_{F0}^s denotes the value of sectoral exports, and Y_{F0}^s denotes its quantity. Lower import prices are associated with more import and higher export prices are associated with less export. Both cases imply improvements in the terms of trade and an increase in real GNI.

Decomposition 2. Alternatively, we can decompose the real income change with the following formula:

$$\text{dlog}(rGNI) = \underbrace{\sum_{s=1}^{S} \frac{w^s L^s}{GNI} \text{dlog}(L^s)}_{\text{Labor Supply}} \underbrace{- \frac{1}{GNI} \sum_{s=1}^{S} \sum_{i \in \Xi_F} \sum_{l \in \Omega_i^s} T_{il}^s t_{il}^s d\tau_{il}^s}_{\text{Importer}} + \underbrace{\frac{1}{GNI} \sum_{s=1}^{S} E_{F0}^s \text{dlog}(P_0^s)}_{\text{Exporter}}$$
$$+ \underbrace{\frac{1}{GNI} dTR}_{\text{Tariff Revenue}} + \underbrace{\frac{1}{GNI} dTD}_{\text{Foreign Transfer}} . \tag{B.24}$$

Proof: The first order approximation of nominal GNI equals the following::

$$\text{dlog}(rGNI) = \sum_{s=1}^{S} \frac{w^s L^s}{GNI} (d\log(w^s) + d\log(L^s)) + \frac{dTD}{GNI} + \frac{dTR}{GNI} - d\log(P). \tag{B.25}$$

The change in trade deficit equals:

$$dTD = \sum_{s=1}^{S} \sum_{i \in \Xi_F} \sum_{l \in \Omega_i^s} T_{il}^s d\log(T_{il}^s) - \sum_{s=1}^{S} E_{F0}^s (1 - \sigma^s) d\log(P_0^s).$$

The change in tariff revenue equals:

$$dTR = \sum_{s=1}^{S} \sum_{i \in \Xi_F} \sum_{l \in \Omega_i^s} \tau_{il}^s T_{il}^s d\log(T_{il}^s) + \sum_{s=1}^{S} \sum_{i \in \Xi_F} \sum_{l \in \Omega_i^s} T_{il}^s t_{il}^s d\log(t_{il}^s).$$

The change in consumer price equals:

$$d\log(P) = \sum_{s=1}^{S} \alpha^s d\log(P^s), \tag{B.26}$$

in which the change in sectoral input price equals:

$$d\log(P^s) = s_0^s d\log(P_0^s) + \sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} s_i^s s_{li}^s d\log(t_{il}^s).$$

Now substitute the final expenditure share in Equation (B.26). Note that:

$$X^s = P^s C^s + \sum_{s'=1}^{S} s_M^{s's} P_0^{s'} Y^{s'},$$

where $P_0^s Y_0^s$ denotes sector s output. Therefore,

$$\alpha^s = \frac{P^s C^s}{GNI} = \frac{1}{GNI}(X^s - \sum_{s'=1}^{S} s_M^{s's} P_0^{s'} Y^{s'}).$$

Plug this into Equation (B.26):

$$d\log(P) = \sum_{s=1}^{S} \frac{X^s}{GNI}\left(s_0^s d\log(P_0^s) + \sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} s_i^s s_{li}^s d\log(t_{il}^s)\right) - \frac{1}{GNI}\sum_{s=1}^{S}\sum_{s'=1}^{S} s_M^{s's} P_0^{s'} Y^{s'} d\log(P^s).$$

We can simplify the last term:

$$\sum_{s=1}^{S}\sum_{s'=1}^{S} s_M^{s's} P_0^{s'} Y^{s'} d\log(P^s) = \sum_{s'=1}^{S} P_0^{s'} Y^{s'} (d\log(P_0^{s'}) - s_L^{s'} d\log(w^{s'}))$$
$$= \sum_{s'=1}^{S} P_0^{s'} Y^{s'} d\log(P_0^{s'}) - \sum_{s'=1}^{S} w^{s'} L^{s'} d\log(w^{s'}).$$

Plug these into Equation (B.25):

$$
\begin{aligned}
d\log(rGNI) = &\sum_{s=1}^{S}\frac{w^s L^s}{GNI}d\log(L^s) + \sum_{s=1}^{S}\frac{w^s L^s}{GNI}d\log(w^s) \\
&+ \frac{1}{GNI}\sum_{s=1}^{S}\sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} T_{il}^s d\log(T_{il}^s) - \frac{1}{GNI}\sum_{s=1}^{S} E_{F0}^s(1-\sigma^s)d\log(P_0^s) \\
&+ \frac{1}{GNI}\sum_{s=1}^{S}\sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} \tau_{il}^s T_{il}^s d\log(T_{il}^s) + \frac{1}{GNI}\sum_{s=1}^{S}\sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} X^s s_i^s s_{li}^s d\log(t_{il}^s) \\
&- \sum_{s=1}^{S}\frac{X^s}{GNI}\left(s_0^s d\log(P_0^s) + \sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} s_i^s s_{li}^s d\log(t_{il}^s)\right) \\
&+ \frac{1}{GNI}\sum_{s=1}^{S} P_0^s Y^s d\log(P_0^s) - \frac{1}{GNI}\sum_{s=1}^{S} w^s L^s d\log(w^s).
\end{aligned}
$$

Collecting terms, we get:

$$
d\log(rGNI) = \sum_{s=1}^{S}\frac{w^s L^s}{GNI}d\log(L^s) + \frac{1}{GNI}\sum_{s=1}^{S}\sigma^s E_{F0}^s d\log(P_0^s) + \frac{1}{GNI}\sum_{s=1}^{S}\sum_{i\in\Xi_F}\sum_{l\in\Omega_i^s} t_{il}^s T_{il}^s d\log(T_{il}^s),
$$

which is Equation (B.23). Alternatively, if we do not plug in the expressions for dTD and dTR, we get Equation (B.24).

Consumption-Equivalent Welfare. Since the model incorporates labor supply decisions, we measure welfare in consumption-equivalent terms, following Lucas (1987) and Jones and Klenow (2016). Given a welfare change $\hat{W}$, we determine the change in consumption while keeping labor constant at the baseline equilibrium level, ensuring that the model predicts the same welfare change.

The household's problem implies the following welfare function:

$$
W = \left(\sum_{s=1}^{S}\left(C^s - \frac{\psi^s}{1+\psi^s}\left(l^s\right)^{\frac{1+\psi^s}{\psi^s}}\right)^{\mu}\right)^{\frac{1}{\mu}}. \tag{B.27}
$$

The household budget constraint and labor supply decision, Equations (9) and (B.1), imply that:

$$l^s = \left(\frac{C^s}{1-\delta}\right)^{\frac{\psi^s}{1+\psi^s}}.$$

Plugging this into Equation (B.27), the welfare when consumption becomes $\tilde{C}^s$ but leisure remains the same as before, equals:

$$\tilde{W} = \left(\sum_{s=1}^{S}\left(\tilde{C}^s - \frac{1}{1-\delta}\frac{\psi^s}{1+\psi^s}C^s\right)^{\mu}\right)^{\frac{1}{\mu}}.$$

The welfare change, $\hat{W}$, is given by the ratio of $\tilde{W}$ to W:

$$\hat{W} = \frac{\tilde{W}}{W} = \left(\sum_{s=1}^{S} s_L^s \left(\frac{1-\delta}{1-\delta-\frac{\psi^s}{\psi^s+1}}\hat{\tilde{C}}^s - \frac{\frac{\psi^s}{1+\psi^s}}{1-\delta-\frac{\psi^s}{\psi^s+1}}\right)^{\mu}\right)^{\frac{1}{\mu}},$$

where $\hat{\tilde{C}}^s = \frac{\tilde{C}^s}{C^s}$. We compute $\hat{W}$ in the counterfactual equilibrium. In the end we solve $\hat{\tilde{C}}^s$, which is the consumption-equivalent welfare change.

