The Downstream Consequences of Non-Tariff Trade Barriers: Theory and Evidence from Import Licenses in Argentina*

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Abstract

As WTO regulations constrained the use of tariffs, non-tariff barriers became increasingly important instruments of trade policy. This paper examines the impact of input-related NAILs on downstream firms in Argentina and how firms' market power mediates the effects of this policy. Using novel data and the staggered rollout of NAILs from 2005 - 2011, we estimate the impact of the policy on firm-level imports, exports, and employment. NAILs significantly reduced exports and employment among firms that relied on imported inputs targeted by the policy. To interpret these findings, we develop a multi-country trade model featuring oligopolistic competition and variable markups. Guided by the model, we design an empirical strategy to estimate the elasticity of a firm's markup across export destinations - an object that is central to recovering the structural elasticities of the model. Empirically, we find that a firm's exports decline less in destinations where it holds a larger market share. In the context of the model, this pattern implies that market power mitigates the adverse effects of the policy in more concentrated markets. Quantitatively, NAILs reduced aggregate exports by 7%. In a counterfactual scenario with CES preferences and constant markups, the decline would have been 39% larger, underscoring that market power and variable markups might attenuate the negative consequences of trade barriers.

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1 Introduction

Since the establishment of the World Trade Organization (WTO) during the Uruguay Round in 1994, countries have collectively committed to lower import tariffs. According to the World Bank, this initiative has led to a steep decline in global average tariffs, which fell from 8.6% in 1994 to just 2.6% by 2017.[1] As WTO regulations rendered tariffs less viable, trade policy landscape experienced a significant transformation. Non-tariff barriers (NTBs) to imports have surged and proliferated, becoming a central instrument in countries' trade policy (Beghin et al. 2015). Therefore, understanding their effects is crucial, especially since escalating geopolitical tensions and other global challenges have brought trade policy back into the spotlight in recent years.

Analyzing the consequences of NTBs has been challenging. NTBs are difficult to quantify, and the lack of exogenous variation further hampers researchers' ability to assess their causal effects. As a result, we know little about NTBs and their consequences. A system of non-automatic import licenses (NAILs) imposed by Argentina offers a unique setting for overcoming these challenges and analyze the effects of non-tariff trade barriers.

This paper investigates the impact of Non-Automatic Import Licenses (NAILs), a type of non-tariff barrier, on the export and employment dynamics of downstream Argentinian firms that rely on imported inputs. Using comprehensive firm-level data, we construct a novel dataset categorizing products affected by NAILs annually from 2005 to 2011. By employing an event-study design, we provide causal estimates of the effects of NAILs. We integrate these findings into a model of importers and exporters that incorporates oligopolistic competition in export markets. This analysis quantifies the role of NAILs on intermediate inputs in shaping firm behavior, while also highlighting how firm market power and overall market concentration can mediate the effects of these barriers.

Between 2005 and 2011, the Argentine government rolled out a system of Non-Automatic Import Licenses (NAILs), which required that certain products obtain approval from a public official before being imported – a process that could delay approval by up to two months and could be refused by the official. In practice, NAILs operated as a non-tariff trade barrier, raising firms' import costs. This policy is ideal to analyze the impact of import restrictions on firm performance for several reasons. Firstly, the stakes were high: by 2011, NAILs affected almost 600 product lines, which accounted for 17% of firms' imports of intermediate inputs and affected 37% of manufacturing firms, marking this as one of the largest non-tariff barriers policy globally. Second, a unique aspect of the policy was that products were phased into the NAILs system at different periods, without any apparent systematic approach, culminating in including all products by 2012. The staggered inclusion of products in the NAILs system provides an ideal empirical framework allowing for causal identification of the effects of non-tariff barriers on firm dynamics.[2]

We create a novel dataset that combines three datasets spanning from 2003 to 2011. First, we use the universe of Argentine exporters and importers, detailing their export and import transactions

[1]We take the average of effectively applied rates weighted by the product import shares corresponding to each partner country.

[2]Our analysis concludes in 2012 for two primary reasons. Initially, not all products were affected by the policy before this date, enabling us to utilize the staggered inclusion of products as a means for identification. Furthermore, in November 2011, the Argentine government imposed significant restrictions on dollar purchases, a policy change likely to have influenced imports and exports, thereby complicating the identification of non-tariff barrier effects after 2012.

at the firm-product-country (destination/origin) level from official customs data. Second, we incorporate firm-level employment data from Argentina's internal revenue services (AFIP). Finally, we digitized a series of government decrees to construct a novel dataset that systematically document the annual imposition of NAILs on imported products at the 8-digit tariff line.

Our empirical strategy exploits exogenous variation in the timing of product entries into the NAILs system from 2005 to 2011, combined with data on each firm's import share of affected products prior to policy implementation. The underlying idea is that firms importing intermediate inputs that later became subject to NAILs faced greater exposure to the policy, increasing their production costs. We use this firm-level exposure as a shock to production costs, examining how downstream firms respond in terms of imports, exports, and employment. This study provides the first causal evidence on how non-tariff barriers on inputs impact these three key economic dimensions.

Our first finding is that the exposure to this policy significantly affected firms' import activities. Firms with 30% of their imports affected by NAILs (average of all exposed firms) reduce their total imports by 46%. This pattern proves that NAILs were effective as a non-tariff import barrier, which might have significantly affected firms' production costs.

Once we have established that NAILs effectively reduce imports, we investigate their impact on firms' exports and employment. Our analysis provides the first causal evidence that non-tariff barriers to imports, represented by non-automatic import licenses (NAILs), decrease firm exports and employment. Specifically, an exposure of 30% of firms' imports to NAIL leads to a 18% reduction in exports and a 3% reduction in employment. Firms more affected by NAILs also reduce number of exported product and destinations and increase the likelihood to exit export markets and leave operations. In particular, exports of differentiated products and to OECD destinations are the most affected by this policy. In light of our model, this indicates that firms that used imported inputs affected by the policy face an increase in their production costs, rendering them less competitive.

We then explore how firms' reactions to NAILs differ across export markets, depending on their relative importance in each market as indicated by their market share. Integrating these findings with our structural model offers new insights into firms' market power in international trade and how market concentration can mediate the overall impact of trade policies. We find that the negative effect of NAILs on exports is smaller in markets where the firm is relatively larger. To strengthen our identification strategy and validate our findings on heterogeneous responses, we compare the reactions to NAILs of multi-destination firms across their various markets. Considering that more than 95% of Argentina's total exports are explained by firms that export to many markets, understanding their behavior is also relevant in other contexts. Armed with the structure of the model, we develop a methodology that requires a large exogenous cost shock to ensure enough variability to include firm-year fixed effects and be able to compare responses across different destinations. NAILs can provide such a shock. We find that a firm's responses in export markets to firm-level exposure to NAILs vary by its market share in each destination. A firm reduces less its exports and maintains prices more stable in markets where the firm's market share is relatively higher. This implies that even the same firm responds differently in different markets depending on its market power in each market.

Understanding the nature of the observed firm behavior is central to this paper. To guide the empirical analysis and quantify the effects of NAILs, we develop a model of exporting and importing that incorporates variable markups across destinations. On the demand side, the framework extends a standard heterogeneous-firm model to include variable markups, closely following the approach in Atkeson and Burstein (2008).[3] On the supply side, firms draw core productivity levels and combine imported intermediate inputs using a CES production function. We assume input markets are perfectly competitive, consistent with standard assumptions in the importing literature.

Our empirical findings uncover novel aspects of market structure in international trade. They are consistent with a model of oligopolistic competition in export markets, where firms set variable markups at the destination level. In response to cost shocks triggered by non-tariff import barriers, exporters strategically adjust their markupsâĂŤreducing them more in markets where they hold greater market share. This behavior allows firms to cushion the impact of shocks by compressing markups, thereby stabilizing prices and quantities in markets where they possess stronger market power. We estimate this relationship in the data and, based on the structural equation, recover two key elasticities that govern the model.

We then combine the model structure with our empirical estimates to obtain firm-level markups and markup elasticities by destination, and to quantify the aggregate effects of NAILs under alternative scenarios. We estimate an average markup of 12% and an average pass-through rate of 80%. Calibrated to the Argentine economy, the model implies that NAILs reduced aggregate exports by 7% when accounting for market power and variable markups. In a counterfactual with constant demand elasticity, the aggregate export decline would have been 39% larger in absolute terms. This finding highlights that the aggregate effects of trade barriers are attenuated by large firms absorbing part of the shock through reductions in their markups.

Finally, we follow Looi Kee et al. (2009) to estimate the average tariff equivalent of the NAILs. We find it to be approximately 9%, implying a fiscal cost of roughly USD 2.1 billion in forgone tariff revenues during the period.

Our paper contributes to three strands of the literature. First, it relates to the literature on the effects of trade policies (Albornoz et al. 2021, Amiti and Konings 2007, Amiti et al. 2019, Bas 2012, Cole and Eckel 2018, De Loecker et al. 2016, Fajgelbaum et al. 2020, Feng et al. 2017, Flaaen et al. 2020, Flach and Gräf 2020, Goldberg et al. 2010, Romalis 2007), and in particular to studies on non-tariff measures (NTMs) (Cali et al. 2022, Fontagné and Orefice 2018, Ghose et al. 2023, Looi Kee et al. 2009). Most existing work in this area either uses product-level data to assess the direct effect of NTMs on imports, or focuses on the direct impact of NTMs imposed by trading partners on exports from other countries to that destination. By contrast, our paper focuses on the causal indirect impact of NTMs imposed by a country on downstream firms in that same country through the impact of this policy on imported inputs costs.[4]

On this ground, our paper relates to two concurrent papers. Atkin et al. (2024) analyzes the effect of a similar policy of discretionary import licenses in Argentina 2013-2015 on import prices. Our study complements their work in two ways. First, while Atkin et al. (2024) focuses solely on the

[3]The main insights regarding variable markups hold in a broader class of trade models. However, the sign and magnitude of the elasticity of markups with respect to market share are model-dependent. See Arkolakis and Morlacco (2017) for a review of alternative modeling approaches.

[4]Nicita and Gourdon (2013) shows that non-automatic licenses are the most commonly used measure to control import quantities, particularly in developing countries.

direct effect of import licenses on import prices, our paper shows that an important aspect of such policies is that they can end up affecting downstream firms' production, employment, and export dynamics by increasing firms' imported input costs. Secondly, by utilizing the staggered implementation of Non-Automatic Import Licenses (NAILs) between 2005 and 2011, and noting that not all products were included in the system at the same time, we can more accurately estimate the causal impacts of import licenses on firm-level outcomes.[5] More similar to our work, Ghose et al. (2023) study a ban to fertilizers imports in Sri Lanka. While their focus is on a specific input and the agricultural sector, we examine a broader and more permanent trade policy affecting over 600 products and nearly one-third of manufacturing firms. Furthermore, we show that the effects of NTMs can be mediated by firm-level market power, an aspect not explored in previous work.

Our paper is also related to Fontagné et al. (2015) and Fontagné and Orefice (2018), who examines how technical barriers to trade imposed by the destination country affect firms' exports to that destination. In contrast, we focus on the effects of non-tariff barriers for firms based in the implementing country. Therefore, while their mechanism is related to conditions at the destination, our mechanism is related to how non-tariff barriers raise the costs of imported inputs at the origin, impacting firms' production costs and exporting potential.

Second, our paper relates to a literature that studies how variable markups mediate the pass-through of shocks to prices and the broader economy. Most of this literature focuses on bilateral exchange rate shocks. More recently, a growing body of work has examined how firmsâĂŹ market power shapes the effects of trade liberalization. When liberalization leads to lower prices, large firms with market power may absorb part of the shock by increasing their markups, thereby reducing the impact on quantities. This mechanism has been studied empirically in India (De Loecker et al. 2016) and also quantitatively (e.g., *edmond2015*). In contrast, we examine whether variable markups and market power can attenuate the effects of trade restrictions. Specifically, we ask whether, in the face of rising trade barriers, firms reduce their markups to partially offset the increase in costs, thereby benefiting consumers.

Third, our paper is also related to the literature that studies the different margins of adjustment of firms to trade policy, viewed as a cost shock (De Loecker et al. 2016). We document a previously unexplored dimension of firm heterogeneity. We highlight the importance of the elasticity of markups for a given firm, across its export destinations. Previous papers have documented that firms charges different prices across destinations (Manova and Zhang (2012)). However, these papers have not analyzed how these prices respond to shocks specific to the firm. We show that firms adjust not only product scope and total export volumes, but also their markups across destinations. In making decisions, multi-destination firms optimally decide to adjust more their markups to cost shocks in markets where they have higher market shares. As most of the trade flows are concentrated in a few firms that export to many markets, this margin of adjustment could potentially be important to estimate welfare gains from trade. In addition, this may affect the distribution of gains from unilateral trade liberalization in foreign countries.

Fourth, our paper contributes to a growing literature that studies heterogeneous responses of firms to shocks but in the context of exchange rate movements and incomplete exchange rate pass-through. [6] More similar to ours is Amiti et al. (2015), which decomposes the exchange rate pass-

[5]Post-2012, all products became subject to import licenses.

[6]For instance, Berman et al. (2012) find that higher performance firms tend to absorb exchange rate movements

through into the role of firms marginal costs, import intensity, and market power of a firm in a given market and do analyze adjustments of firms depending on their market share. We innovate by exploiting an import costs shock (supply shock) that let us identify the markup elasticity and how it depends on market share of the firm in different markets while holding constant demand shocks. By comparing the same firm across destinations, our estimate can be interpreted as a more accurate estimate of the super-elasticity of markup. More broadly, by extending our results to the market level, we contribute to the growing literature on market concentration and pass-through of shocks (Amiti and Heise (2024), Burstein et al. (2020), Juarez (2024), Rubens (2023)).

The remainder of the paper is organized as follows. Section 1 introduces the data and highlights key patterns that inform our theoretical and empirical approach. Section 2 provides a detailed description of the data and historical context. In Section 3, we introduce the theoretical model. Section 4 outlines the empirical strategy, discusses the policy we exploit, and explains our identification assumptions. Section 5 presents the main results at the firm-level. Section 6 examines the role of market power and market concentration in shaping the effects of the policy. Section 7 concludes.

2 Data and descriptive statistics

2.1 Data Sources

In order to study the effects of import licenses in Argentina, we combine three datasets: a dataset with information on the effective non-automatic Import Licenses policy in Argentina, Customs Data, and Employment Data.

To gather information on non-automatic import licenses, we compiled a database including monthly data on non-tariff barriers for various products in Argentina from 2000 to 2011. This database was constructed by tracking and digitizing executive decrees issued during this period using the InfoLEG website for each specific resolution[7]. Each decree was publicly recorded to specify the month and year an administrative barrier was imposed on products at the 8-Digit tariff line. Detailed information about this policy can be found in Section 2.3.

Administrative data from Argentinian Customs provides a comprehensive panel covering the entirety of Argentinian trade flows. This panel has a monthly frequency and spans from 2003 to 2011. For exports, the dataset contains information on the exporter ID, the destination country, the traded product, the transaction value, the quantity, and the unit. For imports, the dataset includes the importer ID, the country of origin, the product, the trade value, the quantity, and the unit. In both datasets, products are classified at the most detailed aggregation level (12-digit level, which includes the HS 6-digit level plus 6 additional digits specific to Argentina).

Employment information is obtained from the Administracion Federal de Ingresos Publicos (AFIP). The *Formulario 931* in Argentina, issued by AFIP, is a mandatory monthly declaration that employ-

in their markups so that their average prices in the foreign market are less sensitive. Amiti et al. (2016) also show the existence of variable markups in the domestic market and analyze the role of strategic complementarity. However, these papers do not analyze differential responses in foreign markets and don't take a stand on whether a firm adjustment depends on characteristics specific to the firm-destination.

[7] Appendix A.3 shows an example of one resolution available on the website, the Resolucion 1660/2007.

ers must submit. This form records the contributions and withholdings made by employers for their employees to the social security system. In *Formulario 931*, employers report detailed information on the number of workers and of the wages they receive [8]. We merge these data, using a unique firm identifier, with firms' employment and main sector of activity[9] , comprising the universe of formal sector. We restrict the sample to only manufacturing that were active and imported for at least 1 year in the period 2003-2007. The final sample consists on 18,109 manufacturing firms. More details on the data cleaning process are described in Appendix A.2.

2.2 Non-Automatic Import Licenses (NAILs) policy

We start by describing non-automatic import licenses in the world. The rules established by the World Trade Organization (WTO) incorporate a variety of tools that allow governments to regulate imports. These tools include tariff measures (a duty applied to imported products, whether ad-valorem or specific), Trade remedies measures against unfair trade (used to counter unfair practices and protect domestic industries, such as anti-dumping duties, safeguards, and countervailing measures), technical barriers to trade (ensure product quality but can also act as indirect barriers, such as safety, health, or environmental standards), and import licensing (a permit that allows an importer to bring in a specified quantity of certain goods during a specified period), among others.[10]

In the WTO agreement, Import Licensing Procedures take two forms: Automatic Import Licensing and Non-Automatic Import Licensing (NAILs). Countries can define lists of products for automatic licensing and separate lists for non-automatic licensing based on specific policy objectives. Automatic import licensing is typically used to collect data on imports and is not administered in a way that restricts imports.[11]In contrast, Non-Automatic Import Licensing procedures (NAILs) serves more complex purposes, such us administering quantitative restrictions and tariff quotas, in line with WTO legal framework. NAILs are significantly more burdensome, often imposing substantial transaction costs on importers. In particular, processing an application can take up to two months, and approval is not guaranteed. As a result, NAILs often function as a non-tariff barrier to trade in practice.

Currently, 85 economies notify the WTO of using non-automatic licenses.[12] We combined data reported to the WTO by countries on products subject to NAILs with import data from BACI for those countries and computed the coverage ratio for each. The results are shown in Figure 1. Except for Israel, which heads the list, the economies with the highest use of these instruments

[8]Failure to submit Formulario 931 can result in various penalties and the loss of social security benefits for employees, as their contributions will not be registered correctly with the relevant authorities.

