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

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Abstract

As tariff-based protection declined under WTO rules, non-tariff barriers gained prominence in trade policy. This paper studies the effects of Argentina's Non-Automatic Import Licenses (NAILs) on downstream firms, while evaluating the role of market power in mediating the aggregate effects. Using novel data on import licenses and the staggered introduction of NAILs from 2005 to 2011, we estimate their impact on firm-level imports, exports, and employment. Firms reliant on restricted imported inputs experienced significant declines in exports and employment. We build a trade model with oligopolistic competition and variable markups to study the aggregate consequences. The structure of the model motivates a novel methodology to estimate how the elasticity of markups varies with firm size, exploiting multi-destination exporters' differential responses to a cost shock across their markets. We find that a given firm reduces exports less in destinations where it holds a larger market share, implying that the markup elasticity increases with market share. According to the model, this implies that market power and variable markups attenuate the negative effects of trade barriers on exports. Quantitatively, NAILs reduced Argentina's aggregate exports by 3.3%, with smaller declines in more concentrated markets. In a counterfactual scenario with constant markups, the decline in aggregate exports would have been 55% larger.

JEL Codes: *D43,F13, F14, F42,F68, L1*

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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 made tariffs less viable, trade policy landscape experienced a significant transformation. Non-tariff barriers (NTBs) to imports have surged and proliferated, becoming a central instrument. Understanding their effects is crucial, especially since trade policy is back in the spotlight.

Analyzing the consequences of non-tariff barriers (NTBs) has proven challenging. These barriers are difficult to quantify, and the lack of exogenous variation limits researchers' ability to assess their causal effects. Beyond this, an important channel has often been overlooked by academics and policy makers: when NTBs restrict access to imported intermediate inputs, they can undermine the performance of downstream firms that rely on those imports. As a result, we know little about the impact of NTBs on downstream producers. A system of non-automatic import licenses (NAILs) applied to manufactured goods in Argentina provides a unique opportunity to overcome these challenges.

This paper examines the impact of a system of Non-Automatic Import Licenses (NAILs) on the export performance and employment dynamics of downstream Argentinian firms. We combine firm-level data with a novel dataset that identifies the specific products subject to NAILs from 2005 to 2011. Using an event-study design, we provide estimates of the effects of these trade barriers on the exports of downstream firms. We embed our empirical estimates into a model of importing and exporting firms that features oligopolistic competition and endogeneous markups in export markets. The framework allows us to quantify the aggregate effects of NAILs on Argentina's trade flows, while highlighting the role of firm market power and market concentration in mediating — amplifying or attenuating — the impact of trade barriers.

Between 2005 and 2011, the Argentine government implemented Non-Automatic Import Licenses, requiring official approval for imports of certain products, a process that could take months. In practice, NAILs operated as a non-tariff trade barrier, raising firms' risk and uncertainty. This policy is ideal for analyzing the impact of NBTs on firm performance for several reasons. First, 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 industrial non-tariff measures globally. Second, a unique aspect of the policy was that products were phased into the NAILs system at different periods, culminating in including all products by 2012. The staggered inclusion of products in the NAIL system provides an ideal empirical framework that allows a causal identification.[2]

To study the effect of the policy on downstream firms, we constructed a dataset that combines three datasets spanning from 2003 to 2011. First, we obtain the universe of Argentine exporters

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

[2] We end our analysis in 2012 because the staggered rollout of the policy allows us to exploit variation in product inclusion for identification. In 2012, all products entered to the NAILs system.

and importers, detailing their export and import transactions 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 documents the annual imposition of NAILs on imported products at the 8-digit tariff line.

To guide the empirical strategy and study the aggregate consequences of NAILs, we develop a structural model that allows us to quantify the aggregate impact of NAILs on exports and imports, with a particular focus on the role of firms' market power in mediating these effects. The model features endogenous exporting and importing decisions and incorporates variable markups in product markets. 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). Importantly, in response to a cost shock, the markups of a given firm may adjust differently across its different destinations. On the supply side, firms draw core productivity levels and combine imported intermediate inputs using a CES production function. We model NAILs as a shock to the cost of imported inputs, increasing the unit costs of firms that depend on the affected products.

Guided by the structural model, our empirical strategy leverages exogenous variation in the timing of product entries into the NAILs system between 2005 and 2011, combined with data on each firm's pre-policy import share of the affected products. The idea is that firms already importing intermediate inputs that were subsequently subjected to NAILs experienced greater exposure to the policy, resulting in higher production costs. We treat this firm-level exposure as a cost shock and analyze how downstream firms adjust their import behavior, export performance, and employment. We then exploit variation among multi-destination exporters to examine how these firms, that represent more than 90% of export flows, adjust to a common cost shock across their different destinations. This exercise enables us to identify the elasticity of markups and how it depends on the firm size in each destination.

Our first empirical finding is that exposure to NAILs significantly disrupted firms' import activities. Firms with 30% of their imports affected by the policy reduced their total imports by 46%. This sharp decline indicates that NAILs functioned effectively as a non-tariff barrier to trade.

Having established that NAILs reduce imports, we next examine their effects on exports and employment. We provide the first evidence that non-tariff barriers to imports can significantly weaken firm performance in downstream sectors. A 30% exposure to NAILs leads to an 18% decline in exports and a 3% decline in employment. Affected firms also cut the range of products and destinations they serve and face a higher likelihood of exiting export markets.