B.5 Comparing the Model to Caliendo and Parro (2015) and Caliendo et al. (2019)

Our model and estimation strategy are different from those of Caliendo and Parro (2015) and Caliendo et al. (2019) in three significant ways. First, we incorporate the substitutability among the final output and the complementarity among the inputs. Second, we introduce flexible labor supply decisions, which allow us to better understand the aggregate employment outcomes. Third, we employ the difference-in-differences method to credibly estimate trade and labor supply elasticities.

Table C.5 shows that a model using Cobb-Douglas production and consumption functions (as in Caliendo and Parro 2015, Caliendo et al. 2019) significantly underpredicts downstream employment losses while significantly overpredicting midstream and upstream employment gains. When final goods are substitutable, an increase in downstream costs leads to substantial substitution away from the downstream sector, resulting in greater downstream employment losses. This decline in downstream sales reduces the demand for midstream and upstream output, thereby reducing the employment effects in these sectors. Furthermore, with complementarity between labor and inputs from upstream sectors for midstream firms, an increase in midstream wages decreases the demand for inputs from upstream sectors, further reducing the upstream employment gains. Without accounting for final goods substitutability and input complementarity, the employment effects across the entire supply chain are biased upward.

Without incorporating labor supply decisions, the model cannot generate aggregate employment effects. The labor supply problem is flexible enough to accommodate sector-specific labor supply elasticities. Without accounting for such heterogeneity, the model overestimates the midstream wage response and underestimates the aggregate employment gains from AD policy.[71]

For most sectors, our estimated trade elasticities are lower than those in Caliendo and Parro (2015), Caliendo et al. (2019) (Section C.2). For instance, their trade elasticity estimates exceed 10 for the computer, electrical, and machinery equipment sectors. A notable

[71] See Tables C.5 and C.7.

difference is that their estimates likely include the impact of both tariffs and trade policy uncertainties, leading to higher estimated trade elasticities.

C Calibration Appendix

C.1 Externally Calibrated Parameters

We calibrate the baseline economy to Brazilian macroeconomic statistics in 1995, which is the initial year of our database. We let each sector $s \in \{1, 2, ..., S-1\}$ refer to a Classificação Nacional de Atividades Econômicas (CNAE) 2.0 4-digit goods sector. $s = S$ represents the combined service sector. The input-output coefficient, $s_M^{ss'}$, is taken from the input-output table. We let each product l represent a Harmonized System (HS) 6-digit product. With a concordance table between HS codes and CNAE 2.0 4-digit sectors from the IBGE (the Brazilian Institute of Geography and Statistics), we calculate the sector-level exports E_{0F}^s. We obtain the Brazilian population and the share of the population that is not working from the IPEA database—a macroeconomic, social, and regional database maintained by the Brazilian government.[72] We compute the sector population share κ^s with RAIS and the total population. We further compute both the sector-level consumption expenditure share α^s and the labor and input shares in gross output, s_L^s and s_M^s, from the estimated input-output table. We calibrate the expenditure shares on countries and products, s_i^s and s_{il}^s, by merging the estimated input-output table with sector- and product-level imports data. We calibrate the social insurance tax rate to the variable "government transfer rate" ("Renda de transferências governamentais") in the IPEA's database, which equaled 10.3% in 1995. Using the government budget constraint (as denoted by Equation (13)), we calibrate social insurance b to be 668.54 (Brazilian Real).[73] We calibrate the elasticity of the non-working population with respect to the social insurance, μ, to the literature studying the cost of public funds (Kleven and Kreiner 2006) and set it to 0.2.

[72] `http://www.ipeadata.gov.br/Default.aspx` is the link to the IPEA database.
[73] More specifically, the unit of value for this amount is 1995 Brazilian Real per annum.

C.2 Estimation of Cross-Product, Trade, and Labor Supply Elasticities

We classify CNAE 2.0 sectors into 6 broad sectors based on their definition, and we estimate these elasticities for each broad sector.[74] Table C.1 presents the concordance between the broad sectors and CNAE 2.0 2-digit sectors.

Table C.1: **Concordance between Broad Sectors and CNAE 2.0 2-digit sectors**

No.	Broad Sector Name	2 Digit CNAE 2.0 Sectors
1	Agriculture, Mining, Food and Textiles	1-14
2	Leather, Wood and Paper	15-18
3	Petrochemicals	19-21
4	Mineral and Metal products	22-25
5	Computer, Electrical and Machinery Equipment	26-28
6	Automobiles and Transportation Equipment	29-33
7	Service	35-97

Description: This table presents the concordance between (a) the broad sectors on which level we estimate the trade and labor supply elasticities and (b) the CNAE 2.0 2-digit sectors.

Elasticity of Substitution across Products. We estimate the elasticity of substitution across products, ζ^s, with the effect of AD tariffs on product-level imports from a given country. Taking the log of Equation (B.7) and adding controls as in our specification in Equation (1), we have:

$$\log(x^s_{i,l,t}) = (1-\zeta^s)\log(t^s_{i,l,t}) + \beta^s_2 \mathbb{I}^s_{i,l,t}\{\text{After AD}\} + \beta^s_3 \mathbb{N}^s_{i,l,t}\{\text{No. of AD}\} + \Phi^s_{i,t} + \eta^s_{i,l} + \epsilon^s_{i,l,t},$$

where $x^s_{i,l,t}$ are the imports of product l from country i in quarter t; $1-\zeta^s$ is the effect of AD tariffs on imports; $\Phi^s_{i,t}$ summarizes the sector-origin-quarter-level price index, the sector-origin-level expenditure, and other factors that are common to all products in the same sector from the same origin (see Equation (B.7)); and $\eta^s_{i,l}$ denotes the origin-product-level fixed effect. To address the potential correlation between the error term and tariffs, we implement a difference-in-differences, as before, adding $\mathbb{I}^s_{i,l,t}\{\text{After AD}\}$ (a dummy that

[74] That is, we assume that the elasticities are heterogeneous across the broad sectors but remains the same within each broad sector.

takes the value of 1 after the first AD investigation) and $\mathbb{N}^s_{i,l,t}\{\text{No. of AD}\}$ (the number of AD investigations) as the control. We constrain our sample to the set of products under investigation. The identification assumption is that conditional on AD investigations, shocks to the origin-product-level consumer preference and the international price (including non-tariff trade barriers) are not correlated with contemporaneous AD tariff changes.

Elasticity of Substitution across Countries. We estimate the trade elasticity, σ^s, which captures how easily sector-level imports can be substituted across different countries. We show that σ^s can be identified from the effect of AD tariffs on imports at the country level.

Taking logs of Equation (B.5) and adding controls, we have:

$$\log(x^s_{i,t}) = (1-\sigma^s)\log(t^s_{i,t}) + \beta^s_2\mathbb{I}^s_{i,t}\{\text{After AD}\} + \beta^s_3\mathbb{N}^s_{i,t}\{\text{No. of AD}\} + \Phi^s_t + \eta^s_i + \epsilon^s_{i,t},$$

where $x^s_{i,t}$ are imports of sector s from country i in quarter t; $t^s_{i,t}$ is the average AD tariffs at the country-sector-quarter level;[75] $1-\sigma^s$ captures the effect of AD tariffs on country level imports; Φ^s_t is a sector-quarter fixed effect capturing the sectoral import price index, expenditure, and other factors that are common to all origin countries (see Equation (B.5)); η^s_i is an origin-sector fixed effect; $\mathbb{I}^s_{i,t}\{\text{After AD}\}$ is a dummy taking the value of 1 after the first AD investigation happens in sector s and targets country i; and $\mathbb{N}^s_{i,t}\{\text{No. of AD}\}$ counts the number of AD investigations that target country i and sector s in quarter t. The identification assumption is that conditional on AD investigations, shocks to the origin-level consumer preference and international price (including non-tariff trade barriers) are not correlated with contemporaneous AD tariff changes.