[9]We use 6-digit CLAE (a domestic classification which closely follows ISIC) as firms' main sector. It is mandatory for firms to report it to AFIP.

[10]Governments cannot implement changes immediately for some of these policies, as they are bound by specific procedures and international commitments. For instance, adjusting tariff rates requires consensus within Mercosur, where member countries must reach consensus, limiting the extent of individual member deviation. Likewise, the application of anti-dumping measures involves a formal investigation to demonstrate injury to domestic industries, a process that can take considerable time. These requirements ensure that modifications to certain trade instruments are deliberate and align with international agreements.

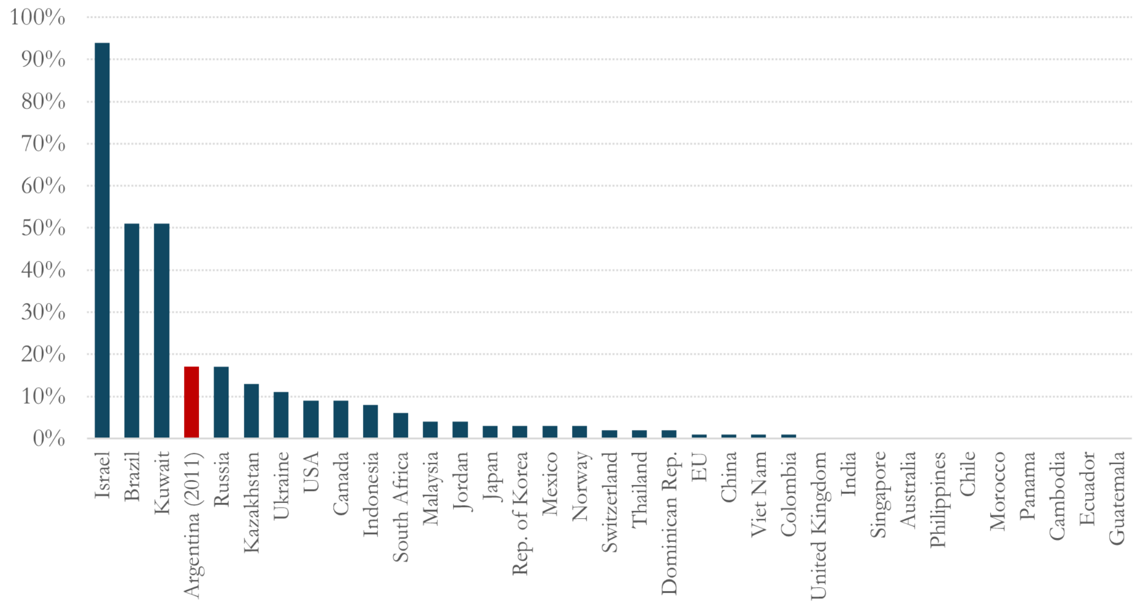
[11]Approval for import requets under Automatic Licenses are granted in all cases. By definition, (I) any person fulfilling the legal requirements should be equally eligible to apply for and obtain import licenses; and, (ii) the application shall be approved immediately on the receipt when feasible or within a maximum of 10 working days.

[12]Since EU countries are represented as a bloc, 11 countries are implementing non-automatic licenses.

are emerging countries. In the next sections, we will focus on the application NAILs in Argentina until 2011. In that year, Argentina had 17% of its imports subject to NAILs. Currently, only four countries exceed that level, which suggests that the magnitude of this policy was significant. [13]

Although not all non-automatic licenses (NAILs) function as import barriers, a large share of these licenses in the world are imposed to inputs and capital goods: 44% of imports subject to NAILs are inputs, primarily basic chemicals, machinery parts, and agricultural products, while 17% are capital goods. NAILs are also commonly applied to products that may pose risks to public health or safety, such as animal products, pesticides, and weapons.[14]

Figure 1: Imports with NAILs by country (% of total imports)



Notes: The figure shows the share of total imports by country that were subject to NAILs. For illustration purposes, we include only the 35 largest economies that report NAILs.

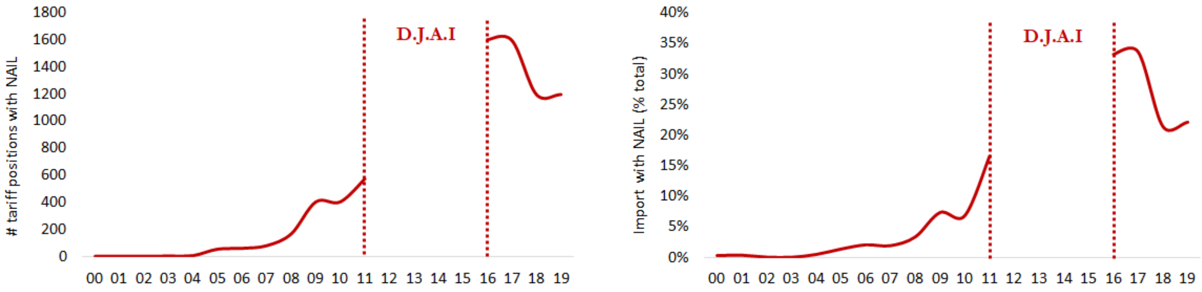
2.3 Non-Automatic Import Licenses (NAILs) in Argentina

Since 2005, the Argentine government has significantly expanded the number of products subject to NAILs. Figure 2 illustrates this evolution. The left panel shows the growth in the number of tariff positions covered by NAILs, while the right panel displays the increasing share of imports subject to this regime. The first licenses were introduced in October 1999, initially covering just four tariff positions in the paper sector. From 2005 to 2011, the government systematically broadened the scope of NAILs, often as a policy response to external sector imbalances. By the end of 2011, the number of products subject to NAILs had increased sixfold compared to 2007 levels. This trend is reflected in the share of imports affected by the regime, which remained below 5% until 2008, but surged to 17% by 2011.

[13] In December 2023, Argentina repealed its NAIL regime. Therefore, its current coverage ratio is 0%.

[14] For example, in Brazil, all agricultural products and their derivatives are subject to NAILs, mainly to ensure compliance with standards such as pest risk analysis, export establishment qualification, product registration, and importer establishment registration.

Figure 2: Evolution of NAIL in Argentina



Notes: The graphs show the evolution of the NAIL in Argentina. The first panel illustrates the amount of products at the 8-digit tariff level that where affected by the policy. The second panel shows the share of import flow affected by the policy throughout the years. Source: Centre of Documentation and Information (CDI) in Argentina.

The composition of Argentina's imports subject to NAILs is much more skew towards inputs and capital goods compared to global patterns. While NAILs globally tend to affect a broader range of consumer goods, in Argentina they are more concentrated on inputs and capital goods. When classifying products based on their use, 61% of imports subject to NAILs in Argentina in 2011 were inputs (17 percentage points higher than the global average). Meanwhile, 20% of these imports were capital goods. In contrast, Argentina had a lower share of consumer goods affected by NAILs, with only 20% of total imports compared to the global figure of 32%.

Until 2011, NAILs were the only significant policy change affecting imports. Between 2003 and 2011, there were no major modifications to tariff structures, with adjustments limited to a small set of products negotiated directly between the Argentine government and other Mercosur member states. Moreover, Argentina did not sign any major trade agreements during this period, as the most significant ones had been concluded in the previous decade. Other non-tariff measures played a minimal role at the time. For instance, anti-dumping measures required an investigation period of at least a year and were applied only to specific products coming from specific countries of origin. Additionally, technical trade measures were not widely implemented during this period. Consequently, NAILs emerged as the primary instrument for regulating imports.

In 2012, the Argentine government introduced more restrictive import controls by replacing the NAIL regime with a new regime in which all products were subject to non automatic licenses to imports. These measures were further reinforced by stringent controls on foreign currency acquisition. After receiving approval for their import requests, importers were required to obtain foreign currency from the central bank. If they were unable to access currency at the official exchange rate, they had to either cancel the import order or purchase foreign currency on the parallel market, where rates were significantly higher. Given that all products were subject to this policy after 2012, alongside concurrent changes in foreign currency regulations, we restrict the analysis to the period 2003 to 2011 that exploit the staggered implementation of the NAILs policy for identification purposes.

A remarkable feature of the NAILs regime in Argentina is that it affected different firms and sectors. In Table 1 we report descriptive statistics for the final year of the sample, 2011. From the 18,109 manufacturing firms that have employees in the base period, 41% were importers and 37% were exposed to NAILs, meaning they imported at least one product during the base period that

Table 1: Descriptive statistics of firms'exposure (year 2011)

	Total firms	Non exporters	Exporters
Number of firms	18,109	11,672	6,437
Share of importers	41%	26%	67%
Sh. of firms exposed to NAIL	37%	30%	52%
Sh. of imports subject to NAIL	11%	11%	11%
Sh. of imports subject to NAIL (if exposed)	30%	37%	21%

Notes: We focus on manufacturing firms that have employees at least one year between 2003 and 2007. The share of imports refers to the average of these firms. Exposed firms are those that import in the base period at least one product with NAIL in 2011. Exporters and non-exporters are defined at the baseline (2003-2007). Share of imports represents the average values per firm.

was subject to NAILs in 2011. [15] Within the group of exposed firms, almost one-third of their imports required NAILs. At the firm-level, the average share of imports affected by NAILs was 11%. However, conditional on firms that have been exposed at least in one product, the average share rise to 30%. NAILs affected exporters relatively more. 67% of exporters in 2011 were exposed to NAILs, while only 26% of non-exporters were affected. NAILs affected firms across several sectors. Appendix Figure 9 summarize firms' average share of imports exposed to NAILs by HS2 sector. Textiles, motor vehicles, printing and reproduction, furniture, electrical equipment, paper, and fabricated metal among the most impacted. Notably, there is substantial heterogeneity in firm exposure to NAILs even within sectors, which is crucial as it allows for comparisons of effects within disaggregated industries.

3 Model

Consider a static small open economy where local firms import their intermediate inputs and export their output. As is standard in the literature, importing inputs from abroad reduces firms' unit cost of production, but it is subject to fixed costs (Antras et al. (2017), Blaum (2017), Blaum et al. (2013), Edmond et al. (2015), Halpern et al. (2009)). Firms sell their products to k foreign markets, which differ in demand. Guided by the patterns in the data described below, there is imperfect competition, and firms charge variable markups in each market. [16]

Our model offers an alternative way to measure the average elasticity of markups with respect to prices when information on unit costs or prices is not easily available.[17] In particular, it suggests that it is possible to estimate it using only information on the firm's total imports and exports.

3.1 Demand

Consider a firm producing in sector s, at year t, a differentiated good i supplying it to destination market k in period t. Consumers in each market have a nested CES demand over the varieties of goods. In particular, provided exporting to market k, a firm i faces the following demand:

[15] Since there are exposed firms that stopped importing, not all exposed firms were importers in 2011.

[16] Our model follows closely Atkeson and Burstein (2008) and Amiti et al. (2015) variable markups model.

[17] Even when available, unit cost and price information is typically measured with error.

$$Q_{ik} = \gamma_{ik} P_{ik}^{-\rho} P_k^{\rho-\eta} D_k,$$

where γ_{ik} is a taste shock for the final good of firm i in market k, P_{ik} is the price of the firm in market k, P_k is the price index in the sector in which the firm operates, D_k is the size of market k. ρ denotes the elasticity of substitution across the varieties within sectors, while η stands for the elasticity of substitution across sectoral aggregates. We assume that $\rho > \eta > 1$ [18]. This demand endogenously generates variable markups that depend on a firm's market share in market k defined in the following way:

$$S_{ik} = \frac{P_{i,k} Q_{i,k}}{\sum_{i'} P_{i',k} Q_{i',k}} = \mu_{i',k} \left(\frac{P_{i',k}}{P_k} \right)^{(1-\rho)}.$$

Note that the effective demand elasticity for Cournot competition for firm i in market k is given by [19],

$$\sigma_{ik} = \left(\frac{1}{\rho}(1 - S_{ik}) + \frac{1}{\eta} S_{ik} \right)^{-1}$$

As $\rho > \eta$, this elasticity is decreasing in the firm's market share. Intuitively, when a large firm changes its price, it also affects considerably the sectorial price index. Hence, market demand for those firms is less responsive to changes in their own price.

Then, the markup, $\mathcal{M}$, is given by

$$\mathcal{M}_{ik} = \frac{\sigma_{ik}}{\sigma_{ik} - 1} = 1 + \left[\frac{1}{\rho}(S_{ik} - 1) - \frac{1}{\eta} S_{ik} \right]^{-1} \tag{3.1}$$

Provided $\rho > \eta$, larger firms within a specific destination tend to have higher markups. Similarly, a given firm's markups are higher in destinations where it represents a larger portion of the market.

The elasticity of the markup with respect to prices is given by,

$$\Gamma_{ik} = -\frac{\partial \log \mathcal{M}_{ik}}{\partial \log P_{ik}} = -\frac{\left(\frac{1}{\rho} - \frac{1}{\eta}\right) \frac{\partial \log S_{i,k}}{\partial \log p_{i,k}}}{\left[\frac{1}{\rho}(S_{i,k} - 1) - \frac{1}{\eta} S_{i,k} \right]} > 0$$

Three key features arise from the inspection of the equations above that are important. First, firms with a higher share in market k also exhibit higher markups in that market. Second, the elasticity of markups with respect to prices is negative, meaning that markups decrease as prices increase. Third, the absolute value of this elasticity increases with the firm's market share in market k. Put it differently, the super-elasticity, defined as the derivative of the absolute value of the elasticity of markups with respect to market share in a destination is positive ($\S = \partial \log \Gamma_{ik} / \partial \log S_{ik} > 0$). Intuitively, firms with larger market share have larger markups and also choose to adjust markups more in response to shocks, while keeping their quantities demanded and prices more stable. In

[18] It is less costly for a consumer to substitute between varieties than sectors.

[19] In Appendix C.2 we solve the same problem but for Bertrand competition. Under both formulations, the following definitions and predictions on the paper hold.

contrast, smaller firms with lower markups have less flexibility to adjust and are more likely to pass the cost shock through to prices, which significantly impacts their quantities demanded.

We summarize these aspects of the markups in the following propositions:

PROPOSITION **1.**

1. *Markup of firm i ($\mathcal{M}_{ik}$) increases with a firm's market share in the market.*
2. *The elasticity of markup with respect to price ($-\Gamma_{ik}$) is negative.*
3. *Increasing superelasticity (§): The absolute value of the elasticity of markup with respect to price is increasing in market share of the firm:* $\S = \frac{\partial \log \Gamma_{ik}}{\partial \log S_{ik}} > 0$.

These aspects of the model will be key features when we study the role of firms' market power in mediating the effects of non-tariff barriers in different export destinations in section 6.

3.2 Import Decision and unit costs

We consider a standard framework of import behavior where firms' import decisions are the solution to a maximization problem. The import behavior of the firm, along with its productivity draw, determines its unit costs. Since foreign suppliers can be more efficient at producing some of the intermediate varieties, firms may be willing to demand imported inputs to reduce the unit cost of production. A measure N of final-good producers each produce a single differentiated product. Firms are characterized by a heterogeneous attribute φ that is interpreted as core productivity. In the same way as in Melitz (2003), this parameter is exogenously drawn from a probability distribution $g(\varphi)$ and revealed to the firms once they start to produce. The production function takes the following CES form:

$$Q = q(z) = \varphi \left[\sum_{v} (z_v)^{\frac{\theta-1}{\theta}} \right]^{(\theta/\theta-1)}$$

where z_v denotes the amount of imports of product variety v (item p sourced from market j) and $\theta > 1$ is the elasticity of substitution of inputs. For the moment, we will not focus on the source market. Let's assume there is only one market from which the firm can source inputs. Hence, $v = product$ from that market.[20] Importing variety v involves a fixed cost (κ^m), which, in this section, we assume is common across firms and sources. We further assume that firms take input prices, adjusted by quality, as given. They are determined by characteristics specific to the origin-product, A_v (i.e, quality, technology, and wages in country j for producing product p), and tariff-equivalent (τ_v):

$$P_v = \frac{\tau_{iv}}{A_v}$$

[20] This leads to the same prediction as Antras et al. (2017), where the gains from variety come from the productivity draws of foreigners, which follow a Fréchet distribution function similar to that proposed by Eaton and Kortum.

3.3 Firm Import Behavior in Equilibrium

In this subsection, we briefly analyze the firm's behavior in equilibrium. We define a sourcing strategy Ω as the set of input varieties v, so the firm imports positive amounts of these varieties. First, we will focus on the firms' decisions, conditional on the sourcing strategy Ω.

3.3.1 Optimal amount of imports conditional on sourcing strategy

To obtain the number of imports of a variety v, the firm minimizes its cost function, which is subject to its production function.