[75]Formally, $t^s_{i,t} = \sum_{l\in\Omega^s_i} s^s_{i,l,t-1}t^s_{i,l,t}$, where $s^s_{i,l,t-1}$ denotes the share of product l in sector s imports from country i in year $t-1$.

Table C.2: **Elasticity of Substitution across Products**

Sector name	ζ^s	Standard Err.
Agriculture, Mining, Food and Textile	8.005	(2.514)
Wood and Paper	2.185	(0.801)
Petrochemicals	1.547	(0.435)
Minerals and Metals	1.152	(0.451)
Computer, Electrical and Machinery Equipment	5.062	(1.714)
Automobiles and Transportation Equipment	1.808	(0.601)
All Sectors	1.633	(0.338)

Description: This table presents the elasticity of substitution across products for CNAE 2.0 4-digit sectors. The elasticities are assumed to be the same within each broad sector but also to vary across broad sectors. Standard errors are clustered at the product-origin-level.

Table C.2 shows that the elasticities of substitution across products range from 1.152 for minerals and metals to 8.005 for agriculture, mining, food, and textiles. These results are consistent with the intuition that products in primary sectors (harvesting and extracting natural resources) are more substitutable than those in secondary sectors (manufacturing and processing). The cross-sector average elasticity of substitution across products equals 1.633. This low estimate is consistent with the insignificant trade diversion to other products that we discovered, as noted in Section 4.1.

Table C.3: **Trade Elasticity**

Sector name	σ^s	Standard Err.
Agriculture, Mining, Food and Textile	2.044	(0.260)
Wood and Paper	3.060	(0.414)
Petrochemicals	1.339	(0.176)
Minerals and Metals	2.338	(0.171)
Computer, Electrical, and Machinery Equipment	5.158	(1.147)
Automobiles and Transportation Equipment	2.248	(0.350)
All Sectors	2.054	(0.091)

Description: This table presents the elasticity of substitution across countries for CNAE 2.0 4-digit sectors. The elasticities are assumed to be the same within each broad sector but also to vary across broad sectors. Standard errors are clustered at the CNAE 2.0 4-digit sector level.

Table C.3 shows that the elasticities of substitution across countries range from 1.339 for petrochemicals to 5.158 for computer, electrical, and machinery equipment. For all sectors except agriculture, mining, food, textiles, and petrochemicals, the cross-country elasticity is higher than the cross-product elasticity. This suggests that within each non-primary 4-digit sector, imports are more homogeneous across countries than across products. The cross-sector average elasticity of substitution across countries equals 1.633, which is consistent with the limited trade diversion to other countries reported in Section 4.1.

Labor Supply Elasticity. The labor supply elasticity, λ^s, can be identified from the effects of AD tariffs on wages and employment. Equation (12) shows the relation between sectoral employment and wages. Taking the log of that equation and adding controls, we get:

$$\log(w^s_{i,t}) = \frac{1}{\lambda^s}\log(L^s_{i,t}) + \beta^s_2 \mathbb{I}^s_{i,t}\{\text{After AD}\} + \beta^s_3 \mathbb{N}^s_{i,t}\{\text{No. of AD}\} + \eta_i + \Psi^s_t + \epsilon^s_{i,t},$$

where $w^s_{i,t}$ is wages at firm i in sector s in year t; $L^s_{i,t}$ is employment at firm i in sector s in year t; η_i is a firm fixed effect; and Ψ^s_t is a year fixed effect. We implement the same identification strategy and control for exposure to an AD investigation with $\mathbb{I}^s_t\{\text{After AD}\}$.

We instrument employment at the firm, $L^s_{i,t}$, with AD tariffs in sector s, t^s_t.[76] AD tariffs affect employment at the firm level, satisfying the relevance condition, and are unlikely to correlate with other firm-level shocks, satisfying the exogeneity condition.

Table C.4 shows that labor supply elasticities are heterogeneous across sectors, ranging from 0.678 to 1.666. Our estimates are higher than the micro estimates, but lower than the macro elasticities (see Chetty et al. 2011 for a summary of these elasticities). Our numbers are close to Eckert (2019), who studies the elasticity of workers' sector choice to sector income and finds an elasticity of around 1.1 to 1.5.[77] Figure C.1 shows that relatively downstream sectors have weakly lower labor supply elasticities but a larger elasticity of substitution across products and across countries.[78]

[76] Because the service sector has no product that is subject to an AD tariff, we instrument service sector employment with upstream tariffs, as discussed in Section 3.

[77] Eckert (2019) assumes that labor supply elasticity is the same across all sectors but is heterogeneous across worker skill groups.

[78] We measure how upstream a sector is by taking advantage of the procedure in Fally (2011), Antràs et al. (2012), and Antràs and Chor (2013). The upstreamness measure computes the average number of sectors that one dollar of a sector's output passes through to arrive at final demand (we present more details in Section C.4).

Table C.4: **Labor Supply Elasticity**

Sector name	Implied λ^s	Standard Err.
Agriculture, Mining, Food and Textile	1.009	(0.199)
Wood and Paper	0.678	(0.354)
Petroleum and Chemicals	0.771	(0.572)
Minerals and Metals	1.666	(0.242)
Computer, Electrical and Machinery Equipment	1.592	(0.251)
Automobiles and Transportation Equipment	0.943	(0.123)
All Non-service Sectors	1.115	(0.083)
Service	0.431	(0.038)

Description: This table presents the labor supply elasticity for CNAE 2.0 4-digit sectors. The elasticities are assumed to be the same within each broad sector but to vary across broad sectors. Standard errors are clustered on the firm level.

C.3 Model Estimation

We use the following algorithm to estimate the parameters. We guess a set of parameters, $\{\rho, \theta\}$ and we provide sector-level annual tariffs, $\{\tau_t^s\}$, to the model.[79] For each year, we solve the counterfactual equilibrium with the model in changes (Section B.3). Then we run the same panel regression in the model as in the data:[80]

$$y_{s,t}^u = \beta^u \tilde{\tau}_{s,t}^u + \eta_s^u + \eta_t^u + \epsilon_{s,t}^u, u \in \{mid, down, up\}. \tag{C.1}$$

On the left-hand side, $y_{s,t}^u$ denotes the sectoral variable of interest in the targeted and non-targeted moments. They include employment, the wage bill, imports, and exports in the midstream, main upstream and main downstream sectors (all in logs). On the right-hand side, $\tilde{\tau}_{s,t}^u$ denotes the exposures to midstream, downstream and upstream tariffs:

$$\tilde{\tau}_{s,t}^u = \begin{cases} \tau_{s,t}, & u = mid \\ \frac{\text{Input Demand of Sector } d(s) \text{ from Sector } s}{\text{Aggregate Input Demand of Sector } d(s)} \times \tau_{s,t}, & u = down \\ \frac{\text{Sales to Sector } s \text{ from Sector } u(s)}{\text{Production of Sector } u(s)} \times \tau_{s,t}, & u = up. \end{cases}$$

η_s^u denotes the sector fixed effect and η_t^u denotes the time fixed effect.

We also include in the non-targeted moments the elasticity of sectoral employment with respect to midstream, average upstream, and average downstream tariffs when the three tariffs enter the right-hand side of the regression at the same time. We apply the following specification to the model-simulated data:

$$y_{s,t} = \beta_1 \tau_{s,t}^{mid} + \beta_2 \tilde{\tau}_{s,t}^{up} + \beta_3 \tilde{\tau}_{s,t}^{down} + \eta_s + \eta_t + \epsilon_{s,t}, \tag{C.2}$$

where $\tilde{\tau}_{s,t}^{up}$ denotes the downstream tariffs faced by upstream firms and $\tilde{\tau}_{s,t}^{down}$ denotes the upstream tariffs faced by downstream firms. Similarly to how we construct them in the

[79] We construct the sector-level tariffs with the country-sector-product level tariffs, $\{\tau_{il}^s\}_{i,l,s}$, as we discussed in Section 6.