The optimal quantities of variety v are given by,

$$z_v^*(\varphi, \Omega, Q) \equiv arg \min_{z_v} \sum_{v \in \Omega} p_v z_v \text{ s.t } Q = \varphi \left[\sum_{v \in \Omega} (z_v)^{\frac{\theta-1}{\theta}} \right]^{(\theta/\theta-1)} . \tag{3.2}$$

After solving, we get the following expression,

$$z_v(\varphi, \Omega, Q) = \frac{Q}{\varphi} \frac{\left(\frac{1}{p_v}\right)^{\theta}}{\left[\sum_{(v) \in \Omega} \left(\frac{1}{p_v}\right)^{\theta-1} \right]^{\theta/\theta-1}} \qquad \forall v \in \Omega, \tag{3.3}$$

which corresponds to the following imports value,

$$p_v z_v(\varphi, \Omega, Q) = \frac{Q}{\varphi} \frac{\left(\frac{1}{p_v}\right)^{\theta-1}}{\left[\sum_{v \in \Omega} \left(\frac{1}{p_v}\right)^{\theta-1} \right]^{\theta/\theta-1}} \qquad \forall v \in \Omega, \tag{3.4}$$

After solving for the intensive margin of imports for any variety corresponding to the firm sourcing strategy (Equation 3.4), obtaining the minimum unit cost function for a given strategy is straightforward;

$$c_i = \frac{h(\Omega)}{\varphi} = \frac{1}{\varphi} \left[\sum_{v \in \Omega} \left(\frac{1}{p_v} \right)^{\theta-1} \right]^{-\frac{1}{\theta-1}} = \frac{1}{\varphi} \left[\sum_{v \in \Omega} \left(\frac{A_v}{\tau_{iv}} \right)^{\theta-1} \right]^{-\frac{1}{\theta-1}} = \frac{1}{\varphi} \left[\Phi_i \right]^{-\frac{1}{\theta-1}}, \tag{3.5}$$

where $h(\Omega)$ is the part of the unit cost given by inputs. We define the sourcing capability of a firm as,

$$\Phi_i = \left[\sum_{v \in \Omega} \left(\frac{A_v}{\tau_{iv}} \right)^{\theta-1} \right].$$

Therefore, the total amount of imports of intermediate goods of firm i is given by,

$$M_i(\Omega) = \frac{Q_i}{\varphi} \left[\sum_{v \in \Omega} \left(\frac{A_v}{\tau_{iv}} \right)^{\theta-1} \right]^{-\frac{1}{\theta-1}}, \tag{3.6}$$

and the expenditure share of firm i on imported variety v is given by,:

$$
\begin{aligned}
m_{iv}(\Omega) &= \frac{\left(\frac{A_v}{\tau_{iv}}\right)^{\theta-1}}{\left[\sum_{v\in\Omega}\left(\frac{A_v}{\tau_{iv}}\right)^{\theta-1}\right]} && \forall v \in \Omega; \\
m_{iv}(\Omega) &= 0 && \forall v \notin \Omega
\end{aligned}
$$

By Shepard's Lemma:

$$
\frac{\partial log c_i}{\partial log \tau_v} = m_{iv} \tag{3.7}
$$

Note that the model predicts that the barrier to import has a higher impact on costs [21], the larger the share of the firm's expenditure on the input affected by the barrier. In our empirical section, we use this to construct our firm-level shock.

3.4 Price setting

Given a sourcing strategy, with its corresponding unit cost $c_i(\Omega, \varphi)$, solving for optimal price in market k is standard:

$$
P_{ik} = \frac{\sigma_{ik}}{\sigma_{ik} - 1} c_i(\Omega, \varphi) \tag{3.8}
$$

PROPOSITION **2.** *Holding constant the sectoral price P_k, the elasticity of price with respect to a tariff to input v of firm i is given by,*

$$
\frac{d \log P_{ik}}{d \log \tau_{iv}} = \frac{1}{1 + \Gamma_{ik}} m_{iv}
$$

With $\Gamma_{ik} - \frac{\mathcal{M}_{ik}}{log \overline{P}_{ik}}$ representing the negative of the elasticity of markup with respect to prices. Recall that Γ_{ik} is increasing in market share of the firm in destination k.

Proof. See proof in Appendix C.3. □

Note that the model predicts that prices (and therefore exports) will react less in markets where the firm is relatively larger. In section 6 we come back to this result to derive predictions about how market power and variable markups mediate the effects of non-tariff trade barriers.

We hold constant P_k, as we do so throughout the empirical section by including sector-year FE in every specification. If the markup is constant, then the effect of a tariff on an intermediate input on price is equivalent to the initial share of the input that the firm was using m_{iv}. In contrast, with variable markups, we expect that the impact is lower for larger firms that have a higher Γ. This

[21] In what follows, we omit the argument Ω, as we will not derive conclusions on the extensive margin of imports.

will be a key feature to explain the differential effects of (lack of) access to intermediate inputs on exports depending on the relative position of the firm in the market.

3.5 Revenues in equilibrium

Revenues for firm i in market k are given by:

$$R_{ik} = \frac{1}{\mathcal{M}_{ik}^{\rho-1}} \frac{\varphi^{\rho-1}}{h_i^{\rho-1}} P_k^{\rho-\eta} D_k, \tag{3.9}$$

and total revenues of a firm are given by, [22]

$$R_i = \frac{\varphi^{\rho-1}}{h_i^{\rho-1}} \sum_k \frac{1}{\mathcal{M}_{ik}^{\rho-1}} P_k^{\rho-\eta} D_k, \tag{3.10}$$

3.6 Predictions

The model generates two sets of predictions that will guide our empirical section. The first set of results is firm-destination specific. We establish the direct effect of increased trade barriers for a given input on the firm's exports in each market k. This proposition predicts the expected responses of a multi-destination firm in its different markets, depending on variable markups and characteristics of the firm-destination. The second set of results are at the firm level. These predictions show how trade barriers affect total export revenues and total imports and guide the estimation of the elasticity of exports for imports at the firm level.

We first analyze the effects at the firm level.

PROPOSITION **3** (Firm level predictions)**.**

A. ***(Effect on total exports)*** *The effect on total exports is negative and decreasing in the size of the firm.*

$$\frac{\partial \log R_i}{\partial \log \tau_{iv}} = (1-\rho) \sum_k \frac{R_{ik}}{R_i} \left[\frac{1}{1+\Gamma_{ik}} m_{iv} \right] < 0 \tag{3.11}$$

B. ***(Effect on total imports)*** *Provided $\rho > 1$, imports are weakly decreasing in the trade costs of importing variety v (τ_{iv}). In addition, the negative effect is stronger, the higher the share of firm's imports corresponding to v:*

$$\frac{\partial \log M_i}{\partial \log \tau_{iv}} = -m_{iv} \left[\rho \sum_k \frac{Q_{ik}}{Q_k} \frac{1}{1+\Gamma_{ik}} - 1 \right] \leq 0 \tag{3.12}$$

$$\frac{\partial \log M_i}{\partial (\log \tau_{iv} \partial m_{iv})} = - \left[\rho \sum_k \frac{Q_{ik}}{Q_k} \frac{1}{1+\Gamma_{ik}} - 1 \right] \leq 0 \tag{3.13}$$

[22] Note that when we extend the model to allow for entry and exit into import and export, lower costs through higher inputs may impact results.

C. ***(Elasticity of exports with respect to imports)*** *The total amount of exports of a firm are increasing on the amount of imports of the firm. That is,*

$$\mathcal{E}_{XM} = \frac{\frac{\partial \log R_i}{\partial \log \tau_{iv}}}{\frac{\partial \log M_i}{\log \tau_{iv}}} = \frac{\partial \log R_i}{\partial \log M_i} = \frac{(1-\rho)\sum_k \frac{R_{ik}}{R_i}\left[\frac{1}{1+\Gamma_{ik}}\right]}{1-\rho\left[\sum_k \frac{Q_{ik}}{Q_k}\frac{1}{1+\Gamma_{ik}}\right]} > 0 \tag{3.14}$$

Proof. See proof in Appendix C.4. □

We then establish the effect of import cost shocks on export revenues in a given market k.

PROPOSITION **4** (Firm-destination responses)**.**

A. *Provided* $\rho > 1$, *revenues in market k are weakly decreasing in the costs of importing variety v* (τ_{iv})*. In addition, the effect is larger (more negative), the higher is* m_{iv}*:*

$$\frac{\partial \log R_{ik}}{\partial \log \tau_{iv}} = (1-\rho)\left[\frac{1}{1+\Gamma_{ik}} m_{iv}\right] \leq 0 \tag{3.15}$$

$$\frac{\partial \log R_{ik}}{\partial \log \tau_{iv} \partial m_{iv}} = (1-\rho)\left[\frac{1}{1+\Gamma_{ik}}\right] \leq 0 \tag{3.16}$$

B. *The effect of increasing import costs on exports to market k is weakly decreasing in the elasticity of markup* Γ_{ik} *(it is strictly decreasing if markups are not constant):*

$$\frac{\partial \log R_{ik}}{\partial(\log \tau_{iv} \partial m_{iv})\partial \Gamma_{ik}} \geq 0 \tag{3.17}$$

C. *Provided* $\S = \frac{\partial \log \Gamma_{ik}}{\partial \log S_{ik}} > 0$, *then the absolute value of the elasticity of exports to market k with respect to import costs is weakly decreasing on the size of the firm* S_{ik}*. It is decreasing if markups are not constant:*

$$\frac{\partial \log R_{ik}}{\partial(\log \tau_{iv} \partial m_{iv})\partial S_{ik}} \geq 0 \tag{3.18}$$

Proof. Proofs are straight-forward from the inspection of equations above. See appendix. □

In the next sections, we explore the predictions of the propositions of the model. In Section 4 we examine predictions of Proposition 6 which establishes results at the firm-level. In section 6, we then evaluate empirically the predictions of Proposition 4 that are related to the differential responses of firms across markets, depending on their relative size and market power.

4 Empirical Strategy

In this section, we put together the model intuitions with a supply shock to import costs of specific products (i.e.: τ_{iv}), combined with information on the share of imports of the products of a firm m_{iv}. On this ground, we exploit exogenous variability in import costs due to the Argentine government's imposition of non-tariff barriers on specific products between 2003 and 2011. On this basis, we exploit exogenous variation in import costs due to the Argentine government's imposition of non-tariff barriers on specific products between 2005 and 2011. First, we explain the methodology used to compute firms' exposure to the policy. Next, we demonstrate that the policy was effective in reducing imports. Finally, we show that the policy also impacted firms' exports, and that the pre-treatment parallel trends assumption holds.

4.1 Methodology

We use the NAILs to construct a cost shock for a firm. In particular, to construct a time-varying firm-level variable that proxies a firm's exposure to import barriers, we proceed as follows: we use the import basket of the firm in the period 2003-2007 (before the large increase in the products included in this policy) and calculate the share of the firm's expenditure on imported inputs that corresponds to each product v ($m_i v$). Then, holding this share constant over time, we multiply it by an indicator that takes a value of 1 in those years when the product is affected by the NAILs. Then, we sum across products for a given firm. Formally, we define a firm's exposure to NAILs in time t as,

$$NAILexposure_{it} = \sum_{v} m_{iv} NAIL_{vt}, \tag{4.1}$$

where m_{iv} represents the share of expenditure on imported input v in the period 2003-2005 and $NAIL_{vt}$ is an indicator that takes value 1 if the product v is affected by NAILs in period t.

Intuitively, guided by Proposition 6.B., we assume that a firm is more exposed to the import shock, the higher the initial share of expenditure that corresponded to the affected product in the period before the policy took place.

4.2 Relevance of the policy and identifying assumption

4.2.1 Effectiveness of the NAILs in reducing imports

Before moving to the paper's main results, we first explore whether the NAILs effectively reduced imports of items that were added to the list. To do so, we use aggregate data to perform an event study at the product level to analyze if being added to NAILs, reduces imports of an item at the 8-digits tariff level. Formally,

$$\log(Imports_{vt}) = \sum_{j=-27}^{12} \beta_j 1[QuartersSinceNAILs_{vt} = j] + \alpha_v + \gamma_t + u_{vt}, \tag{4.2}$$

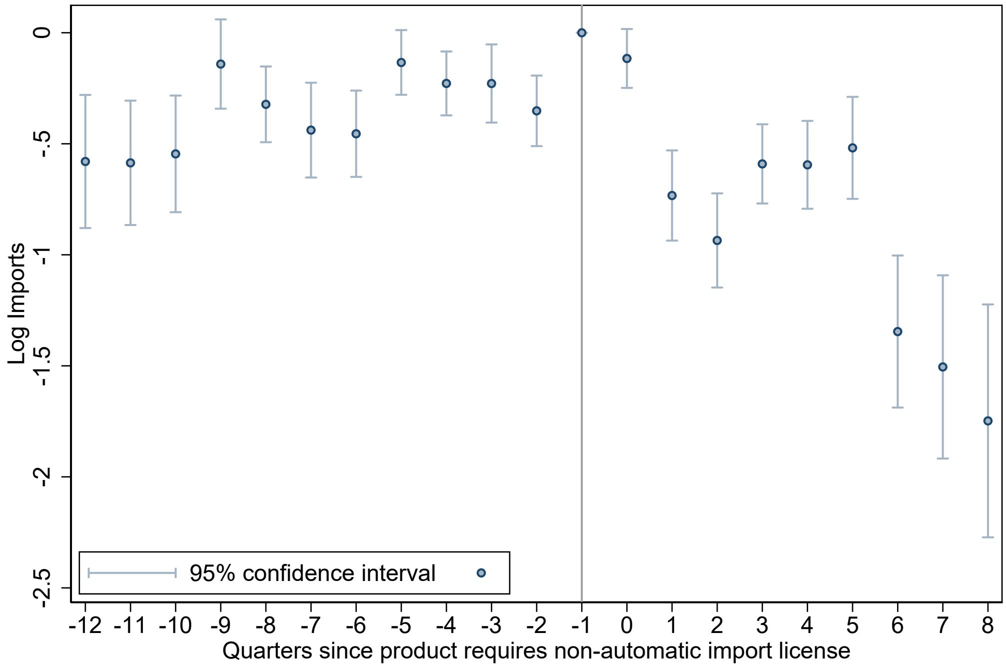
where the negative values correspond to quarters before product v entered the NAILs list. We focus on parameter β that represents the impact of the incorporation of NAIL on products' imports. Figure 3 plots the coefficients β. [23] We do not observe systematic differences in the years before the product was added to the NAIL system. As expected, the NAILs work as an important barrier to trade, especially since the second quarter after the product was included in the policy.[24] We find

[23] We restrict the sample to those products that entered at some point into the NAILs system.

[24] In the first months, importers could use previously approved automatic licensing to imports, so NAILs might re-

that imports of a product that is added to the NAILs list decline by 50% the first year relative to its counterfactual.

Figure 3: Event study. The impact of Non Automatic Import License on firms' imports (logs).



Notes: The figure shows the effects on the log of import values up to 8 quarters after the imposition of the non-automatic import license and the pre-trend from 12 quarters before between 2002Q1 and 2010Q4. Standard errors are clustered at the 8-digit tariff level.

4.2.2 Identification assumption

After showing that imports of products added to the NAILs system decline, we turn to test our identification assumption. Our main identification assumption is that the timing in which a product enters the NAILs system is not correlated with changes in the firm's export decisions. In other words, the evolution of exports in firms that were more exposed to NAILs would have been similar to the evolution of exports of firms less exposed in the absence of the policy. In this section we test the identification assumption and in Section **??** we perform several robustness checks to deal with alternative mechanisms and threats to the identification assumption.

In order to indirectly test this assumption, we design an event study. We define as an event at $t = 0$ when the year for which at least one product of the firm was affected. We then graph the event study for the differences in log (exports) between these groups. Formally, we run the following equation,

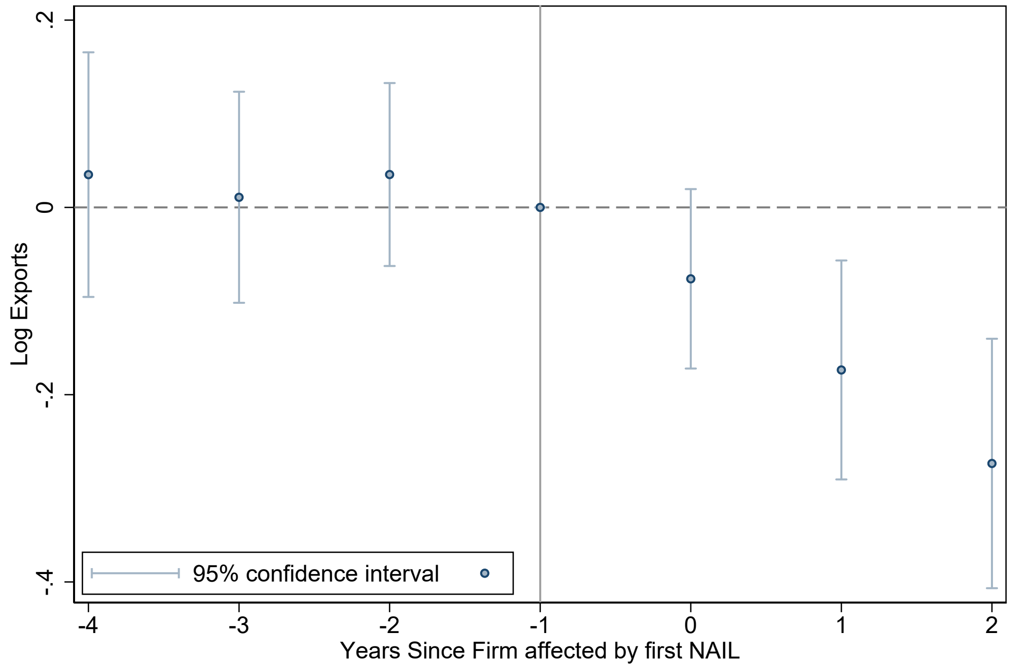
$$\log(exports_{it}) = \sum_{j=-4}^{2} \beta_j 1[YearsSinceExposureToNAILs_{it} = j] + \alpha_i + \gamma_{st} + u_{it}. \quad (4.3)$$

Figure 4 plots the coefficients β_j of this regression. Reassuring, we do not observe any systematic differences in the firms' exports in the years before the firm became affected by NAILs. This is suggestive evidence that the parallel trend assumption may hold in our context. In addition, the

quire some months to effectively affect imports.

Figure provides a first glance at the results that we will show in the next section: the value of exports is significantly reduced after the firm is exposed to NAILs.

Figure 4: Event study. The impact of Nonautomatic Import licenses on firms' exports (logs).



Notes: The figure shows the effects on the export values for firms that were exposed to non-automatic licenses up to 2 years after the exposition and the pre-trend from 4 years before. A firm is classified as exposed if at least one of its products imported during 2003-2007 was affected by non-automatic import licenses. Standard errors are clustered at the firm level. The regression includes fixed effect at the firm level and sector-year level.

5 Results

In this section we present the main results of the paper. First, we document the effect of the policy on imports and exports at the firm level. We identify the direct effect of NAILs on exports at the intensive and extensive margin, we estimate the elasticity of total exports and the heterogeneous effects of NAILs across product and market differentiation. We also show the impact on employment. Then, in Section 6 we use the model's predictions to estimate whether it is increasing on a firm's relative size in the market.

5.1 The effect of NAILs on imports and exports

5.1.1 Average Effect of NAILs on imports and exports

We begin by estimating the effect of NAILs exposure on firms' exports. According to our model, introducing import barriers to intermediate inputs v increases the marginal cost for firms exposed to this barrier and reduces their competitiveness in foreign markets. To quantitatively test this, we run the following equation

$$Y^X_{ist} = \beta NAILexposure_{ist} + \gamma_i + \gamma_t + \gamma_{st} + \mu_{it}, \tag{5.1}$$

where Y^X_{ist} is a set of outcomes measuring intensive and extensive margin of exports, such as log exports, export status, number of products and number of destinations. Results from the estimation of equation 5.2 are reported in Table 8.

Table 2: Reduced form. The effect of NAILs exposure on firm's total exports

	(1) $log(exports)_{it}$	(2) $Exportstatus_{it}$	(3) $\#Products$	(4) $\#Destinations$
$NAILexposure_{it}$	-0.3494***	-0.0282***	-0.3115**	-0.1690***
	(0.1058)	(0.0094)	(0.1350)	(0.0367)
Observations	162,981	162,981	162,981	162,981
R-squared	0.85	0.80	0.93	0.95
Mean dep variable	4.66	0.38	3.00	1.67
Firm FE	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes

Notes: Clustered standard error at the firm level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1 $NAILexposure_{it}$ represents the share of firms' imports of the period 2003-2005 affected by NAIL in year t Column (1) outcome use the inverse hyperbolic sine transformation to account exports of all firms. Column (2) outcome is a dummy variable that takes values 1 if firms i export at year t and 0 otherwise. Columns (3) and (4) outcomes indicate the firms' number of exported products and destinations.

Exposure to NAILs significantly reduced both the intensive and extensive margins of exports. Firms with 10% exposure to NAILs experienced a 3.49% reduction in export volumes compared to unaffected firms. The policy also affected the extensive margin of exports. On average, firms with 10% exposure to NAILs saw a reduction of 2,8 percentage points (-7.4% relative to the unconditional mean) on the probability of continuing exporting.In addition, they decrease the number of exported products by 0.31 (-33%) and the number of export destinations reached by 0.169 (-18%).

Once we have demonstrated the reduced form effects, we proceed to the IV estimation of the elasticity of exports with respect to imports at the firm level. As Proposition 6.C indicates, this elasticity is given by:

$$\mathcal{E}_{XM} = \frac{\frac{\partial \log R_i}{\partial(\log \tau_{iv} m_{iv})}}{\frac{\partial \log M_i}{\partial(\log \tau_{iv} m_{iv})}}.$$

Note that this is equivalent to dividing the coefficient of the effect of NAIL exposure on exports (reduced form) by the coefficient from a regression of NAIL exposure on imports (first stage). Thus, it is equivalent to running an IV regression of imports on exports, using NAILs exposure as the instrument for imports.

Results are reported in Table 3. In the second panel we report the first stage coefficient, which is -1.54. Namely, a firm for which 10% of their inputs are affected by the NAILs reduces their total imports by 15%. The first stage F-statistic is 154. In the first panel we report the coefficient of the elasticity of exports with respect to imports. We find that the elasticity is 0.23. An increase in 10% of imports of intermediate inputs increases export values by 2.2%. In addition, access to imports also have considerably effects on the extensive margin of exports, as reflected by an increase in export status, number of products and number of destinations.

We have shown that exposure to non-tariff trade barriers reduced firms import capabilities, which

Table 3: Elasticity of exports with respect to imports at the firm level

	(1) $log(exports)_{it}$	(2) $Exportstatus_{it}$	(3) $\#Products$	(4) $\#Destinations$
$log(imports)_{it}$	0.2266***	0.0183***	0.2020**	0.1096***
	(0.0671)	(0.0060)	(0.0873)	(0.0241)
Observations	162,981	162,981	162,981	162,981
Firm FE	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes
First Stage				
$NAILexposure_{it}$	-1.5420***	-1.5420***	-1.5420***	-1.5420***
	(0.1242)	(0.1242)	(0.1242)	(0.1242)
F	154.07	154.07	154.07	154.07
Mean dep variable	5.09	5.09	5.09	5.09

Notes: Clustered standard error at firm level in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ $NAILexposure_{it}$ represents the share of firms' imports of the period 2003-2005 affected by NAIL in year t. Column (1) outcome use the inverse hyperbolic sine transformation to account exports of all firms. Column (2) outcome is a dummy variable that take values 1 if firms i export at year t and 0 otherwise. Columns (3) and (4) outcomes indicates the firms' number of exported products and destinations.

in turn affected exports of firms that used intensively inputs affected by the policy. In the next section, we investigate heterogeneous effects depending on the type of destinations and products that the firm export.

5.1.2 Heterogeneous Effects of NAILs on exports: product and market differencitation

In this section, we explore whether non-tariff barriers on imports affects firms' ability to export specific types of products or access certain markets. To answer this question, we separate firm exports depending on the destinations and products that they sell. First, we separate firms total exports into those are related to differentiated goods and those that are related to undifferentiated goods, according to Micro-D classification (Bernini et al. 2018). Second, we separate firms total exports according to their destinations in OECD, Mercosur (Argentina's most important regional trade agreement), and other countries.

Results are presented in Table 4. The coefficient of differentiated exports with respect to NAILs exposure is 0.34, which is three times higher than the coefficient for non-differentiated exports. This finding indicates that access to imported inputs is particularly critical for producing differentiated goods, and non-tariff barriers affect exporters of these goods relatively more. Moreover, exports to OECD countries are 46% more sensitive to NAILs than exports to Mercosur countries. This suggests that NAILs have a more significant impact on firms exporting to high-income economies, where competition is more intense and access to imported inputs to reduce production costs and gain competitiveness is more important.

These findings are consistent with the fact that differentiated products and more complex markets typically require more intensive use of high quality intermediate inputs.

Table 4: Heterogeneity of the effect of NAILs exposure on exports

	(1) $log(exports)_{it}$ $Differenciated$	(2) $log(exports)_{it}$ $Undifferenciated$	(3) $log(exports)_{it}$ $OECD$	(4) $log(exports)_{it}$ $Mercosur$	(5) $log(exports)_{it}$ $Other$
$NAILexposure_{it}$	-0.3412***	-0.1124**	-0.2813***	-0.1916**	-0.2208***
	(0.1023)	(0.0512)	(0.0728)	(0.0871)	(0.0849)
Observations	162,981	162,981	162,981	162,981	162,981
R-squared	0.8519	0.8809	0.8534	0.8556	0.8591
Firm FE	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes

Notes: Clustered standard error at firm level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. $NAILexposure_{it}$ represents the share of firms' imports of the period 2003-2005 affected by NAIL in year t. All outcomes are the inverse hyperbolic sine transformation of firms' exports. Columns (1) and (2) discriminate exports into differentiated and undifferentiated products. Columns (3), (4) and (5) disaggregate firms'exports in terms of destinations in OECD (countries that were members in 1997), Mercosur and Others.

5.2 The Effect of NAILs on Employment

Next, we examine the effect of non-tariff barriers, as proxied with NAILs, on firm employment. This is especially interesting given the absence of previous studies on the impact of non-tariff barriers on the labor market. The direction of the effect is not obvious. Firms typically rely on a mix of foreign intermediate inputs and local labor for production. When NTBs limit access to these inputs, firms are compelled to adjust their production processes, with two opposing effects on employment decisions. On the one hand, higher marginal costs may lead firms to scale back production, resulting in workforce reductions (scale effect). On the other hand, the increased cost of imported inputs may drive firms to substitute labor for these inputs, potentially leading to more hiring (substitution effect). We use exposure to NAILs to investigate which channels prevail and study the impact of the policy on employment. Formally, we estimate

$$log(employment)_{ist} = \beta NAILexposure_{ist} + \gamma_i + \gamma_{st} + \gamma_{st} + \mu_{it}, \qquad (5.2)$$

First, Column (1) evaluates the effect on employment, accounting for both the intensive and extensive margins. We find that a 10 percentage point increase in a firm's exposure to NAILs leads to an average reduction of 1.40% in employment. Column (2) focuses on continuing firms with positive employment across consecutive years. The results suggest that this margin of adjustment is not particularly significant, possibly indicating that the opposing forces of scale and substitution effects offset one another for these firms. Column (3) examines the impact on the probability of a firm remaining active. A 10% increase in NAIL exposure decreases this probability of remaining active by 0.5 percentage points, implying that exposure to NAILs increased the likelihood of firm closures or temporary shutdowns.[25]

[25] In Appendix **??**, we extend these results to the market level.

Table 5: Labor Market Effects

	(1) Log(Employees) - all	(2) Log(Employees) - continuers	(3) Active
$NAILexposure_{it}$	-0.1040***	-0.0212	-0.0511***
	(0.0274)	(0.0137)	(0.0106)
Observations	162,981	116,366	162,981
R-squared	0.83	0.96	0.53
Mean dep variable	2.22	2.22	0.76
Firm FE	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes

Notes: Clustered standard error at firm level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. $NAILexposure_{it}$ represents the share of firms' imports from 2003-2005 affected by NAIL in year t. Column (1) outcome is the inverse hyperbolic sine transformation of the number of employees of firm i in year t. Column (2) replicates column (1) but only for firms with employees in 2 t and $t-1$. Column (3) outcome is a dummy variable that takes value 1 if the firm has employees at year t and 0 otherwise.

5.3 Robustness

Potential Bias of Government Selecting Sectors. One concern for our estimation is if the government targeted LNA to firms in specific sectors. This would only be problematic if LNA was allocated to inputs of firms in sectors where firms' decline in exports was expected. In this section we will show that even if some sectors where more exposed than others to the policy, this will not affect our results.

In Appendix B.4 it can be shown that some sectors were more affected than others. To deal with this the first thing we do is control by sector x time FE. this fixed effects compare the effects of the NAILs on firms of the same same sector in the same year. There is alot of variabilityh in the exposure meassure so we are able to use this variation to understand the effects of the nails. In addition our coefficient is very stable to different variations of the sector deffinition, that is 2 digit CLAE or 4 digit CLAE.

Potential Bias in Government Selection of Firms. A key concern in our study is whether the government strategically targeted firms when imposing Non-Automatic Licenses (LNAs). If the government deliberately selected firms whose imports were essential for their production, especially those highly reliant on imported inputs for their export activities, this could introduce a bias in our estimation of the impact of LNAs on firms' exports. In this scenario, the observed decline in exports following the imposition of LNAs might not solely reflect the policyâĂŹs impact but rather a pre-existing government strategy aimed at restricting specific firms. This would challenge the causal interpretation of our findings.

	(1) ln(Exports)	(2) ln(Exports)	(3) ln(Exports)
$NAILexposure_{it}$	-0.3494***	-0.2120**	-0.5048***
	(0.1058)	(0.1003)	(0.1007)
Observations	162,981	162,981	162,981
R-squared	0.7297	0.7381	0.7403
Sector-Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Controls×Year	No	Yes	Yes

Notes: Clustered standard errors at firm level in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Potential Firms' Responses through Bribes. Another potential concern is that firms might have worked around the restrictions imposed by Non-Automatic Licenses (LNAs) through informal payments or bribes. Even if some firms were able to bypass the restrictions, it is important to note that such payments would still represent an additional cost, effectively acting as a barrier to imports. While the cost structure would differ between firms that managed to import despite the LNAs and those that could not, the presence of these informal costs still imposes a friction in trade.

To assess whether larger firms were better able to evade LNAs, potentially through informal channels, we introduce an interaction term in our regression of imports on exposure to LNAs. If larger firms had more resources or influence to avoid the impact of LNAs, we would expect that more exposed firms would experience a weaker effect as firm size increases. In other words, the interaction between firm size and exposure should be positive, partially offsetting the negative effect of exposure to LNAs.

Table 6 presents the estimation results for the effect of Non-Automatic Import Licenses (LNAs) on firm imports, with an interaction term to test whether firm size mitigates the impact of LNAs.

The coefficient on *NAILexposure* is negative and highly significant as before, and the interaction term, *NAILexposure* $\times$ *numempl*, is also negative ($\beta_3 = -0.0035$) and significant ($p < 0.1$). This result suggests that, rather than mitigating the negative impact of LNAs, larger firms actually experienced a slightly stronger reduction in imports. This finding contradicts the hypothesis that firm size helped firms circumvent trade barriers. If larger firms had found ways to bypass the restrictions (e.g., through informal payments or influence), we would expect a positive and significant interaction term. Instead, the negative coefficient implies that larger firms may have been more affected by LNAs, possibly because their supply chains were more reliant on restricted imports.

Table 6: Robustness on informal payments

	(1)
$NAILexposure_{it}$	-1.4440***
	(0.1396)
$NAILexposure_{it} \times$ numempl	-0.0035*
	(0.0018)
Observations	162,981
R-squared	0.8554
Sector-Year FE	Yes
Firm FE	Yes

Notes: Clustered standard errors at the firm level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Market Power, Market Concentration, and the Impact of NAILs on Exports

Having analyzed the effects of NAILs at the firm level, we now assess whether market power and concentration influence the policy's overall impact. We begin by exploring these dynamics at the firm level before extending the analysis to the market level.

6.1 Firm Market Power, Market Share, and the Impact of NAILs on Exports

In this section, we empirically explore the predictions of Proposition 4 of the model about heterogeneous effects of the policy depending on firms' market shares to understand how larger firms can react differently to price changes compared to smaller firms. This is important because it helps explain competitive dynamics within markets and firms' strategic behavior. Larger firms with substantial market shares have more pricing power and can significantly influence market conditions. This analysis also sheds light on how market share impacts firms' resilience to economic shocks and their ability to maintain stability in prices and quantities. Understanding these effects is essential for designing effective economic policies and anticipating broader market implications.

We can begin this analysis by recalling Proposition 4. It establishes that if $\S = \frac{\partial \log \Gamma_{ik}}{\partial \log S_{ik}} > 0$, the negative impact of a cost shock on exports to market k is smaller in destinations where the firm has relatively larger market share:

$$\frac{\partial \log R_{ik}}{\partial(\log \tau_{iv} \partial m_{iv})\partial S_{ik}} \geq 0 \tag{6.1}$$

Thus, in response to a cost shock, we expect firms' exports to decline less in markets with a larger share. Proposition 4 also indicates a methodology to uncover the super-elasticity of markups across destinations by comparing export responses of firms in different destinations to a given cost shock.

As proposition 4 C. of our model guides the methodology to estimate the theoretical relationship between the elasticity of markup and market share in the destination (super-elasticity of markup), we now turn to the empirical estimation of the super-elasticity of markup. Specifically, we aim to test whether a given multi-destination firm adjusts its prices (export revenues) less in response to a cost shock in destinations where it holds a higher market share.

We can identify the theoretical coefficients in the relationship between markup elasticity and market share by estimating the following equation for those firms that report active exports to a market in $t-1$ and in t:

$$\Delta \log Expo_{iskt} = \beta_1 \Delta Nailexp_{it} + \beta_2 \Delta Nailexp_{it} * S_{ikt-1} + \gamma S_{ikt-1} + \gamma_{it} + \gamma_{skt} + \Delta e_{iskt} \tag{6.2}$$

where

$$S_{ikt} = \frac{ExportValues_{ikt}}{\sum_{i \in s} ExportValues_{iskt}} \times 100$$

Equation 6.2 is our benchmark empirical specification. Since we focus on markups, we restrict our attention to firm destinations with positive revenues in t and $t-1$. In our preferred specification, we include firm-by-year fixed effects and sector-by-destination fixed effects. Hence, the strategy relies on comparing changes in the firm's response to a change in its costs in the same year across destinations in which the firm has different market shares. To account for the fact that firms import from their export destinations, which can affect the pass-through of shocks, we control in all specifications for firm imports from the destination k.[26].

If the elasticity of markup does not depend on a firm's size in the market, then we expect β_2 to be zero. In contrast, if the elasticity of markup is increasing in the market share, then we expect $\beta_2 > 0$. Appendix Figure 13 visually represents our methodology to identify the markup super-elasticity, based on comparing how a given firm responds to a cost shock in its different destinations.

Table 7 reports the results for different specifications of equation 6.2. The first row reports the average effect, while the second row shows the effect interacted with destination market share. In Column (1) we do not include firm-year fixed effects to be able to observe the direct effect coefficient. Column (1) indicates that the average impact of the cost shock on exports is approximately -0.54 for firms in destinations where they hold a negligible market share. Consistent with the theory, the positive coefficient in the second row suggests that the negative impact on exports is mitigated in markets where firms have a higher market share, indicating a positive super-elasticity of markups.

In column (2) includes firm-year fixed effect to effectively compare a given firm in the same year across their destinations. In line with the theoretical model, results show that in response to a cost shock, a firm adjusts their export revenues (and thus prices) less in those destinations where they are relatively large.

Quantitatively interpreting our results in Column (2), we find that a firm impacted in 10% of its import basket reduces its export values by 5.3% in a destination where it has nearly zero market share. In contrast, it reduces export revenues by only 3.3% in a market where it holds a 20% share.

An alternative explanation to the markup story is that firms may reduce their presence more significantly in markets they value less. For instance, in response to a cost shock, firms might prioritize maintaining exports in markets where they have a larger sales volume. To test this hypothesis, we construct a variable that captures the share of a destination in a firm's total exports. This variable is

[26] Albornoz and Garcia-Lembergman (2022) and Amiti et al. (2015) document that the fact that firms import from their export destinations can affect the pass-through

interacted with the firm's exposure to LNA and included as an additional control in the regression. Column (3) presents the results. Consistent with the markup story, the main coefficient remains relatively stable at approximately 0.0059, while the coefficient for the importance of the market to the firm is close to zero and not statistically significant.

Finally, in column (4) we interact exposure with a destination country's per capita income and add it as a control. Our coefficient of interest remains robust to the inclusion of this control.