[80] As AD tariffs are the only shock in this counterfactual exercise, parallel trends between the treatment and control groups in the model simulated data are naturally guaranteed. Therefore, we do not control the investigations in these regressions with model simulated data.

empirical section, they equal the following:

$$\tilde{\tau}_{s,t}^{up} = \sum_k \frac{\text{Sales of Sector } s \text{ to Sector } k}{\text{Aggregate Sales of Sector } s} \times \tau_{k,t},$$

$$\tilde{\tau}_{s,t}^{down} = \sum_k \frac{\text{Input Demand of Sector } s \text{ from Sector } k}{\text{Aggregate Input Demand of Sector } s} \times \tau_{k,t}.$$

With the model moments computed with the model-simulated data and these regressions, we search for the parameters that minimize the sum of squared normalized distance between these targeted moments in the model and in the data:

$$\begin{aligned} \min_{\rho,\theta} & \left(\frac{\beta_{\text{data}}^{\text{mid,emp}} - \beta_{\text{model}}^{\text{mid,emp}}}{\beta_{\text{data}}^{\text{mid,emp}}} \right)^2 + \left(\frac{\beta_{\text{data}}^{\text{down,emp}} - \beta_{\text{model}}^{\text{down,emp}}}{\beta_{\text{data}}^{\text{down,emp}}} \right)^2 \\ \text{s.t.} & \text{ Equilibrium constraints in Section B.3.} \end{aligned}$$

To compute the standard errors of the estimated parameters, we bootstrap the AD tariffs on the year level; that is, for each bootstrapped sample, we randomly draw years (with replacement) from the original database and we impose all sectoral tariffs in that year.[81] By doing so, we ensure that every sector in the bootstrapped sample faces the factual midstream, upstream and downstream tariffs in the year when the sample is drawn. With the standard errors we can compute the 95% confidence interval of our estimates.

In Table C.5, we present how the model matches the targeted and non-targeted moments. We also show how we calibrate alternative model specifications and their ability to match these moments. We find that the baseline model performs better than alternative models in matching most of the non-targeted moments.

[81] See Blume et al. (2008) for a survey of indirect inference and bootstrap methods used in macroeconomics.

Table C.5: **Targeted and Non-targeted Moments, Data and Model**

	Moment names	(1) Data	(2) Baseline Model	(3) Same Input and Final Elasticity	(4) Sector-specific Input Elasticity	(5) Same Labor Supply Elasticity	(6) Same Trade Elasticity	(7) No Input-output	(8) Cobb-Douglas Input and Final Demand
	Elasticity with respect to midstream tariffs								
1	Midstream employment	0.0184	0.0184	0.0184	0.0184	0.0184	0.0184	0.0184	0.0898
2	Main downstream employment	-0.0383	-0.0383	-0.0045	-0.0383	-0.0383	-0.0383	-0.0019	-0.0084
3	Main upstream employment	0.0032	0.0029	-0.0019	0.0029	-0.0004	0.0074	0.0006	0.0167
4	Midstream wage bill	0.0186	0.0218	0.0272	0.0218	0.0349	0.0311	0.0259	0.1632
5	Main downstream wage bill	-0.0857	-0.0769	-0.0087	-0.0769	-0.0727	-0.0747	-0.0051	-0.0104
6	Main upstream wage bill	-0.0003	0.0037	-0.0057	0.0037	-0.0008	0.0147	0.0013	0.032
7	Midstream firm exports	0.0133	-0.0061	-0.0103	-0.0061	-0.0099	-0.0123	0.0009	-0.0186
8	Midstream firm imports	0.0286	0.0167	-0.0585	0.0165	-0.0229	0.001	NA	0.0085
	Employment elasticity with respect to average tariffs								
9	Midstream tariffs	0.009	0.0117	0.0106	0.0117	0.0125	0.012	0.0109	0.0513
10	Upstream tariffs	-0.0158	-0.0256	-0.0039	-0.0256	-0.0221	-0.0268	-0.0042	-0.0123
11	Downstream tariffs	-0.009	-0.0093	-0.0076	-0.0093	-0.0159	0.0016	-0.0069	0.0059
	Targeted Moments		1,2	1	1,2,3	1,2	1,2	1	NA
	Estimated Parameter Values		$\rho = 0.6694$ $\theta = 4.4082$	$\rho = \theta =$ 2.0127	$\rho = 0.6757\exp(-2.5e-3 \cdot U)$ $\theta = 4.4020$	$\rho = 1.1097$ $\theta = 3.3340$	$\rho = 0.4674$ $\theta = 3.8915$	$\theta = 2.1734$	NA

Description: This table presents the targeted and non-targeted moments in the data and in the model. Moments 1-8 refer to the elasticity of midstream, main downstream and main upstream employment, wage bill, exports and imports with respect to midstream tariffs. Moments 9-11 refer to the joint impact of midstream, average downstream and average upstream tariffs. The data moments (Column 1) refer to the corresponding estimated coefficients that are presented in the empirical section. The model moments (Column 2-8) refer to those estimated with the model-simulated data. Row "Targeted Moments" show the moments that the models target to estimate the parameters, whose values are reported in Row "Estimated Parameter Values". Specifically, Column 4 assumes sector-specific elasticity of substitution across inputs is log linear in sector upstreamness. The employment elasticity with respect to average tariffs refers to the joint impact of own sector, average upstream, and average downstream tariffs.

C.4 Sector Upstreamness

We follow the procedure outlined by Fally (2011), Antràs et al. (2012), and Antràs and Chor (2013) to compute sector upstreamness. Upstreamness measures the average number of sectors that one dollar of a sector's output passes through to reach the final demand. If a sector's output is used solely for the final demand, its upstreamness equals 1. If a sector sells to other sectors, its upstreamness exceeds 1. The higher the upstreamness measure, the greater the share of output sold to other sectors, indicating a more upstream position for the sector.

To compute the fraction of a sector's output used in other sectors, we rely on the input-output coefficients $s_M^{ss'}$. Following the approach in the literature, we adjust the coefficients to take into account imports and exports with $\tilde{s}_M^{ss'} = s_M^{ss'} \frac{P_0^s Y_0^s}{P_0^s Y_0^s - E_{F0}^s + X^s(1-s_0^s)}$, where $P_0^s Y_0^s$ denotes gross output, E_{F0}^s denotes total export in sector s and $X^s(1 - s_0^s)$ denotes sector s total import. The denominator is thus total domestic absorption of sector s output. Finally, the sector upstreamness equals:

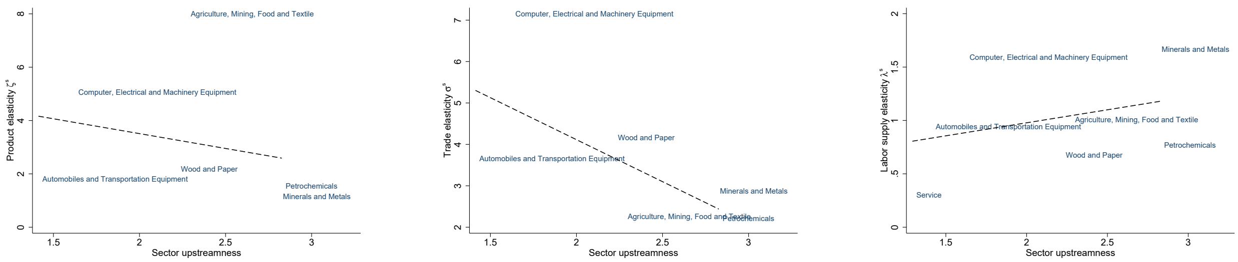
$$\vec{U} = (I - \tilde{\Gamma}')^{-1} \vec{Y}./\vec{Y},$$

where ./ denotes element-wise division, the $s - s'$ element of $\tilde{\Gamma}$ is $\tilde{s}_M^{ss'}$, and I is an identity matrix.