Table 7: Elasticity of markup and relation with market share

	(1)	(2)	(3)	(4)
		$\Delta log(Exports_{iskt})$		
$\Delta NAILexposure_{it}$	-0.5357***			
	(0.1477)			
$\Delta NAILexposure_{it} * S_{ikt-1}$	0.0108***	0.0069**	0.0059*	0.0065*
	(0.0028)	(0.0035)	(0.0034)	(0.0035)
$\Delta NAILexposure_{it} * ShareWithinFirm_{ikt-1}$			-0.0002	
			(0.0050)	
$\Delta NAILexposure_{it} * log(gdppc)_{kt-1}$				-0.1632
				(0.1577)
Observations	173,044	173,044	173,044	173,044
R-squared	0.6923	0.8799	0.8919	0.8800
Sector-Destination FE	Yes	Yes	Yes	Yes
Year FE	Yes	-	-	-
Firm-Year FE	No	Yes	Yes	Yes
Imports from K	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at the firm-year level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. We restrict data to observations with positive values of exports at the firm-market level and firms' main export product. $NAILexposure_{it}$ represents the share of firms' imports from 2003-2007 affected by NAIL in year t. S_{ikt-1} is the market share of firm i in destination k in the year t. The variable $log(gdppc)_{kt-1}$ represents the destination GDP per capita in year $t-1$. $ShareWithinFirm_{ikt-1}$ refers to the share of exports to destination k within total exports of firm i.

7 Quantitative analysis

7.1 Parameter estimation

In our model exporters' markups and the elasticity of markups is a function of their market shares and the elasticities ρ and η demand they face. The markup of firm i in market k, μ_{ik}, is given by:

Therefore, provided values for ρ and η, we can characterize these variables.

To estimate ρ and η, we employ an indirect inference approach based on the Simulated Method of Moments (SMM). We proceed in four steps:

1. We take the reduced-form coefficients, $\hat{\beta}_1$ and $\hat{\beta}_2$, from regression 6.2.
2. We simulate firm-level data by drawing from the empirical distribution of productivity and exposure shocks, aiming to replicate the observed distribution of S_{ik}.
3. Given initial guesses for ρ and η, we run the same regressions on the simulated data to obtain model-implied coefficients $\beta_1(\rho, \eta)$ and $\beta_2(\rho, \eta)$.

4. We choose $(\hat{\rho}, \hat{\eta})$ to minimize the distance between the simulated and empirical coefficients:

$$(\hat{\rho}, \hat{\eta}) = \arg\min_{\rho,\eta} \left\{ \left\| \hat{\beta}_1 - \beta_1(\rho, \eta) \right\| + \left\| \hat{\beta}_2 - \beta_2(\rho, \eta) \right\| \right\}. \tag{7.1}$$

See details in Appendix (Recall: add details).

The estimation yields $\hat{\rho} = 5.7$ and $\hat{\eta} = 2.1$. These imply an average markup across firms of $\bar{\mu}_i = 1.12$, and an average elasticity of markups with respect to market shares of $\bar{\Gamma}_i = 0.26$.

7.2 Counterfactual Analysis: The Role of Concentration and Variable Markups

We use the estimated model to evaluate the role of firm concentration and variable markups in shaping the aggregate impact of NAILs on exports. Specifically, we consider two counterfactual scenarios:

- **Counterfactual 1: Equalized Export Shares.** We reassign firms equal market shares within each sector, removing differences in market power across firms.
- **Counterfactual 2: Constant Elasticity of Substitution (CES).** We solve the model under the assumption of constant elasticity, eliminating variable markups.

Table 8 summarizes the results.

Table 8: Impact of NAILs under alternative market structures

	Full Model	$S_{ik} = 1/N_k$	CES
Δ log Exports	-7.21%	-8.11%	-10.05%

The results indicate that the negative effect of NAILs on firms' exports would have been 39% larger in an economy with constant elasticity of substitution, where markups do not adjust with firms' market shares.

7.3 Aggregation: Market Level

In this section, we draw conclusions at the market level by aggregating firm-level effects. Using our theoretical model, we take firm-level market shares as sufficient statistics and translate them into measures of market concentration, particularly through the Herfindahl-Hirschman Index (HHI). This aggregation enables a better understanding of how changes in market concentration affect overall market outcomes, providing deeper insights into economic competition and trade behavior.

We begin by defining the elasticity of demand in Cournot competition as:

$$\sigma_{i,k} = \left(\frac{1}{\rho}(1 - S_{i,k}) + \frac{1}{\eta} S_{i,k}\right)^{-1}$$

and we can express the markup as:

$$\mathcal{M}_{i,k}^{-1} = \frac{\sigma_{i,k} - 1}{\sigma_{i,k}} = 1 - \frac{1}{\sigma_{i,k}} = 1 - \sigma_{i,k}^{-1}$$

When aggregating at the sector level, sectoral markups can be expressed as a harmonic mean (weighted by market shares) of firm-level markups, following Burstein et al. (2020):

$$\mathcal{M}_{sk} = \left[\sum_{i=1}^{N_k} \mathcal{M}_{ik}^{-1} S_{ik}\right]^{-1}$$

Substituting the markup-market-share relationship 3.1 under Cournot competition, we can express the sectoral markup, M_{sk}, as a simple function of the sector's Herfindahl-Hirschman index, $HHI_{kt} = \sum_i S_{ik}^2$: [27]

$$\mathcal{M}_{sk} = \frac{\sigma_{ik} - 1}{\sigma_{ik}} = \left[1 + \frac{1}{\rho}(HHI_{s,k} - 1) - \frac{1}{\eta} HHI_{s,k}\right]^{-1} \tag{7.2}$$

Revenues for sector s in market k are given by (see Appendix C.6.1 for proof.):

$$R_{sk} = \frac{1}{\mathcal{M}_{sk}^{\rho-1}} \frac{\varphi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_k$$

And, replacing the sectoral markup, the total revenues of a sector are given by:

$$R_s = \frac{\varphi^{\rho-1}}{h_s^{\rho-1}} \sum_k \frac{1}{\left(\left[1 + \frac{1}{\rho}(HHI_{s,k} - 1) - \frac{1}{\eta} HHI_{s,k}\right]^{-1}\right)^{\rho-1}} P_k^{\rho-\eta} D_k \tag{7.3}$$

Given equation 7.2 and 7.3, we can derive the analogous propositions 1 and 2 in our model but at the market level. First, we look at the super-elasticity of the sectoral markup. The first result shows that markups increase as market concentration (HHI) rises. Secondly, the elasticity of the sectoral markup to price is always negative, meaning that as prices increase, the elasticity decreases. Lastly, the absolute value of this elasticity increases as market concentration grows, meaning the more concentrated the market, the more responsive the sectorial markup are to price changes. The formal proofs of these results are provided in Appendix C.6.3.

Given these propositions, we can examine market-level predictions regarding the effects of market shares on exports and imports. First, we find that total exports increase with the Herfindahl-Hirschman Index (HHI), meaning that higher market concentration makes exports less sensitive to price changes. Second, we observe that total imports are weakly decreasing in the trade costs of the

[27] The Herfindahl-Hirschman Index (HHI) is calculated as the sum of the squares of market shares of all firms in the market, resulting in a value between 0 and 1, where higher values indicate greater market concentration.

importing varieties, highlighting the relationship between trade costs and import volumes. Lastly, we establish a positive relationship between exports and imports within a sector, emphasizing the interconnectedness of trade dynamics. These results' full formal derivations and proofs are provided in the appendix C.6.4. The following section matches these theoretical propositions and predictions with the data to quantify the effects of the policy.

7.4 Discussion on aggregate level effect

In this section, we quantify the effect of the policy at the market level, defined as a sector-destination combination (s, k). According to the theoretical framework from section 7.3, in the presence of a cost shock, exports are less sensitive to import price changes the higher the concentration of exporters in a market, that is, the higher the HHI is. We propose an exercise leveraging our firm-level estimates derived in previous sections, taking advantage of the exogeneity of the shocks and the set of controls incorporated in the model. To investigate the impact of concentration on changes in export values at the sector level, we begin by taking the estimated coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$, from equation 6.2. We then multiply both sides of the equation by S_{iskt-1} (representing firm i's share in market sk at time $t-1$) and sum over all firms i within the market. [28] This approach allows us to express the coefficient on exposure as a function of the Herfindahl-Hirschman Index (HHI), capturing the role of market concentration in shaping sectoral export dynamics.

$$\Delta Log(Expo_{iskt}) = \hat{\beta}_0 + \hat{\beta}_1 \Delta Exposure_{it} + \hat{\beta}_2 S_{iskt-1} + \hat{\beta}_3 \Delta Exposure_{it} S_{iskt-1} + \Phi(\cdot) \tag{7.4}$$

where $\Phi(\cdot)$ corresponds to the terms in 6.2 related to the fixed effects. [29] Now, multiply both sides by S_{ikt-1} and sum over i:

$$\sum_i S_{iskt-1} \Delta \log(\text{Expo}_{iskt}) = \hat{\beta}_0 + \hat{\beta}_1 \sum_i \Delta\text{Exposure}_{iskt} S_{iskt-1} + \hat{\beta}_2 HHI_{sk,t} + \hat{\beta}_3 \sum_i \Delta\text{Exposure}_{iskt} S^2_{iskt-1}$$

We define the average sector exposure as:

$$\Delta\text{Exposure}_{sk,t} = \sum_i \Delta\text{Exposure}_{iskt} S_{iskt-1} \tag{7.5}$$

Then we can rewrite:

$$\sum_i S_{iskt-1} \Delta \log(\text{Expo}_{iskt}) = \hat{\beta}_0 + \hat{\beta}_1 \Delta\text{Exposure}_{skt} + \hat{\beta}_2 HHI_{sk,t} + \hat{\beta}_3 \sum_i \Delta\text{Exposure}_{skt} \times f_{iskt} \times S^2_{iskt-1}$$

where $f_{iskt} = \frac{\Delta\text{Exposure}_{iskt}}{\Delta\text{Exposure}_{skt}}$ is the ratio between firm i exposure and the sector exposure.

$$\frac{\sum_i S_{iskt-1} \Delta \log(\text{Expo}_{iskt})}{\Delta\text{Exposure}_{skt}} = \hat{\beta}_1 + \hat{\beta}_3 \sum_i f_{iskt} \times S^2_{iskt-1}$$

[28] Note that market is defined as a sector-destination combination. However, as for each firm, in the data we use the main product sold by the firm referring as a market, k is equivalent to sk

[29] From now on, we will exclude this term since it is not relevant for the market analysis and would become zero when taking the derivative with respect to the change in exposure.

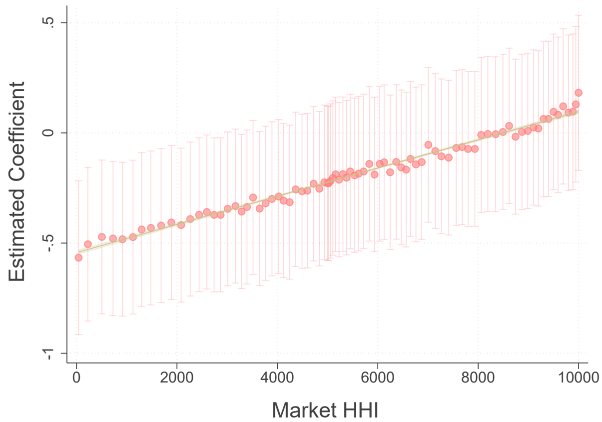
Note that if there is no heterogeneity across firms in a sector's exposure to NAILs, there is a linear relationship between the sector's HHI and the effect of sector exposure:

$$\frac{\sum_i S_{iskt-1} \Delta \log(\text{Expo}_{iskt})}{\Delta \text{Exposure}_{skt}} = \hat{\beta}_1 + \hat{\beta}_3 HHI_{skt} \tag{7.6}$$

We estimate the general case with heterogeneity. We then plot it with respect to the HHI_{skt} of the sector. The Herfindahl-Hirschman Index (HHI) is computed for the year $t-1$ within each 8-digit HS level $\times$ market combination. The Herfindah index ranges from 0 to 10000. Results are shown in Figure 5. [30] As expected, the relationship is positive. For example, a low-concentration sector with an HHI of 2000 shows a NAILs effect of -0.20. In contrast, a high-concentration sector with an HHI around 8000 exhibits a null effect.

These findings indicate that the characteristics of the affected market shape the effect of non-trade barriers. In highly concentrated markets, non-trade barriers may impact sector sales less, as firms can absorb the shock by adjusting their markups. In contrast, in sectors with low concentration markets, the effect on the costs of the barriers has a higher impact on downstream firms.

Figure 5: Aggregate effect of exposure to NAILs at Market-level and HHI index



Notes: Market is defined as the destination-product combination using the 8-digit HS level for products. The confidence intervals at the 95% level. Estimated coefficient by concentration of the sector, defined at 8-digit tariff line-destination-year. Using the mean standard error per bin, 5% confidence intervals were computed around the bin scatter points

8 Tariff-Equivalent to NAILs

We combine our empirical estimates with the model structure to compute the tariff-equivalent of NAILsâĂŤthat is, the average percentage increase in tariffs that would produce the same effect on export revenues. Expressing the impact of NAILs in tariff-equivalent terms offers a transparent measure of their trade restrictiveness and facilitates comparison with conventional tariff policies and results in the trade literature. It also highlights the fiscal revenue that the government does not capture associated with the use of non-tariff barriers.

[30] The standard errors were computed as the mean standard errors by bin, where the standard errors are defined as $Var(Coefficient_{skt}) = Var(\hat{\beta_1}) + Var(\hat{\beta_3}) \left(\sum_i f_{iskt} S^2_{iskt})\right)^2 + 2 \sum_i f_{iskt} S^2_{iskt} cov(\hat{\beta_1}, \hat{\beta_3})$.

Define the average tariff-equivalent percentual change as$d\log\tau_v = d\log\bar{\tau}$.

Recall from our baseline empirical specification reported in column (1) of Table that:

$$\hat{\beta} = \frac{\partial \log R_i}{\partial \text{NailExposure}_i} = -0.35$$

In the model, a firm's log export revenue responds to changes in τ_v is:[31]

$$d\log R_i = (1-\rho)\sum_v \frac{d\log P_i}{d\log \tau_v}\cdot d\log\tau_v = (1-\rho)\sum_v m_{iv}\cdot d\log\tau_v$$

To obtain a unique value fot the Tariff equivalent change in every product, we set $\tau_v = d\log\bar{\tau}$ for products affected by NAILs and zero for products not affected by NAILs. Substituting above

$$d\log R_i = (1-\rho)\cdot d\log\bar{\tau}\cdot\sum_v m_{iv}\cdot \mathbb{I}[\text{Nail}_v = 1]$$

By definition, the summation term is the change in $NAILexposure_i$. Therefore,

$$d\log R_i = (1-\rho)\cdot d\log\bar{\tau}\cdot d\text{NailExposure}_i$$

Re-arranging terms, we obtain

$$d\log\bar{\tau} = \frac{\hat{\beta}}{1-\rho}$$

We obtain $\hat{\beta} = -0.35$ from our empirical estimate in Section 4and take the demand elasiticty from previous papers $\rho = 4$. Then, we can calculate the average tariff-equivalent change of the NAILs

$$d\log\bar{\tau} = \frac{-0.35}{1-4.5} = \frac{-0.35}{-3} \approx 0.12$$

The NAILS policy was equivalent to a 12% increase in tariffs on the affected products during the years of implementation. To put this into perspective, India's trade liberalization involved a 32% reduction in tariffs, while US tariffs imposed in 2018-19 represented a 600% increase in targeted products.

9 Conclusion

The imposition of Non-Automatic Import Licenses (NAILs) in Argentina between 2005 and 2011 provides a unique opportunity to study the broader consequences of non-tariff trade barriers. This paper investigates how these import restrictions affected downstream firms, with a particular focus on their impacts on imports, exports, and employment. We find that NAILs significantly re-

[31] For simplicity—and without loss of generality—we abstract from variable markups, as for each firm they cancel out in this derivation and do not affect the final result.

duced firm imports, leading to subsequent declines in both exports and employment for firms that rely on these imported inputs. These findings underscore the critical role that non-tariff barriers play in shaping firm behavior and broader economic outcomes.

Our analysis further explores the role of firm market power and market concentration in mediating the effects of NAILs. We develop a theoretical model with oligopolistic competition in export markets, demonstrating that firms with greater market power in specific destinations can adjust their markups in response to cost shocks from NAILs. This ability to absorb shocks by altering markups reduces the impact on prices and output, particularly in more concentrated markets. Consequently, the aggregate effects of non-tariff barriers like NAILs are unevenly distributed, with firms in more concentrated markets being better equipped to manage these trade restrictions.

Additionally, our findings highlight the importance of understanding how firms, especially those that export to multiple markets, set prices and react to shocks. In our sample, roughly 60% of exporters serve more than one destination, and these firms account for over 99% of total manufacturing exports. Understanding the behavior of these multi-destination exporters is crucial for assessing aggregate trade flows and the distribution of welfare gains from trade. We document that within-firm responses to NAIL-induced cost shocks vary across destinations, with firms adjusting their export revenues less in markets where they hold a larger market share by reducing their markups in those destinations.

This heterogeneity in responses across destinations has significant implications for the impact of trade shocks at the aggregate level. Our results suggest that unilateral trade liberalization, which reduces local costs for Argentine firms, would disproportionately benefit richer countries where these firms have a lower market share, as the reduction in costs would lead to relatively greater price reductions in those markets. In contrast, in poorer countries where multi-destination exporters have a higher market share, the cost reductions would be partially absorbed in the firms' markups, limiting the extent of the gains. These insights are crucial for policymakers, who must consider the varied impacts of trade barriers across different market environments when designing and implementing trade regulations.

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A Appendix: Data construction

A.1 Data Sources

Data	Data Source	Notes
Argentinian Exports	Aduanas (2000-2012)	Access through Ministry of Productive Development
Argentinian Imports	Aduanas (2000-2012)	Access through Ministry of Productive Development
Decrete Information	Secretary of Trade, Argentina	Ministry of Productive Development
Employment	Form 931 Declaration	Administracion Federal de Ingresos Publicos (AFIP)
Micro-D Classification	Bernini et al. (2018)	Classification of differentiated exports
NAILS in Argentina	InfoLEG, MECON	Centre of Documentation and Information (CDI)
NAILS Worldwide	World Trade Organization	WTO Import Licensing Portal

A.2 Baseline Sample

In this section, we describe how the data for the baseline analysis was constructed. We put together three datasets: (i) AFIP Employment Data, (ii) Customs import data, and (iii) InfoLEG decrees.

First, we take AFIP Employment Data. This dataset includes information on employment and activity sectors for the universe of firms in Argentina (e.g. exporters, importers, domestic firms, etc.) from 2001 to 2019. We keep information for the period 2003-2011. To construct our sample we proceed with some cleaning steps: (i) keep firms with positive employment (e.g. more than 1 employee), (ii) keep firms with information on the activity sector, (iii) keep all firms that were active in 2007 [32] and were active for at least 1 year in our sample [33].

Second, we add data from Customs containing the universe of importers and exporters in Argentina. The customs dataset is at the firm level and includes information on the trade flows of each firm, destination or origin, year, and product at the most detailed aggregation level (12-digit level, which includes HS 6-digit level and 6 digits specific to Argentina). We restrict the sample to (i) manufacturing firms to avoid trading companies whose imports are not intermediate inputs to their production and whose exports are not produced by other firms and (ii) firms that exported at least once in 2002-2007. Exclusions include imports of used goods, products originating from provinces in Argentina, those associated with consignment export returns, and products originating from Argentina. Regarding the export database, firm-level data between 2000 and 2012 are considered, excluding non-reexported products and those produced in Argentina. Products destined for Argentina are also excluded, retaining only newly exported items.

Third, we constructed a unique database containing monthly data on (non) tariff barriers to different products imposed in Argentina during the 2002-2011. We tracked and digitized executive decrees during the period to construct a database listing the month-year in which an administrative barrier was imposed on each of the products at (HS-8-Digit). We get this information from InfoLEG. InfoLEG is a juridical database, where the Legislative Information and Documentation Area of the Centre of Documentation and Information (CDI) of the Ministry of Economy and Finance (MECON) co-ordinates the collection and updating of national legislation, its rules of interpretation and background.

[32] Note that this step does not have relevant consequences since most of the firms being excluded here are very small and do not import or export.

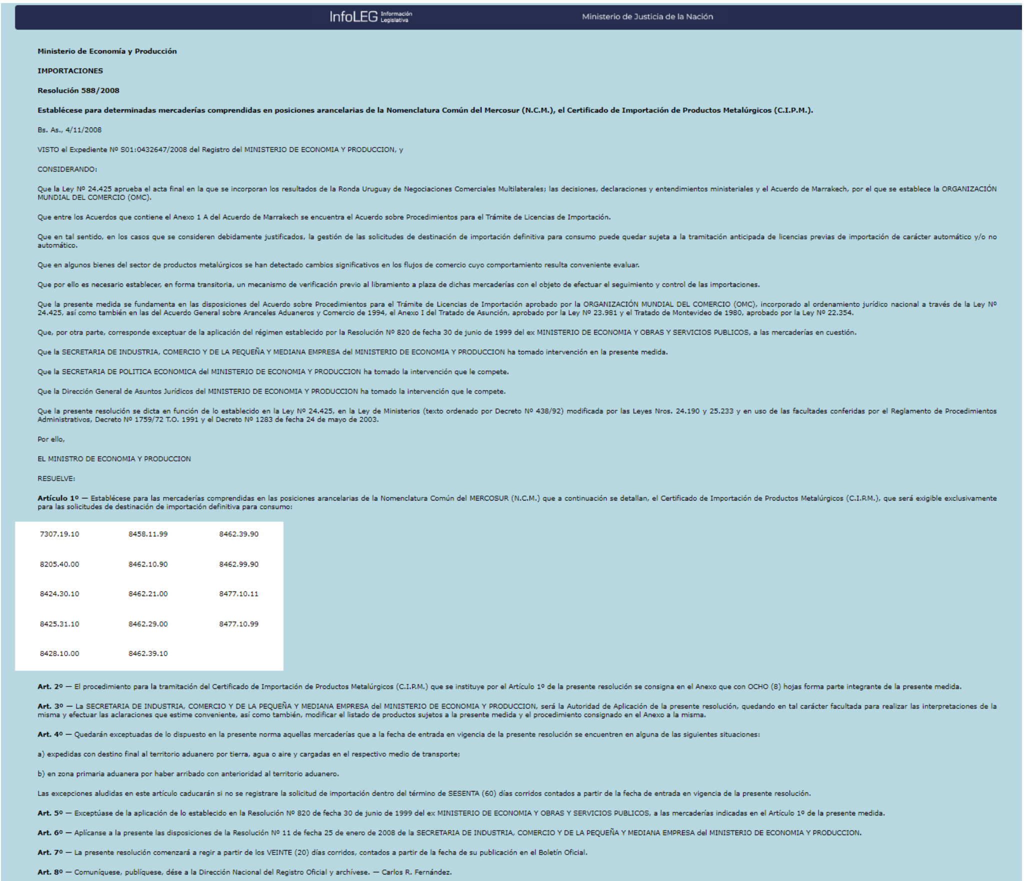
[33] Results remain qualitatively unchanged if we don't impose this last restriction.

The main challenge in constructing price and volume indices with customs data is the unit value bias. Unit values, determined by dividing observed values by quantities, do not accurately reflect real prices. They can fluctuate even when there is no actual price change due to shifts in composition. We follow the methodology developed by Boz et al. (2019) to mitigate this issue.

A.3 InfoLEG - Centre of Documentation and Information (CDI)

A page on the InfoLEG website for a specific resolution, such as ResoluciÃşn 1660/2007, typically includes the official title and number, the date of issuance, the main text detailing the legal provisions and regulations, and the names and positions of the signatories. It also provides information on related legal documents and amendments, the applicability and scope of the resolution, and specific implementation instructions, including timelines and responsible authorities.

Figure 6: Example of NAILs



InfoLEG Información Legislativa — Ministerio de Justicia de la Nación

Ministerio de Economía y Producción

IMPORTACIONES

Resolución 588/2008

Establécese para determinadas mercaderías comprendidas en posiciones arancelarias de la Nomenclatura Común del Mercosur (N.C.M.), el Certificado de Importación de Productos Metalúrgicos (C.I.P.M.).

Bs. As., 4/11/2008

VISTO el Expediente Nº S01:0432647/2008 del Registro del MINISTERIO DE ECONOMIA Y PRODUCCION, y

CONSIDERANDO:

Que la Ley Nº 24.425 aprueba el acta final en la que se incorporan los resultados de la Ronda Uruguay de Negociaciones Comerciales Multilaterales; las decisiones, declaraciones y entendimientos ministeriales y el Acuerdo de Marrakech, por el que se establece la ORGANIZACIÓN MUNDIAL DEL COMERCIO (OMC).

Que entre los Acuerdos que contiene el Anexo 1 A del Acuerdo de Marrakech se encuentra el Acuerdo sobre Procedimientos para el Trámite de Licencias de Importación.

Que en tal sentido, en los casos que se consideren debidamente justificados, la gestión de las solicitudes de destinación de importación definitiva para consumo puede quedar sujeta a la tramitación anticipada de licencias previas de importación de carácter automático y/o no automático.

Que en algunos bienes del sector de productos metalúrgicos se han detectado cambios significativos en los flujos de comercio cuyo comportamiento resulta conveniente evaluar.

Que por ello es necesario establecer, en forma transitoria, un mecanismo de verificación previo al libramiento a plaza de dichas mercaderías con el objeto de efectuar el seguimiento y control de las importaciones.

Que la presente medida se fundamenta en las disposiciones del Acuerdo sobre Procedimientos para el Trámite de Licencias de Importación aprobado por la ORGANIZACIÓN MUNDIAL DEL COMERCIO (OMC), incorporado al ordenamiento jurídico nacional a través de la Ley Nº 24.425, así como también en las del Acuerdo General sobre Aranceles Aduaneros y Comercio de 1994, el Anexo I del Tratado de Asunción, aprobado por la Ley Nº 23.981 y el Tratado de Montevideo de 1980, aprobado por la Ley Nº 22.354.

Que, por otra parte, corresponde exceptuar de la aplicación del régimen establecido por la Resolución Nº 820 de fecha 30 de junio de 1999 del ex MINISTERIO DE ECONOMIA Y OBRAS Y SERVICIOS PUBLICOS, a las mercaderías en cuestión.

Que la SECRETARIA DE INDUSTRIA, COMERCIO Y DE LA PEQUEÑA Y MEDIANA EMPRESA del MINISTERIO DE ECONOMIA Y PRODUCCION ha tomado intervención en la presente medida.

Que la SECRETARIA DE POLITICA ECONOMICA del MINISTERIO DE ECONOMIA Y PRODUCCION ha tomado la intervención que le compete.

Que la Dirección General de Asuntos Jurídicos del MINISTERIO DE ECONOMIA Y PRODUCCION ha tomado la intervención que le compete.

Que la presente resolución se dicta en función de lo establecido en la Ley Nº 24.425, en la Ley de Ministerios (texto ordenado por Decreto Nº 438/92) modificada por las Leyes Nros. 24.190 y 25.233 y en uso de las facultades conferidas por el Reglamento de Procedimientos Administrativos, Decreto Nº 1759/72 T.O. 1991 y el Decreto Nº 1283 de fecha 24 de mayo de 2003.

Por ello,

EL MINISTRO DE ECONOMIA Y PRODUCCION

RESUELVE:

Artículo 1º — Establécese para las mercaderías comprendidas en las posiciones arancelarias de la Nomenclatura Común del MERCOSUR (N.C.M.) que a continuación se detallan, el Certificado de Importación de Productos Metalúrgicos (C.I.P.M.), que será exigible exclusivamente para las solicitudes de destinación de importación definitiva para consumo:

7307.19.10	8458.11.99	8462.39.90
8205.40.00	8462.10.90	8462.99.90
8424.30.10	8462.21.00	8477.10.11
8425.31.10	8462.29.00	8477.10.99
8428.10.00	8462.39.10	

Art. 2º — El procedimiento para la tramitación del Certificado de Importación de Productos Metalúrgicos (C.I.P.M.) que se instituye por el Artículo 1º de la presente resolución se consigna en el Anexo que con OCHO (8) hojas forma parte integrante de la presente medida.

Art. 3º — La SECRETARIA DE INDUSTRIA, COMERCIO Y DE LA PEQUEÑA Y MEDIANA EMPRESA del MINISTERIO DE ECONOMIA Y PRODUCCION, será la Autoridad de Aplicación de la presente resolución, quedando en tal carácter facultada para realizar las interpretaciones de la misma y efectuar las aclaraciones que estime conveniente, así como también, modificar el listado de productos sujetos a la presente medida y el procedimiento consignado en el Anexo a la misma.

Art. 4º — Quedarán exceptuadas de lo dispuesto en la presente norma aquellas mercaderías que a la fecha de entrada en vigencia de la presente resolución se encuentren en alguna de las siguientes situaciones:

a) expedidas con destino final al territorio aduanero por tierra, agua o aire y cargadas en el respectivo medio de transporte;

b) en zona primaria aduanera por haber arribado con anterioridad al territorio aduanero.

Las excepciones aludidas en este artículo caducarán si no se registrare la solicitud de importación dentro del término de SESENTA (60) días corridos contados a partir de la fecha de entrada en vigencia de la presente resolución.

Art. 5º — Exceptúase de la aplicación de lo establecido en la Resolución Nº 820 de fecha 30 de junio de 1999 del ex MINISTERIO DE ECONOMIA Y OBRAS Y SERVICIOS PUBLICOS, a las mercaderías indicadas en el Artículo 1º de la presente medida.

Art. 6º — Aplícanse a la presente las disposiciones de la Resolución Nº 11 de fecha 25 de enero de 2008 de la SECRETARIA DE INDUSTRIA, COMERCIO Y DE LA PEQUEÑA Y MEDIANA EMPRESA del MINISTERIO DE ECONOMIA Y PRODUCCION.

Art. 7º — La presente resolución comenzará a regir a partir de los VEINTE (20) días corridos, contados a partir de la fecha de su publicación en el Boletín Oficial.

Art. 8º — Comuníquese, publíquese, dése a la Dirección Nacional del Registro Oficial y archívese. — Carlos R. Fernández.

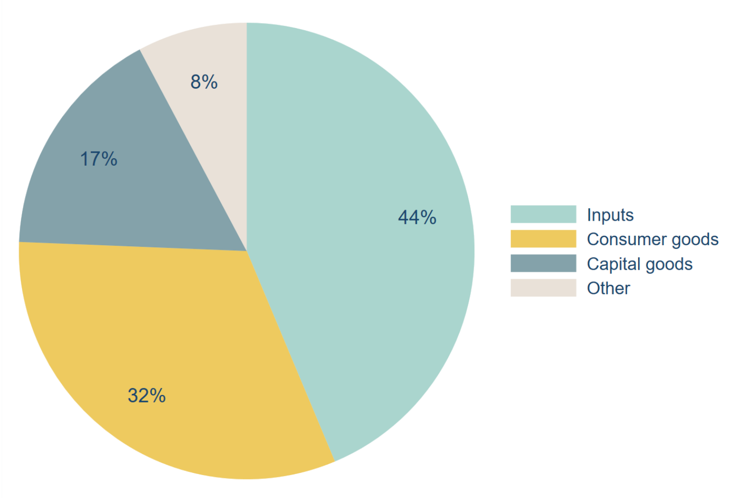
Notes: The figure shows an example of one of the digitalized decretes.

Source:InfoLEG

B Appendix: Empirical Part

B.1 Broad economic categories affected by NAILs

Figure 7: Imports with NAIL by broad economic categories



Notes: This graph corresponds to all countries with NAILs.

B.2 Value of inputs affected by NAILs each year

Year	NAILs	Cost of imports	Total
2004	0	12,734,746,100	12,752,283,992
2004	1	17,537,892	
2005	0	16,210,993,354	16,282,472,533
2005	1	71,479,179	
2006	0	19,513,615,201	19,722,572,776
2006	1	208,957,576	
2007	0	25,358,945,252	25,635,543,803
2007	1	276,598,551	
2008	0	32,896,953,666	33,177,931,881
2008	1	280,978,215	
2009	0	19,829,920,560	20,987,230,314
2009	1	1,157,309,755	
2010	0	31,177,724,555	32,966,737,562
2010	1	1,789,013,007	
2011	0	36,255,410,490	42,830,291,055
2011	1	6,574,880,564	

Notes: The table shows the cost of imports affected by NAILs each year. The data include only goods associated with manufacturing industries.

B.3 Relevance of affected inputs by firm

To address this concern, we test whether the government targeted firms based on the importance of specific imported products to their operations. We construct a ranking of imported products for each firm using import data from 2003 to 2007. Each imported product is ranked by its total import value, where Rank 1 corresponds to the most valuable imported product, and Rank N represents the least valuable one.

Next, we compute a relative ranking ratio for each imported product i, defined as:

$$Ratio_i = \frac{Rank_i}{Rank_N}$$

We then plot a histogram of this ratio for products affected by LNA to examine the distribution. If the mass is highly concentrated near **0**, this would indicate that, on average, the targeted products were the most important to the firms, suggesting potential strategic selection. Conversely, if the distribution appears more uniform, this suggests that LNAs were not systematically based on the importance of products to firms, reducing the likelihood of a targeted selection bias.

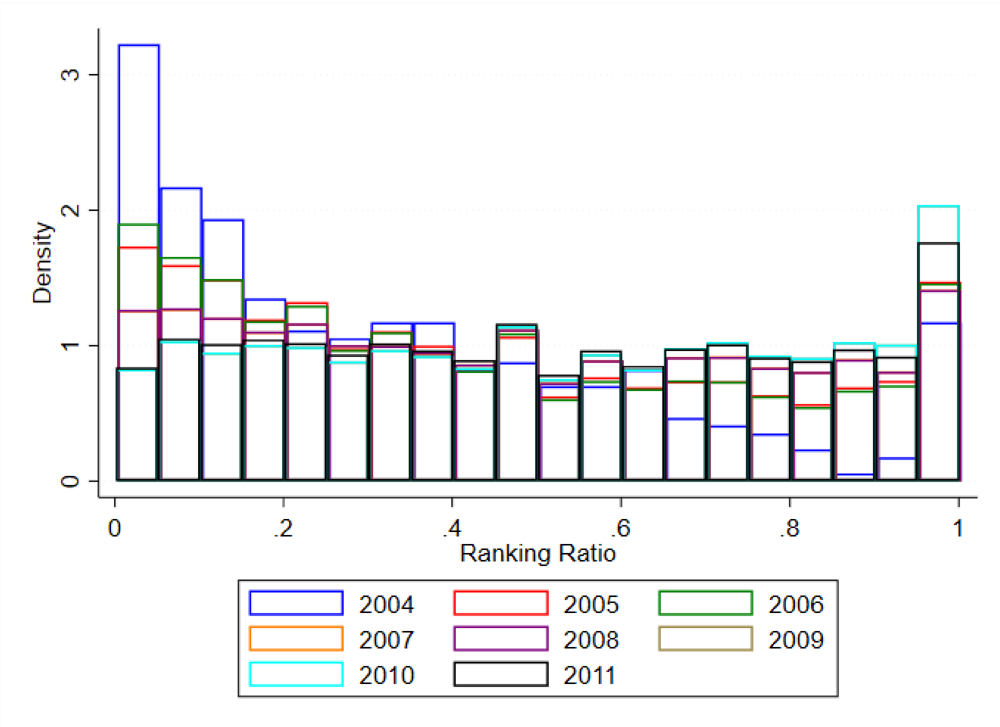
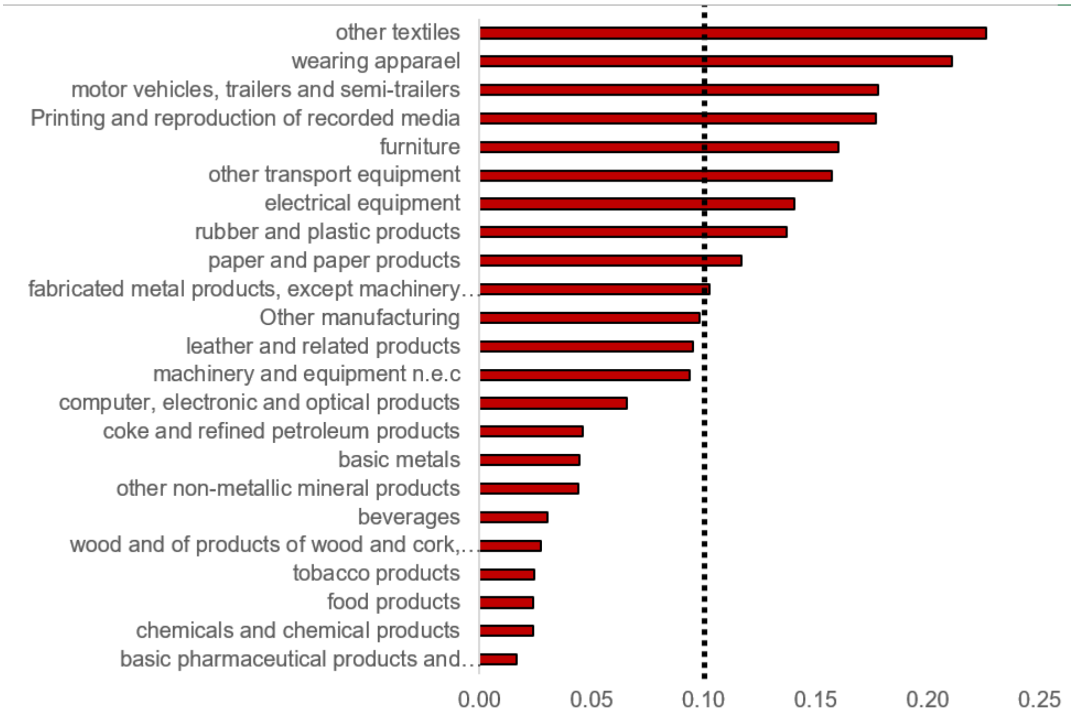


Figure 8: Histogram of Relative Importance Ranking for Affected Products

From Figure 8, we observe that while in 2004 there is some concentration at the top ranks, in all other years, the distribution appears relatively uniform. This suggests that there was no clear targeting based on product importance to firms, reinforcing the idea that LNAs were not specifically designed to impact firms expected to experience export declines.