In Figure C.1 we plot the correlations between the estimated elasticity of substitution across products, trade elasticity, and labor supply elasticity, against sector upstreamness.

Figure C.1: **Correlation between product, trade and labor supply elasticities and sector upstreamness**

(a) **Product Elasticity** (b) **Trade Elasticity** (c) **Labor Supply Elasticity**



Description: This figure shows the correlation between the estimated elasticity of substitution across products, trade elasticity, and labor supply elasticity, with sector upstreamness. To measure sector upstreamness on the broad sector level–the same level on which the elasticities are estimated, we first compute the upstreamness measure on the CNAE2.0 4-digit sector level with the input-output table and sectoral imports and exports (see Section C.4 for details). Then we calculate the weighted average upstreamness for each sector for which the weight equals a CNAE2.0 4-digit sector's share in the broad sector.

C.5 Optimal tariffs problem

A country's policy maker maximizes changes in the following aggregate variables (defined in Section B.4):

1. Total employment: $\text{dlog}(L^e)$, or
2. GDP: $\text{dlog}(rGDP)$, or
3. Real income: $\text{dlog}(rGNI)$, or
4. Welfare: $\text{dlog}(W)$

subject to the following equilibrium constraints: changes in prices summarized in Equations (B.14), (B.15), (B.16), market clearing conditions (B.17) and (B.18), as well as government budget constraint (B.19). Furthermore, the government satisfies the additional fiscal constraint in that the government collects the same tariff revenue as from the baseline tariffs:

$$TR' = TR'^{,\text{benchmark}},$$

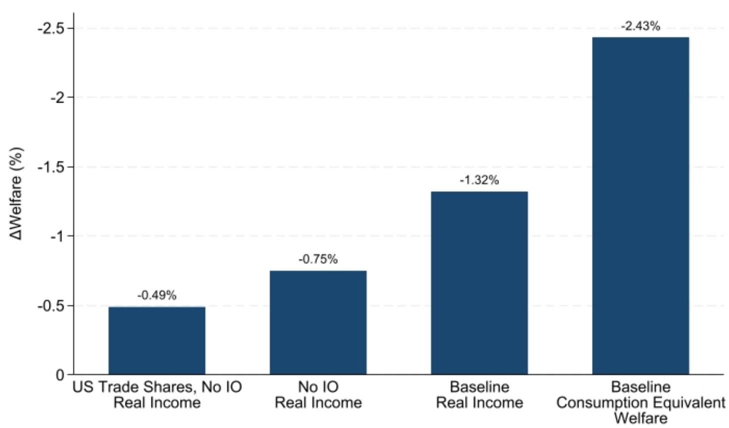
where TR' follows Equation (B.20) and $TR'^{,\text{benchmark}}$ equals the value of TR' under baseline tariffs.

C.6 Quantitative Results

C.6.1 Understanding the Greater Welfare Effects of AD Policy Compared to Previous Works

We find a greater welfare loss from AD policies compared to Egger and Nelson (2011) because we measure welfare in consumption-equivalent terms and account for input-output linkages. Since our model considers labor supply decisions, welfare should be measured in terms of consumption while holding the labor supply fixed (Lucas 1987, Jones and Klenow 2016). As AD policy increases employment and reduces the utility of leisure, consumption must decrease further for households to experience the same welfare change as if employment were fixed. This results in a greater consumption-equivalent welfare loss compared to real income. Furthermore, a model without input-output linkages ignores employment losses in downstream sectors and overestimates income and welfare. Figure C.2 shows that the loss in real income is lower than the consumption-equivalent welfare loss. Without input-output linkages, real income loss is reduced to -0.75%, similar to Egger and Nelson (2011)'s findings for developing countries. Substituting 1995's Brazilian trade shares with US counterparts further reduces the real income loss to -0.49%, comparable to what they find for the US.

Figure C.2: **Welfare Effects of AD Policies in Different Models**



Description: This figure shows the welfare effects of AD policies as predicted by different models.

We also find a greater real income loss from tariffs than Gallaway et al. (1999) and Fajgelbaum et al. (2020), because we account for the endogenous decrease in foreign transfers (trade deficit) due to tariffs; however, both models (with and without endogenous trade balance adjustment) predicted significant welfare loss in consumption-equivalent terms.[82] In our small open economy model, since foreign income is fixed, foreign transfers (trade deficits) endogenously respond to and decrease with tariffs. This assumption regarding the trade balance is also imposed in Dhyne et al. (2023). In contrast, their models assume that foreign transfers remain fixed regardless of tariff changes. To maintain a fixed trade balance in their models, the country needs to receive an extra transfer from abroad and workers need to work more to earn higher income and increase imports. This is accompanied by wage increases, which reduce exports. The lack of a decrease in foreign transfers and the increased income both significantly reduce the real income loss from tariffs. However, in this model, workers have to increase the labor supply more than tenfold compared to the labor supply increase in the baseline model, leading to significant welfare loss in consumption-equivalent terms even with a fixed trade balance (-1.88%).

Welfare Effects of AD Policy in a Model with Fixed Trade Balance. We modify Equation (B.21) so that the trade deficit in the counterfactual equilibrium equals that in the baseline equilibrium, incorporating a transfer from the rest of the world:

$$TD = \sum_{s=1}^{S} \sum_{i=1}^{N} \sum_{l \in \Omega_i^s} p_{il}^{s\prime} y_{il}^{s\prime} - \sum_{s=1}^{S} (\hat{P}_0^s)^{1-\sigma^s} E_{F0}^s + T',$$

where variables with a "prime" denote their values in the counterfactual equilibrium. Specifically, T' represents the transfer from the rest of the world, ensuring that the trade balance remains fixed.

Table C.6: **Decomposing Welfare Changes in Baseline Model and Model with Fixed Trade Deficit**

	Labor Supply	Importer	Exporter	Tariff Revenue	Trade Deficit (Foreign Transfer)	Real Income	Consumption Equivalent Welfare
Baseline Model	0.03%	-1.46%	0.38%	0.69%	-0.96%	-1.32%	-2.43%
Model with Fixed Trade Deficit	0.37%	-1.46%	0.00%	0.73%	0	-0.3%	-1.88%

Description: This table shows the various components of welfare effects of AD policy in the baseline model and in the model with fixed trade deficit. The decomposition is based on Equation (B.24).

[82]Fajgelbaum et al. (2020) study the 2018 US-China trade war, but the scope and magnitude of the trade war tariffs are comparable to the AD policy in Brazil. The trade war tariffs affected 13% of US imports, leading to an average price increase of 14% among the targeted varieties, while the US import-to-GDP ratio

As tariffs primarily reduce imports, without the additional transfer, the trade deficit must decrease. To maintain the same trade deficit, Brazil must receive an extra transfer from the rest of the world, which will likely reduce the real income loss from tariffs.

Table C.6 decomposes the effect of AD policy on real income in both the baseline model and the model with a fixed trade balance. The model with a fixed trade balance predicts a much smaller real income loss but a similar welfare change in consumption-equivalent terms compared to the baseline model. This decomposition is based on Equation (B.24) and extends the analysis of Fajgelbaum et al. (2020).[83]

In the baseline model, an increase in the household labor supply contributes weakly to real income. Importers lose, exporters gain, and the government collects tariff revenue. The increase in tariffs reduces foreign transfers (trade deficit), leading to significant income loss. Overall, the baseline model predicts a real income loss of 1.32% and a consumption-equivalent welfare loss of 2.43%.

In contrast, the model with a fixed trade balance is not affected by the income loss due to reduced foreign transfers and shows a larger increase in labor supply, resulting in a smaller predicted real income loss but still significant consumption-equivalent welfare loss. To maintain the same trade balance, workers need to work more to increase income and imports. This is accompanied by higher wages, which also reduce exports. These two channels cause the labor supply in this model to increase more than tenfold compared to the labor supply increase in the baseline model. Consequently, the real income loss from the AD policy in this model is much smaller (-0.3%) than in the baseline model, similar to Gallaway et al. (1999) and Fajgelbaum et al. (2020), who do not consider trade balance adjustment and income loss from reduced foreign transfers. However, due to a much larger decrease in leisure, the model with a fixed trade balance also predicts a significant consumption-equivalent welfare loss (-1.88%).

was 15%. Similarly, in 1995, the AD policy in Brazil affected 6% of imports, with an average tariff increase of 14.3%, and Brazil's import-to-GDP ratio was 10.2%.

[83]Neither Gallaway et al. (1999) nor Fajgelbaum et al. (2020) consider endogenous increases in the labor supply or trade balance adjustments in response to tariffs.

C.6.2 Impact of Brazilian Annual AD Tariffs

We calculate the AD tariffs imposed on each sector in each year by combining the product-country level AD tariffs and use Equations (B.15) and (B.16). We simulate the model with these yearly tariffs and compute changes in the following aggregate variables: employment, real GDP, real income (GNI), and welfare.

Figure C.3 shows that in all years except 2004-2006, AD tariffs cause moderate aggregate employment gains and GDP gains. This indicates that the positive midstream employment effect outweighs the decline in downstream employment. However, AD tariffs cause larger annual real income and welfare losses. This indicates that the increase in consumer price due to more expensive imports dominates the rise in nominal income. Table C.3b shows that in an average year, from AD tariffs Brazil gains 0.03% employment, 0.02% GDP, but loses 0.49% real income, and 0.92% welfare.

Figure C.3: **Aggregate Consequences of AD Tariffs**

(a) **Each Year**

(b) **Annual Average**

Aggregate statistics	**Employment**	**GDP**	**Real income**	**Welfare**
Annual average	0.03%	0.02%	-0.49%	-0.92%
95%	0.02%	0.01%	-0.58%	-1.06%
Confidence interval	0.03%	0.04%	-0.40%	-0.78%

Description: Figure C.3a shows the impact of AD tariffs imposed in each year on aggregate employment, GDP, real income and welfare. Table C.3b shows the annual average of these aggregate consequences and the 95% confidence intervals of the means.

Alternative Model Specifications. Table C.7 shows that the alternative models (except the one with sector-specific input elasticity) substantially misunderstand the aggregate effects of Brazilian AD policy.

Table C.7: **Aggregate Consequences of Brazilian AD Policy in Different Model Specifications**

Aggregate Consequence	**(1) Baseline Model**	**(2) Same Input and Final Elasticity**	**(3) Sector-specific Input Elasticity**	**(4) Same Labor Supply Elasticity**	**(5) Same Trade Elasticity**	**(6) No Input-output**	**(7) Cobb-Douglas Input and Final Demand**
Employment	0.06%	0.15% (126.97%)	0.06% (-2.35%)	-0.08% (-230.40%)	0.08% (22.02%)	0.15% (124.86%)	0.02% (-63.99%)
GDP	0.05%	0.11% (149.07%)	0.04% (-2.88%)	-0.13% (-377.84%)	0.12% (156.29%)	0.14% (199.65%)	0.08% (71.23%)
Real income	-1.32%	-1.35% (-2.48%)	-1.33% (-0.57%)	-1.54% (-16.45%)	-1.35% (-2.10%)	-0.75% (42.95%)	-1.36% (-3.08%)
Welfare	-2.43%	-2.40% (1.20%)	-2.44% (-0.58%)	-2.65% (-8.90%)	-2.68% (-10.13%)	-1.53% (37.10%)	-2.36% (2.83%)

Description: This table shows the impact of Brazilian AD policy in different model specifications. The value outside the bracket refers to the level of the effect, and the value inside the bracket refers to the percentage difference of the impact predicted by the alternative model relative to the absolute value of the impact predicted by the baseline model. The Brazilian AD policy refers to, for each sector, the maximum AD tariff of all years.

C.6.3 Impact of Sectoral Tariffs

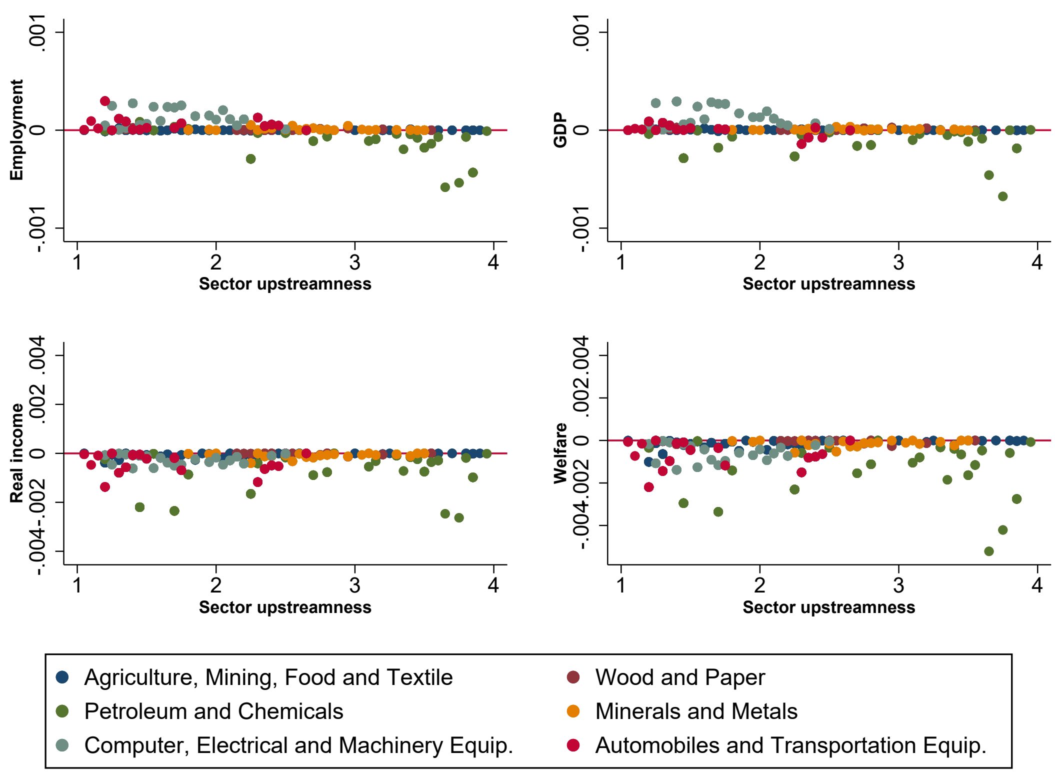
In Figure C.4a we plot the aggregate consequences of 200% sectoral tariffs imposed on every CNAE 2.0 4-digit sector. We plot them against how upstream the sectors are. While the average impact of sectoral tariffs is small,[84] imposing tariffs on downstream sectors, for example, automobiles and transportation equipment as well as computer, electrical and machinery equipment, can significantly raise aggregate employment and GDP. On the other hand, tariffs on upstream sectors, for example, petroleum and chemicals, significantly reduce aggregate employment and GDP. Table C.4b shows that the associations between aggregate employment and GDP effects of sectoral tariffs with sector upstreamness are negative (-0.3513 and -0.3193) and significant at the 1% confidence interval. The negative correlations are robust to sector characteristic controls. In Table C.8, Column 1 we show the simple regression of the aggregate employment effects of sectoral tariffs on sector upstreamness. Columns 2 and 3 control 2-digit sector fixed effects and broad sector fixed effects, respectively. Columns 4 to 6 show that protecting the sectors that are smaller, import a larger share from abroad, and have a larger elasticity of substitution between domestic and foreign output, can also lead to larger aggregate employment gains. Across all specifications the negative correlation between aggregate employment effect and sector upstreamness is negative and significant.