B.4 NAILs by sector

Figure 9: Average firm's share of imports corresponding to affected inputs (2011)



Notes: Firm's share of imports corresponding to affected inputs (2011), by sector HS2. Source: Centre of Documentation and Information (CDI) in Argentina.

B.5 Robustness in event study

Figure 10: Event study. The impact of Nonautomatic Import licenses on firms' exports (logs). CLAE 2 digits

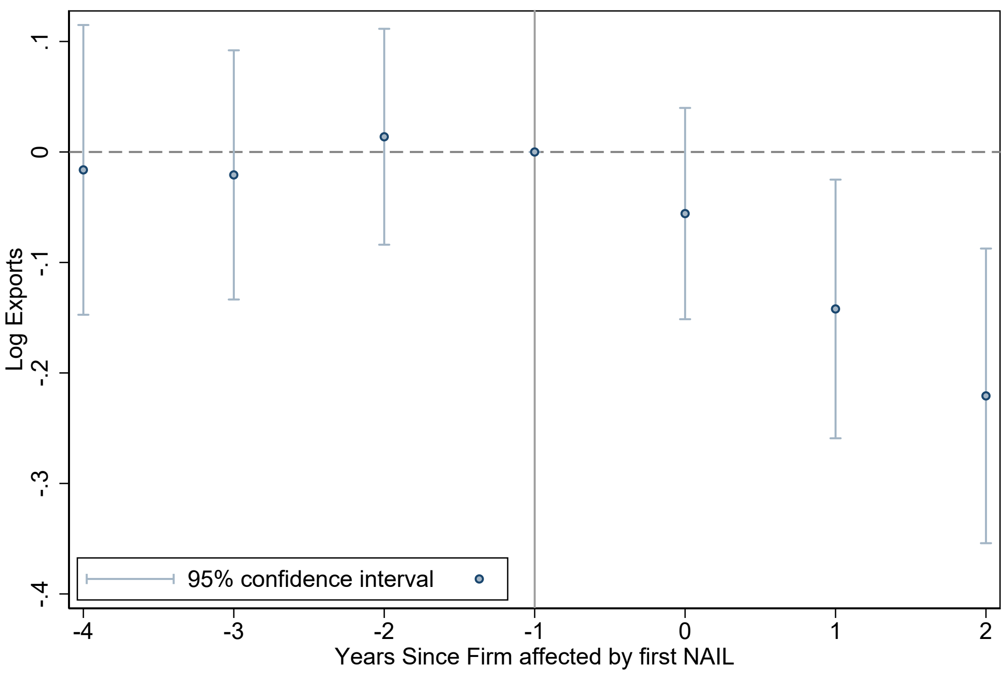
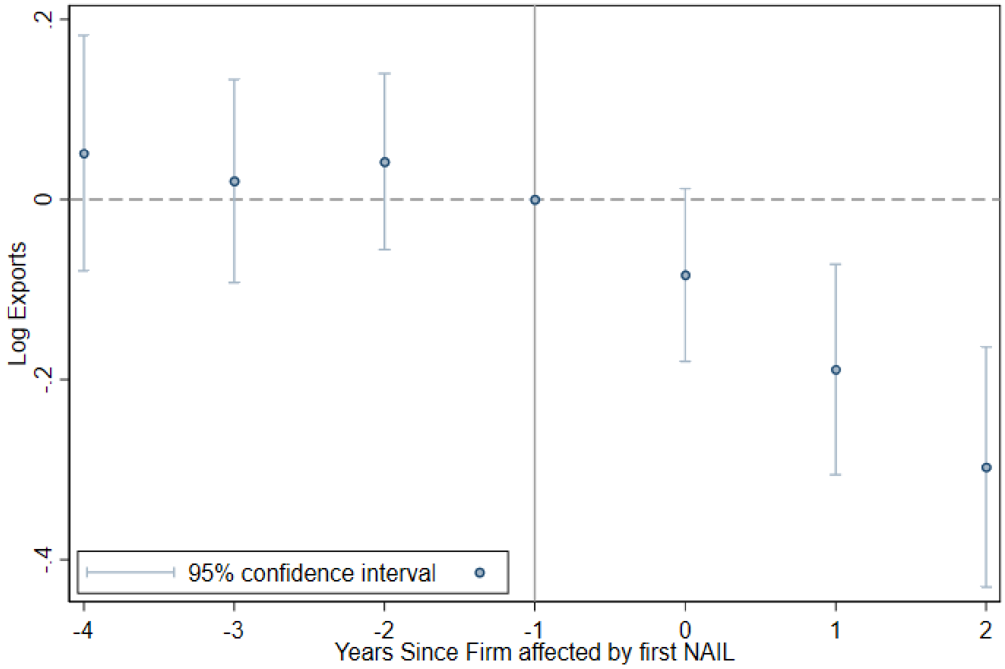


Figure 11: Event study. The impact of Nonautomatic Import licenses on firms' exports (logs). CLAE 6 digits



B.6 Market Share

Distribution of Market share variable S_{iskt}

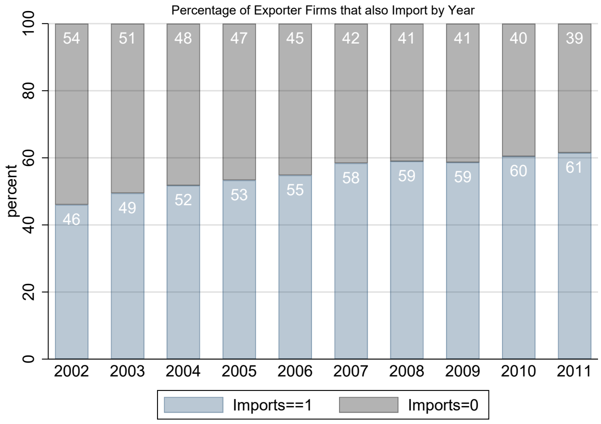
Table 9: Market Share distribution. Year 2006

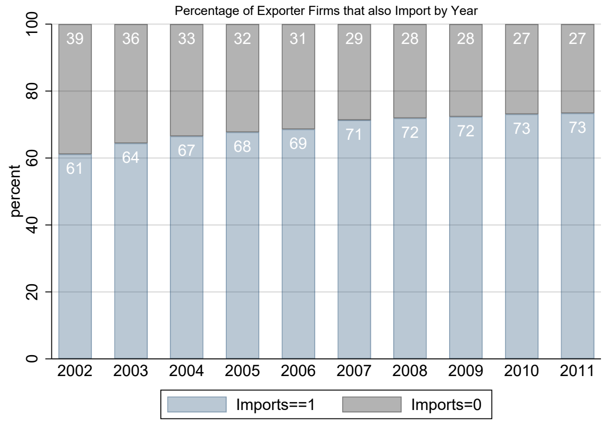
percentile	S_{iskt}
p10	0.004
p25	0.038
p50	0.299
p75	2.043
p99	9.633
Average	4.163

B.7 Exporters are also importers

We show that exporters are also importers. The first figure highlights that a large share of exporters also import, with this share remaining stable but slightly increasing to about 61% by 2011. The second figure focuses on a subset of exporters, showing an even higher proportionâĂŤconsistently around 72-73% in later years.

These figures underscore the interconnected nature of export and import activities, suggesting that many firms rely on imported inputs for production. This dual role as both exporters and importers implies significant impacts from trade policies, such as non-tariff barriers, on firm performance, resilience to cost shocks, and strategic adaptation to regulatory changes.

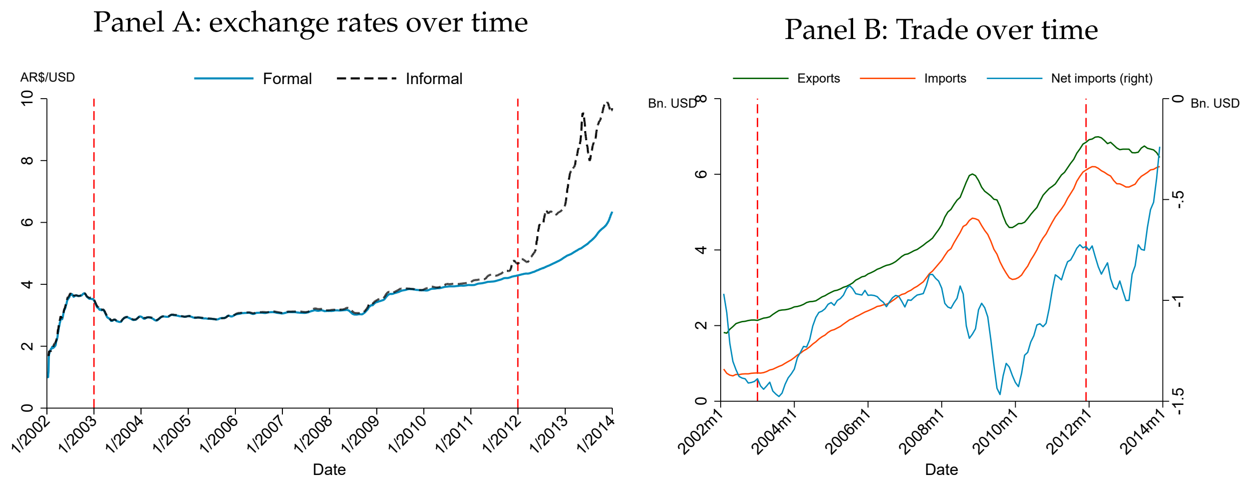




Notes: In the first pane, a firm is considered an importer if, in the corresponding year, it makes at least one import operation. In the second panel, a firm is considered an importer if between 2002-2012 makes at least one import operation.

B.8 Other trends on the studied period

The graphs in the appendix provide an insightful overview of exchange rates and trade dynamics over time, specifically focusing on the period surrounding the implementation of non-automatic import licenses (NAILs). Panel A shows the exchange rates (ARS/USD) over time, distinguishing between formal and informal rates. Despite fluctuations, there are no significant changes during the period of NAILs application. Panel B illustrates trade over time, depicting exports, imports, and net imports. While there are variations in trade volumes, the overall trends in exports and imports remain relatively stable, with no abrupt shifts corresponding to the implementation of NAILs. This consistency suggests that other factors, rather than exchange rates or trade volumes, play a more significant role in the impact of NAILs, underscoring the importance of examining firm-level responses and market structures in our analysis. These graphs support the conclusion that the application of NAILs did not coincide with major macroeconomic changes, allowing for a clearer assessment of their direct effects on firms.

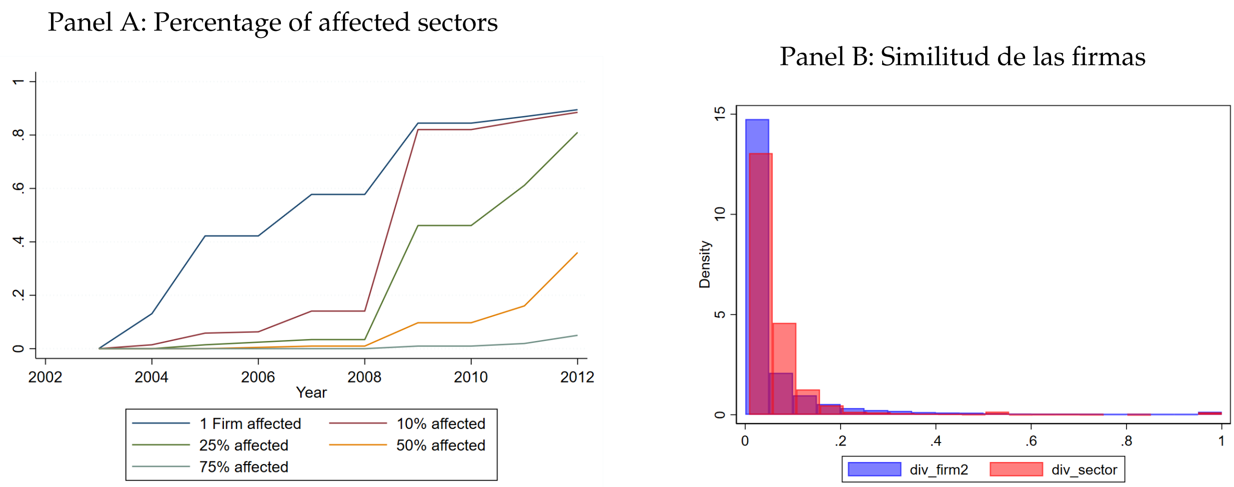


Notes: Panel A shows the exchange rates (ARS/USD) over time, distinguishing between formal (solid line) and informal (dashed line) rates. The red dashed vertical lines indicate the periods during which non-automatic import licenses (NAILs) were applied. Panel B depicts trade over time, with exports (green line), imports (red line), and net imports (blue line, right axis).

B.9 Inputs affected per sector

Panel A of Figure 12 shows the average number of firms per sector affected each year, indicating that only closer to 2012 did 80% of firms in a sector receive LNA. Also, it is important to notice firms within the same sector may use different inputs. To illustrate this, we compute the ratio of unique inputs used by a firm to the total unique inputs in the sector. A value closer to 1 implies that the firm and sector use the same inputs. Panel B of Figure 12 presents a histogram of this measure at the sector and firm levels, showing that the mass is concentrated near zero, suggesting that firms within the same sector differ significantly in their input usage.