In contrast, the impact of sectoral tariffs on real income and welfare is negative for almost all sectors. The associations between real income and welfare effects of sectoral tariffs with sector upstreamness are weakly positive. Taxing downstream sectors substitutes more imports with domestic labor, increases domestic prices, and harms domestic welfare. On the other hand, taxing upstream sectors decrease employment in more downstream sectors by cutting wages, leading to lower nominal income.

[84] There are 297 CNAE 2.0 4-digit non-service sectors. Therefore, the average share of each of these sectors in the economy is small.

Figure C.4: **Aggregate Consequences of 200% Sectoral Tariffs**

(a) **Aggregate Consequences**



(b) **Correlation with Sector Upstreamness**

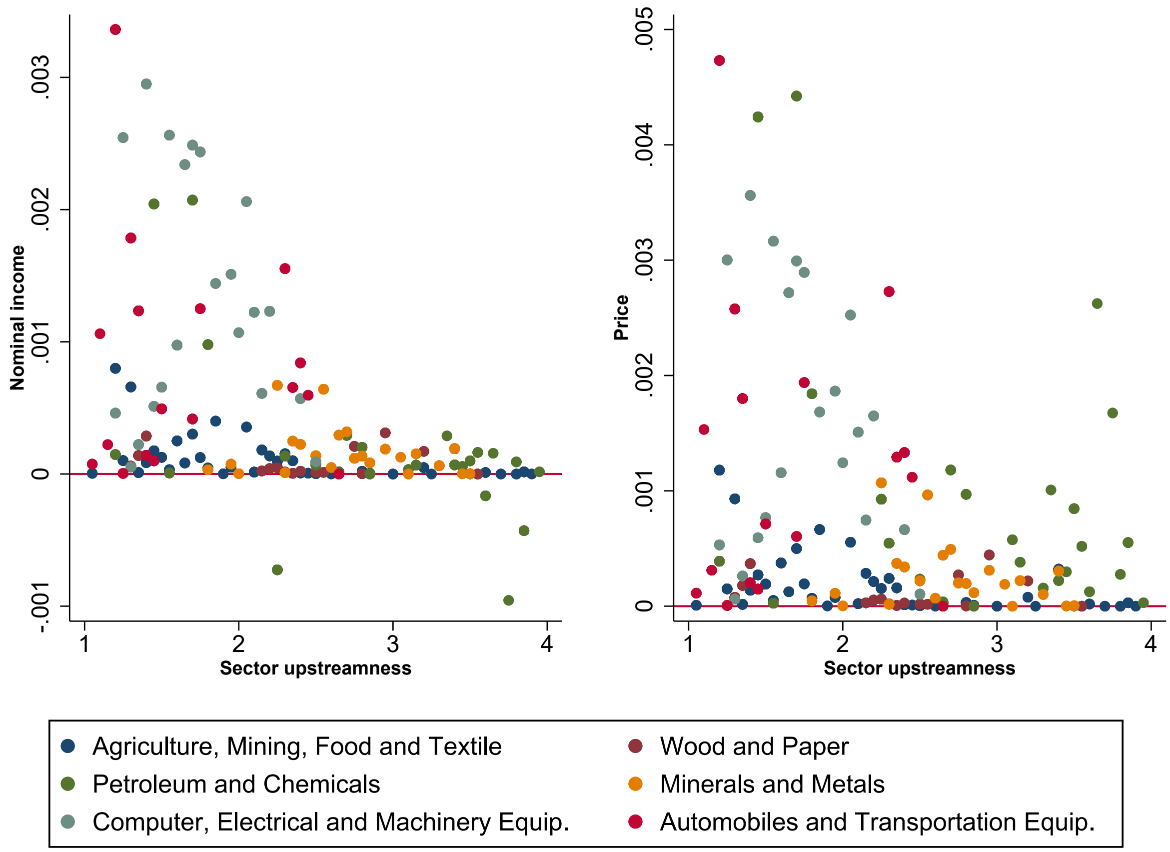
Aggregate statistics	Employment	GDP	Real income	Welfare
Correlation	-0.3513***	-0.3193***	0.0499	0.0350

Description: This figure shows the aggregate consequences of 200% sectoral tariffs imposed on every CNAE 2-digit sector. Panel (a) plots the employment, GDP, real income and welfare effects on the vertical axis, and sector upstreamness on the horizontal axis. Each dot in the figure represents the average value in each 0.05 bin of sector upstreamness. Panel (b) shows the correlation between the aggregate consequences of sectoral tariffs and the upstreamness of the sector. *, **, and *** represent significance on the 0.1, 0.05, and 0.01 level.

To understand the sources of low correlation between the impact of sectoral tariffs on real income with sector upstreamness, in Figure C.5 we show that the impacts of these tariffs on both nominal income and consumer price are negatively correlated with sector upstreamness. Protecting downstream sectors leads to a greater increase in nominal income like the increase in total employment and GDP. However, it also increases the consumer price more. The two forces offset each other for real income, as it equals the ratio of nominal income to consumer price. Figure C.6 shows that the relationship also holds when we take the average of CNAE

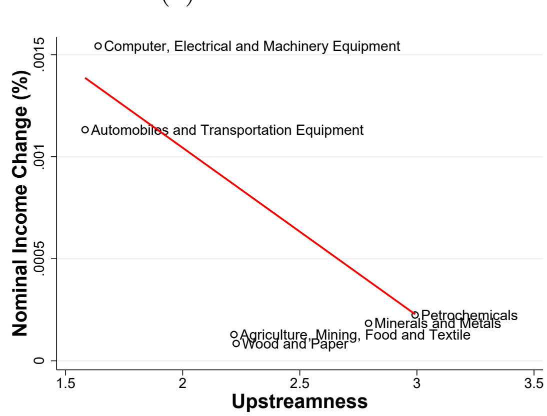
2.0 4-digit sectors for each broad sector.

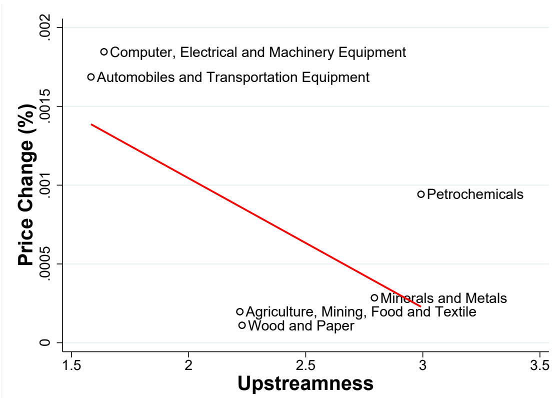
Figure C.5: **Consequences of 200% Sectoral Tariffs on Nominal Income and Consumer Price**



Description: This figure shows the impact of 200% sectoral tariffs imposed on every CNAE 2.0 4-digit sector on nominal income and consumer price. Changes in nominal income and consumer price due to the tariff changes are plotted on the vertical axis, and sector upstreamness is plotted on the horizontal axis.