Figure 12: Robustness

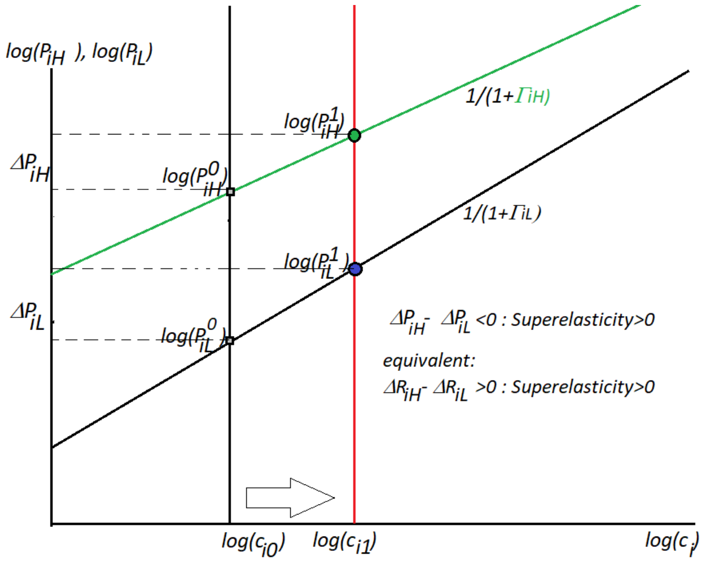


C Appendix: Theory

C.1 Graphical example of our strategy to get §

Recall that $\frac{dlnP_{ik}}{dlnc_i} = \frac{1}{1+\Gamma_{ik}}$

Figure 13: Cost shock, elasticity and super-elasticity



C.2 Bertrand Competition

The demand elasticity for the case of Bertrand competition for firm i in market k is given by,

$$\sigma_{i,k} = \rho(1 - S_{i,k}) + \eta S_{i,k}.$$

Then, the markup, $\mathcal{M}$, is given by

$$\mathcal{M}_{ik} = \frac{\sigma_{i,k}}{\sigma_{i,k} - 1} = \frac{\rho + (\eta - \rho)S_{i,k}}{\rho + (\eta - \rho)S_{i,k} - 1}$$

Holding constant sector price index, markup elasticity with respect to firm's price is given by,

$$\Gamma_{ik} = -\frac{\partial \log \mathcal{M}_{ik}}{\partial \log P_{ik}} = \frac{S_{ik}}{\left(\frac{\rho}{\rho-\eta} - S_{ik}\right)\left(1 - \frac{\rho-\eta}{\rho-1} S_{ik}\right)} > 0$$

C.3 Proof of Proposition II

$$P_{ik} = \mathcal{M}(\frac{P_{ik}}{P_k})c(\Omega, \varphi)$$

$$d \log P_{ik} = -\Gamma_{ik}(d \log P_{ik} - d \log P_k) + \frac{\partial \log c(\tau, \varphi)}{\partial \log \tau_{iv}} d \log \tau_{iv}$$

$$\frac{d \log P_{ik}}{d \log \tau_{iv}} = \frac{1}{1 + \Gamma_{ik}} \frac{\partial \log c(\Omega, \varphi)}{\partial \log \tau_{iv}}$$

Applying Shepard's Lemma and rearranging we have the result:

$$\frac{d\log P_{ik}}{d\log \tau_{iv}} = \frac{1}{1+\Gamma_{ik}} m_{iv}$$

C.4 Proof of Proposition III

C.4.1 Lemma 1: Proof

$$R_{sk} = \frac{1}{\mathcal{M}_{sk}^{\rho-1}} \frac{\phi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_K$$

Taking logs,

$$\begin{aligned}
logR_{sk} &= (1-\rho)log\mathcal{M}_{sk} + (1-\rho)logh_s \\
\frac{dlogR_{sk}}{dlog\tau_{sv}} &= (1-\rho)\left[\frac{dlog\mathcal{M}_{sk}}{dlog\tau_{sv}} + \frac{dlogh_s}{dlog\tau_{sv}}\right] = \\
&= (1-\rho)\left[\frac{dlog\mathcal{M}_{sk}}{dlogP_{sk}}\frac{dlogP_{sk}}{dlog\tau_{sv}} + m_{sv}\right] = \\
&= (1-\rho)\left[-\frac{\Lambda_{sk}}{1+\Lambda_{sk}} m_{sv} + m_{sv}\right] = \\
&= (1-\rho)\frac{1}{1+\Lambda_{sk}} m_{sv} \leq 0
\end{aligned}$$

Now, given $R_s = \sum_k R_{sk}$. Applying logs

$$logR_s = log(\sum_k R_{sk})$$

Then,

$$\begin{aligned}
\frac{dlogR_s}{dlog\tau_{sv}} &= \sum_k \frac{1}{\sum_k R_{sk}} R_{sk} \frac{dlogR_{sk}}{dlog\tau_{sv}} = \\
&= (1-\rho)\sum_k \frac{R_{sk}}{R_s}\frac{1}{1+\Lambda_{sk}} m_{sv} \leq 0
\end{aligned}$$

C.4.2 Lemma 2: Proof

Imports are given by:

$$M_i = Qc_i$$

In a sector level:

$$\sum_{i=1}^{N_k} M_i = \sum_{i=1}^{N_k} Qc_i \rightarrow M_s = Qc_s$$

By Shepard Lemma's, we know that the derivative of the log unit cost with respect to $\log(\tau_{sv})$ is equal to m_{sv}. Then

$$\frac{\partial \log M_s}{\partial \log \tau_{sv}} = \frac{\partial \log Q_s}{\partial \log \tau_{sv}} + m_{sv}$$

The adjustment in quantities is given by:

$$\frac{\partial \log Q_s}{\partial \log \tau_{sv}} = -\rho m_{sv} \sum_k \frac{Q_{sk}}{Q_s} \frac{1}{1+\Lambda_{sk}}$$

So

$$\frac{\partial \log M_s}{\partial \log \tau_{sv}} = -m_{sv} \left[\rho \sum_k \frac{Q_{sk}}{Q_s} \frac{1}{1+\Lambda_{sk}} - 1 \right] \leq 0$$

C.4.3 Another Proof

First, we prove that the elasticity of imports with respect to τ_{iv} is as described above.

Imports are given by:

$$M_i = Qc_i$$

By Shepard Lemma's, we know that the derivative of the log unit cost with respect to $log(\tau_{iv})$ is equal to m_{iv}. Then,

$$\frac{\partial \log M_i}{\partial \log \tau_{iv}} = \frac{\partial \log Q_i}{\partial \log \tau_{iv}} + m_{iv}$$

The adjustment in quantities is given by,

$$\frac{\partial \log Q_i}{\partial \log \tau_{iv}} = -\rho m_{iv} \sum_k \frac{Q_{ik}}{Q_k} \frac{1}{1+\Gamma_{ik}},$$

so

$$\frac{\partial \log M_i}{\partial \log \tau_{iv}} = -m_{iv} \left[\rho \sum_k \frac{Q_{ik}}{Q_k} \frac{1}{1+\Gamma_{ik}} - 1 \right]$$

Note that the elasticity of total exports with respect to total imports is the ratio between the effect of barriers on total exports over the effect of barriers on total imports.

C.5 Proof of Proposition IV

Adding the time subscript to equation 3.15 and recalling that we include sector-year-destination FE throughout the empirical analysis, the effect of barriers on exports to market k is given by,

$$\frac{\partial \log R_{iskt}}{\partial \log \tau_{ivt} m_{iv}} = (1-\rho) \left[\frac{1}{1+\Gamma_{ik}} \right] \leq 0$$

We can rewrite the above derivative as,

$$\frac{\partial \log R_{ikt}}{\partial \log \tau_{ivt} m_{iv}} = (1-\rho) \left[\frac{1}{1+\bar{\Gamma}_i} \right] + (1-\rho) \left[\left(\frac{1}{1+\Gamma_{ik}(S_{ik})} \right) - \left(\frac{1}{1+\bar{\Gamma}_i} \right) \right]$$

where $\bar{\Gamma}_i$ is the average elasticity of markup of firm i and we make explicit that the elasticity of markup in market k Γ_{ik} depends on the share of the firm in that market.

C.6 Market Level Formal Proposition

C.6.1 Demonstration Revenues

We can express the revenues of the sector as:

$$R_{sk} = \frac{1}{\mathcal{M}_{sk}^{\rho-1}} \frac{\varphi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_k$$

We can define τ_{sv} as $\sum_{i=1}^{N_k} \tau_{iv}$ and:

$$P_v = \frac{\tau_{iv}}{A_v} \rightarrow \sum_{i=1}^{N_k} P_v = \sum_{i=1}^{N_k} \frac{\tau_{iv}}{A_v}$$

$$N_k P_v = \frac{\tau_{sv}}{A_v}$$

$$P_v = \frac{\tau_{sv}}{A_v N_k}$$

The problem for optimal amount of imports does not change and we can define c_s as:

$$\sum_{i=1}^{N_k} c_i = c_s = \sum_{i=1}^{N_k} \frac{h(\Omega)}{\phi} = \frac{1}{\phi} \sum_{i=1}^{N_k} \left(\sum_{v\in\Omega} \left(\frac{A_v N_k}{\tau_{sv}} \right)^{\theta-1} \right)^{-\frac{1}{\theta-1}}$$

Then we can define the sectoral price as:

$$P_{sk} = \mathcal{M}_{st} c_s(\Omega, \phi)$$

And if we define the sectoral demand as:

$$Q_{sk} = \gamma_{sk} P_{sk}^{-\rho} P_k^{\rho-\eta} D_k$$

The revenues are:

$$R_{sk} = P_{sk} Q_{sk} = \gamma_{sk} P_{sk}^{1-\rho} P_k^{\rho-\eta} D_k$$

$$R_{sk} = \gamma_{sk} (\mathcal{M}_{st} c_s(\Omega, \phi))^{1-\rho} P_k^{\rho-\eta} D_k = \frac{1}{\mathcal{M}_{sk}^{\rho-1}} \frac{\varphi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_k$$

C.6.2 Demonstration of m_{sv}

Remember that:

$$\sum_{i=1}^{N_k} c_i = c_s = \sum_{i=1}^{N_k} \frac{h(\Omega)}{\phi} = \frac{1}{\phi} \sum_{i=1}^{N_k} \left(\sum_{v\in\Omega} \left(\frac{A_v N_k}{\tau_{sv}} \right)^{\theta-1} \right)^{-\frac{1}{\theta-1}}$$

Total amount of imports of intermediate goods of sector s is given by (**assumption**):

$$M_s(\Omega) = \frac{Q_s}{\phi} \sum_{i=1}^{N_k} \left(\sum_{v \in \Omega} \left(\frac{A_v N_k}{\tau_{sv}} \right)^{\theta-1} \right)^{-\frac{1}{\theta-1}}$$

Expenditure share of sector s on imported variety v is given by (**assumption**):

$$m_{sv} = \frac{\left(\frac{A_v N_k}{\tau_{sv}} \right)^{\theta-1}}{\sum_{v \in \Omega} \left(\frac{A_v N_k}{\tau_{sv}} \right)^{\theta-1}}$$

By Shepard's Lemma:

$$\frac{\partial logc_s}{\partial log\tau_{sv}} = m_{sv}$$

Alternatively, from $P_{sk} = \mathcal{M}_{sk}(P_{sk}(P_{ik}), P_k)c_s(\Omega, \phi)$

$$logP_{sk} = log\mathcal{M}_{sk}(\cdot) + logc_s(\cdot)$$
$$\frac{dlogP_{sk}}{dlog\tau_{sv}} = \frac{dlog\mathcal{M}_{sk}}{dlogP_{sk}} \frac{dlogP_{sk}}{dlog\tau_{sv}} + \frac{dlogc_s}{dlog\tau_{sv}} =$$
$$\frac{dlogP_{sk}}{dlog\tau_{sv}}[1 + \Lambda_{sk}] = \frac{dlogc_s}{dlog\tau_{sv}}$$

By Sheppard's Lemma.

$$\frac{dlogP_{sk}}{dlog\tau_{sv}} = \frac{1}{1 + \Lambda_{sk}} m_{sv}$$

C.6.3 Formal Proposition on Super-elasticity

Definition 2
Super-elasticity of sectoral markup ($\S_{s,k}$): The derivative of the absolute value of the elasticity of markup with respect to HHI in sector s, destination k. Formally, ($\S_{s,k} = \partial \log \Lambda_{sk} / \partial \log HHI_{sk}$).

PROPOSITION **5.**

1. *Market level markups ($\mathcal{M}_{s,k}$) are increasing in the HHI in sector s, destination k.*

2. *The elasticity of markup with respect to price (Λ_{sk}) is negative.*

$$\Lambda_{sk} = \frac{\partial \log \mathcal{M}_{sk}}{\partial \log p_{sk}} = -\frac{(\frac{1}{\rho} - \frac{1}{\eta}) \frac{\partial \log HHI_{sk}}{\partial \log p_{sk}}}{\left[\frac{1}{\rho}(HHI_{sk} - 1) - \frac{1}{\rho} HHI_{sk} \right]} < 0 \tag{C.1}$$

3. *The absolute value of the market elasticity of markup with respect to price is increasing in the HHI of the market.*

Proof. Because $\sum_{i=1}^{N_k} S_{i_k} = 1$ and using $\sigma_{i,k}^{-1} = \frac{1}{\rho}(1 - S_{i,k}) + \frac{1}{\eta} S_{i,k}$ and defining the Herfindahl Hirschman Index as follows $\sum_{i=1}^{N_k} = S_{i,k}^2 = HHI_{s,k}$:

$$\mathcal{M}_{sk} = \left[\sum_{i=1}^{N_k}(1-\sigma_{ik}^{-1})S_{ik}\right]^{-1} \tag{C.2}$$

$$= \left[\sum_{i}^{N_k} S_{ik} - \sum_{i}^{N_k} S_{ik}\sigma_{ik}^{-1}\right]^{-1} \tag{C.3}$$

$$= \left[1 - \sum_{i}^{N_k}\left(\frac{1}{\rho}(1-S_{ik}) + \frac{1}{\eta}S_{ik}\right)S_{ik}\right]^{-1} \tag{C.4}$$

$$= \left[1 - \frac{1}{\rho} + \left(\frac{1}{\rho} - \frac{1}{\eta}HHI_{sk}\right)\right]^{-1} \tag{C.5}$$

$$= \left[1 + \frac{1}{\rho}\left(HHI_{sk}-1\right) - \frac{1}{\eta}HHI_{sk}\right]^{-1} \tag{C.6}$$

We can define $\Lambda_{s,k}$ as:

$$\Lambda_{s,k} = \frac{\partial \log \mathcal{M}_{s,k}}{\partial \log p_{s,k}} = -\frac{(\frac{1}{\rho}-\frac{1}{\eta})\frac{\partial \log HHI_{s,k}}{\partial \log p_{s,k}}}{\left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\eta}HHI_{s,k}\right]} < 0$$

$$\mathcal{M}_{s,k} = 1 + \left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\eta}HHI_{s,k}\right]^{-1} \tag{C.7}$$

Taking logs:

$$\log \mathcal{M}_{s,k} = \log\left(1 + \left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\eta}HHI_{s,k}\right]^{-1}\right) \approx \log\left(\left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\eta}HHI_{s,k}\right]^{-1}\right)$$

$$\log \mathcal{M}_{s,k} = -\log\left(\left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\rho}HHI_{s,k}\right]\right)$$

Differentiating

$$\partial \log \mathcal{M}_{s,k} = -\partial \log\left(\left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\eta}HHI_{s,k}\right]\right) = -\frac{(\frac{1}{\rho}-\frac{1}{\eta})\frac{\partial \log HHI_{s,k}}{\partial \log p_{s,k}}\partial \log p_{s,k}}{\left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\eta}HHI_{s,k}\right]}$$

$$\Lambda_{s,k} = \frac{\partial \log \mathcal{M}_{s,k}}{\partial \log p_{s,k}} = -\frac{(\frac{1}{\rho}-\frac{1}{\eta})\frac{\partial \log HHI_{s,k}}{\partial \log p_{s,k}}}{\left[\frac{1}{\rho}(HHI_{s,k}-1) - \frac{1}{\rho}HHI_{s,k}\right]} < 0$$

$\square$

C.6.4 Market Level Outcomes

In this section, we explore market-level predictions regarding the heterogeneous effects of market shares. First, the effect on total exports is increasing in the Herfindahl-Hirschman Index (HHI).

Specifically, the relationship is described by the equation

$$R_{sk} = \frac{1}{\mathcal{M}_{s,k}^{\rho-1}} \frac{\varphi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_k, \tag{C.8}$$

The elasticity of total exports to a firm's price is given by

$$\frac{\partial \log R_{sk}}{\partial \log \tau_{sk}} = (\rho - 1) \sum_k \frac{R_{sk}}{R_s} \frac{1}{1 + \Lambda_{sk}} m_{sv} > 0, \tag{C.9}$$

which is positive if $\rho > 1$. The Λ_{sk} function incorporates the HHI index, indicating that higher market concentration leads to a greater sensitivity of exports to price changes.

Second, the effect on total imports suggests that imports are weakly decreasing in the trade costs of the importing varieties, provided ρ. The equation captures this relationship.

$$\frac{\partial \log M_s}{\partial \log \tau_{sv}} = -m_{sv} \left[\rho \sum_k \frac{Q_{sk}}{Q_s} \frac{1}{1 + \Lambda_{sk}} - 1 \right] \leq 0, \tag{C.10}$$

implying that as trade costs increase, total imports decrease, reflecting the sensitivity of import volumes to cost variations.

Finally, the elasticity of exports with respect to imports indicates that the total amount of exports in a sector is positively related to the amount of imports in that sector. This is formalized by the equation.

$$\Sigma_{X,M} = \frac{\frac{\partial \log R_{sk}}{\partial \log \tau_{sk}}}{\frac{\partial \log M_s}{\partial \log \tau_{sv}}} = \frac{\partial \log R_{sk}}{\partial \log M_s} = \frac{(1-\rho) \sum_k \frac{R_{sk}}{R_s} \left[\frac{1}{1+\Lambda_{sk}} \right]}{(1-\rho) \left[\sum_k \frac{Q_{sk}}{Q_k} \frac{1}{1+\Lambda_{sk}} \right]} > 0, \tag{C.11}$$

indicating a positive relationship between imports and exports, underscoring the interconnected nature of trade dynamics within a sector. Together, these findings highlight the importance of considering market shares and trade costs in understanding the broader economic impacts on exports and imports. Below, we can show the formal propositions:

PROPOSITION **6** (Market level predictions)**.**

A. ***(Effect on total exports)*** *Effect of total exports is increasing in HHI.*

$$R_{s,k} = \frac{1}{\mathcal{M}_{s,k}^{\rho-1}} \frac{\varphi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_k \tag{C.12}$$

$$\frac{\partial \log R_{s,k}}{\partial \log \tau_{s,k}} = (\rho - 1) \sum_k \frac{R_{s.k}}{R_s} \frac{1}{1 + \Lambda_{s.k}} m_{s,v} > 0 \tag{C.13}$$

If $\rho > 1$ that equation is positive. Inside the $\Lambda_{s,k}$ function is the HHI index.

B. ***(Effect on total imports)*** *Provided ρ, imports are weakly decreasing in the trade costs of the importing* *varieties.*

$$\frac{\partial \log M_s}{\partial \log \tau_{s,v}} = -m_{s,v} \left[\rho \sum_k \frac{Q_{s.k}}{Q_s} \frac{1}{1+\Lambda_{s.k}} - 1 \right] \leq 0 \tag{C.14}$$

C. ***(Elasticity of exports with respect to imports)*** *The total amount of exports of a sector are increasing on the amount of imports of the sector. That is,*

$$\Sigma_{X,M} = \frac{\frac{\partial \log R_{s,k}}{\partial \log \tau_{s,k}}}{\frac{\partial \log M_s}{\partial \log \tau_{s,v}}} = \frac{\partial \log R_{s,k}}{\partial \log M_s} = \frac{(1-\rho) \sum_k \frac{R_{s,k}}{R_s} \left[\frac{1}{1+\Lambda_{s.k}} \right]}{(1-\rho) \left[\sum_k \frac{Q_{s,k}}{Q_k} \frac{1}{1+\Lambda_{s.k}} \right]} > 0$$