Figure C.6: **Consequences of 200% Sectoral tariffs on nominal income and consumer price, broad sector average**





Description: This figure shows the impact of 200% sectoral tariffs imposed on every CNAE 2.0 4-digit sector on nominal income and consumer price. Changes in nominal income and consumer price due to the tariff changes are plotted on the vertical axis, and sector upstreamness is plotted on the horizontal axis. Averages are taken on the broad sector level.

Table C.8: **Correlation between Aggregate Employment Effects of Sectoral Tariffs and Sector Characteristics**

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Employment	Employment	Employment	Employment	Employment	Employment
Upstreamness	-6.55e-05***	-5.61e-05***	-2.75e-05**	-6.59e-05***	-4.09e-05***	-4.11e-05***
	(1.01e-05)	(1.97e-05)	(1.18e-05)	(1.02e-05)	(1.04e-05)	(1.04e-05)
Employment share				-0.000133		-3.84e-05
				(0.000207)		(0.000196)
Import share					4.38e-05	4.35e-05
					(3.85e-05)	(3.86e-05)
Trade elasticity					3.97e-05***	3.96e-05***
					(7.27e-06)	(7.29e-06)
Observations	298	295	297	298	298	298
R-squared	0.123	0.356	0.260	0.125	0.225	0.225
Fixed effect	NA	2-digit	Broad sector	NA	NA	NA

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Description: This table shows the correlation between the aggregate employment consequence of sectoral tariffs and sector characteristics including sector upstreamness, employment share in the economy, share of import, and trade elasticity.

C.6.4 Optimal AD Tariff Policy

Figure C.7a presents CNAE 2.0 4-digit sectoral optimal tariffs that maximize employment and GDP. They should be high for many downstream sectors in automobiles, transportation equipment, as well as agriculture, mining, food and textile. Sometimes they even exceed 900%. Those on upstream sectors should be lower. For example, the employment-maximizing tariffs on petroleum and chemical sectors should be negative, which means that to increase employment Brazil should decrease their MFN tariffs for these sectors. In contrast, optimal tariffs that maximize real income or welfare never exceed 100%, and they should be set negative for many sectors.

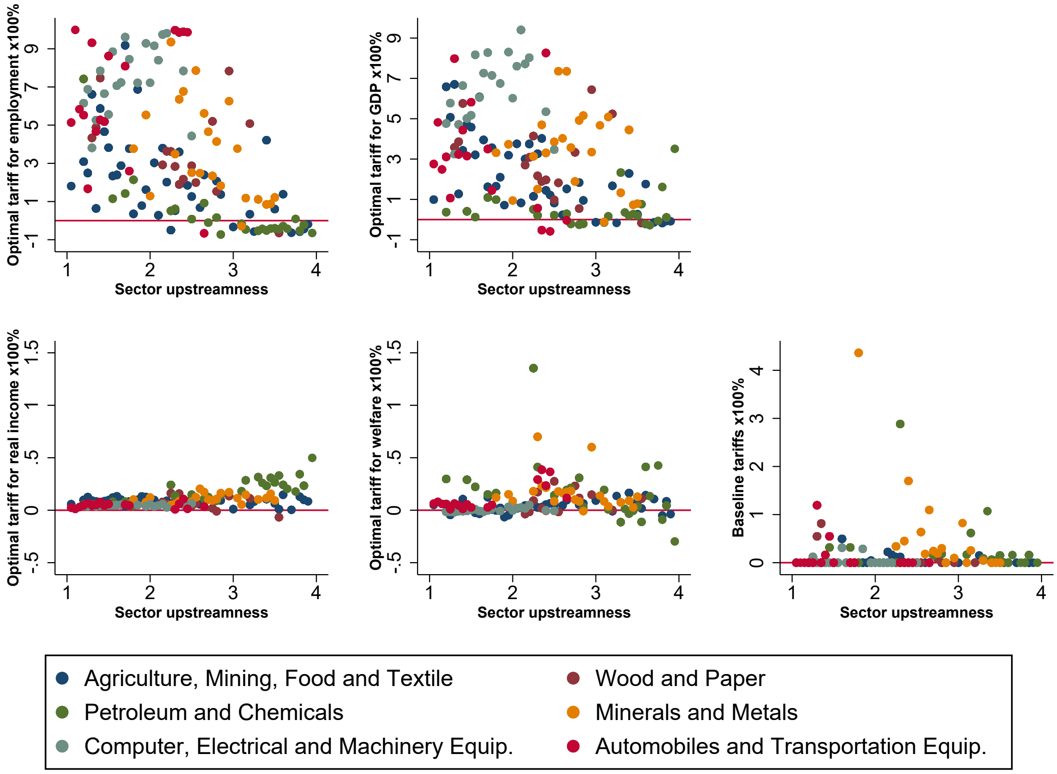
Table C.7b shows that employment- and GDP-maximizing tariffs strongly negatively correlate with sector upstreamness, whereas real income- and welfare-maximizing tariffs positively correlate with it. These findings are consistent with Sections 7.2 and C.6.3, which find that compared to upstream sectors, imposing higher tariffs on downstream sectors increases employment and GDP but decreases real income and welfare.

In Table C.9 we present the correlations of these optimal tariffs with one another, with the benchmark tariffs and with sector upstreamness. Employment-maximizing tariffs are positively correlated with GDP-maximizing tariffs and negatively correlated with real-income–maximizing tariffs. They weakly positively correlate with welfare-maximizing tariffs.

Table C.9 also shows that the factual Brazilian AD tariffs are negatively associated with sector upstreamness, which suggests that employment may be a strong motivation driving AD tariffs. However, the levels of all actual tariffs stay below 500% (see the bottom right panel of Figure C.7a). This suggests that the Brazilian government is either prevented by WTO rules, bilateral/multilateral trade agreements, and domestic political institutions from further increasing tariffs, or it is concerned that raising tariffs may impose additional harm on welfare.

Figure C.7: **Optimal Tariffs**

(a) **Sectoral Optimal Tariffs that Maximize Employment, GDP, Real Income and Welfare**



(b) **Correlations of Sectoral Optimal Tariffs with Sector Upstreamness**

	Optimal tariffs that maximize				
Correlation	Employment	GDP	Real income	Welfare	Benchmark tariffs
Sector upstreamness	-0.4979***	-0.4486***	0.4520***	0.1978***	-0.3381***

Description: This figure shows the sectoral optimal tariffs that maximize employment, GDP, real income and welfare. The optimal tariffs solve a problem that maximize the respective aggregate variable, subject to the equilibrium constraints and the additional constraint that the government collects the same tariff revenue as from the benchmark tariffs (see Section 7.3). The benchmark tariffs refer to, for each sector, the sector's maximum AD tariff of all years. Panel (a) plots these optimal tariffs against sector upstreamness, and Panel (b) presents the correlations.

Table C.9: **Correlations of Sectoral Optimal Tariffs**

		Optimal tariffs that maximize					
	Optimal tariffs that maximize	Employment	GDP	Real income	Welfare	Benchmark tariffs	Sector upstreamness
(1)	Employment	1.0000					
(2)	GDP	0.6754***	1.0000				
(3)	Real income	-0.3807***	-0.1054*	1.0000			
(4)	Welfare	0.0484	-0.2998***	-0.0936	1.0000		
(5)	Benchmark tariffs	0.2575**	0.1250	-0.1912	0.2005	1.0000	
(6)	Sector upstreamness	-0.4979***	-0.4486***	0.4520***	0.1978***	-0.3381***	1.0000

Description: This table shows the correlation of optimal tariffs that maximize employment, GDP, real income, and welfare, as well as benchmark tariffs and sector upstreamness. The optimal tariffs solve a problem that maximize the respective aggregate variable, subject to the equilibrium constraints and the additional constraint that the government collects the same tariff revenue as from the benchmark tariffs (see Section 7.3) The benchmark tariffs refer to, for each sector, the sector's maximum AD tariff of all years.