Estimating the model and the extent to which variable markups mediate the aggregate effects requires two key elasticities: the demand elasticity within the sector and the demand elasticity between sectors. These elasticities govern the markups and the extent to which they adjust in response to shocks. Armed with the structure of the model, we develop a novel methodology that requires a large exogenous cost shock at the firm-level and detailed information for multi-destination exporters. By estimating the responses of a given firm in its different destinations, we can assess how the sensitivity of the elasticity of its markup varies with the firm's market share in each destination. NAILs policy can provide such a shock. In turn, results from this estimation can inform the two key elasticities.

We find that multi-destination firms' responses to NAILs vary systematically across their export markets according to their market share. Firms reduce exports less in destinations where they hold a larger share, revealing a novel empirical fact about the set of firms—accounting for over 95% of export volumes—that serve multiple markets: in response to a cost shock, they adjust their markups more in destinations where they have greater market power. By compressing markups in these markets, large firms partially absorb cost shocks, thereby stabilizing prices and sustaining export volumes.[3]

Leveraging the coefficients from our multi-destination analysis, we estimate the two key elasticities of the model using indirect inference. We recover a within-sector demand elasticity of 6.2 and a cross-sector elasticity of 2.8. These imply an average markup of 35% and a markup elasticity of 0.7, corresponding to a cost pass-through rate of 60%.

We use the model to quantify the aggregate impact of NAILs on trade and to assess how market structure mediates these effects. Specifically, we use the model to: (i) examine how market concentration and variable markups dampen the negative impact of import barriers on downstream exports; and (ii) assess the extent to which the reduction in Argentinian imports is offset by falling exports, limiting the effectiveness of non-tariff barriers in addressing trade imbalances.

Under the baseline scenario with market power and variable markups, NAILs reduced aggregate exports by 3.3%. In a counterfactual scenario with constant markups, the decline in exports would have been 55% larger. Across all specifications, aggregate export losses are smaller in more concentrated markets. These results underscore the key role of large firms in buffering trade shocks: by adjusting markups rather than quantities, they stabilize prices and volumes, thereby attenuating the aggregate effects of import restrictions.

On the import side, NAILs led to a 10% drop in total imports. A large part of this reduction was offset by a reduction in exports, ultimately weakening the ability of the policy to improve trade balance, an objective often cited by governments when implementing trade restrictions.

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 studies either use product-level data to assess the direct effects of NTMs on imports or focus on the direct impact of NTMs imposed by trading partners on exports from other countries to that destination. In contrast, our paper focuses on the indirect impact of NTMs imposed by a country on downstream firms in that same country through the impact of this policy on imported input costs.[4]

[3] Amiti et al. (2014) document a similar pattern in the context of exchange rate pass-through, focusing on differences across firms of varying sizes. In contrast, our analysis examines variation within firms across export destinations.

[4] Nicita and Gourdon (2013) shows that non-automatic licenses are the most commonly used measure to control

On this ground, our paper relates to two concurrent papers. Atkin et al. (2024) analyzes the direct effect of a similar policy of import licenses in Argentina from 2013-2015 on import prices. Our study complements their work in two ways. First, while Atkin et al. (2024) focuses solely on the 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' production 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 accurately estimate the causal impacts of import licenses on firm-level outcomes.[5] More similar to our work, Ghose et al. (2023) study a short-run 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 also relates to Fontagné et al. (2015) and Fontagné and Orefice (2018), who study how technical barriers to trade imposed by destination countries affect firms' exports to those markets. In contrast, we examine how non-tariff barriers on imported inputs affect downstream firms. While their focus is on how regulations at the destination limit market access, our focus is on how import restrictions at the origin raise input costs, reducing firms' production capacity and export performance in other markets.

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 (Amiti et al. 2014, Atkeson and Burstein 2008, Auer and Schoenle 2016, Berman et al. 2012, Gopinath et al. 2020).[6] More related to our paper, a recent literature has shown that market power shapes how firms respond to trade liberalization. When liberalization drives prices down, large firms with market power often respond by raising markups, dampening the pass-through of cost savings to consumers (Alviarez et al. 2023, De Loecker et al. 2016, Edmond et al. 2015a). But what happens when the shock goes in the opposite direction—when trade barriers drive firms' costs up? We examine whether, in this case, firms lower their markups, which would in turn limit price increases and partially offset the consumer losses from protection.

We also innovate by exploiting an import cost shock (supply shock) that lets 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 elasticity of markup with respect to market share. This strategy also allows us to learn a new aspect about how multi-destination exporters respond to shocks in their different markets. More broadly, by extending our results to the market

import quantities, particularly in developing countries.

[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 in their markups so that their average prices in the foreign market are less sensitive. Amiti et al. (2014) shows the existence of variable markups, but do not analyze the differential response of multi-destination exporters across their different markets.

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)).

Third, our paper contributes to the literature on how firms adjust along different margins in response to trade policy. We uncover a previously unexplored source of firm heterogeneity: the elasticity of markups across destinations within the same multi-destination firm. While prior work has shown that firms charge different prices across markets (Manova and Zhang 2012), it has not examined how these prices respond to firm-specific shocks. We show that, following a cost shock, multi-destination firms adjust their markups unevenly—reducing them more in markets where they hold larger market shares.

The remainder of the paper is organized as follows. Section 2 describes the data and provides historical context and details of the policy. Section 3 introduces the theoretical model. Section 4 outlines the empirical strategy and presents the results. Section 5 presents the quantitative analysis. Section 6 concludes.

2 Data and Institutional Setting

2.1 Data

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 employers 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,

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

[8] Failure to submit Formulario 931 can result in various penalties and the loss of social security benefits for employ-

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 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

ees, 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.

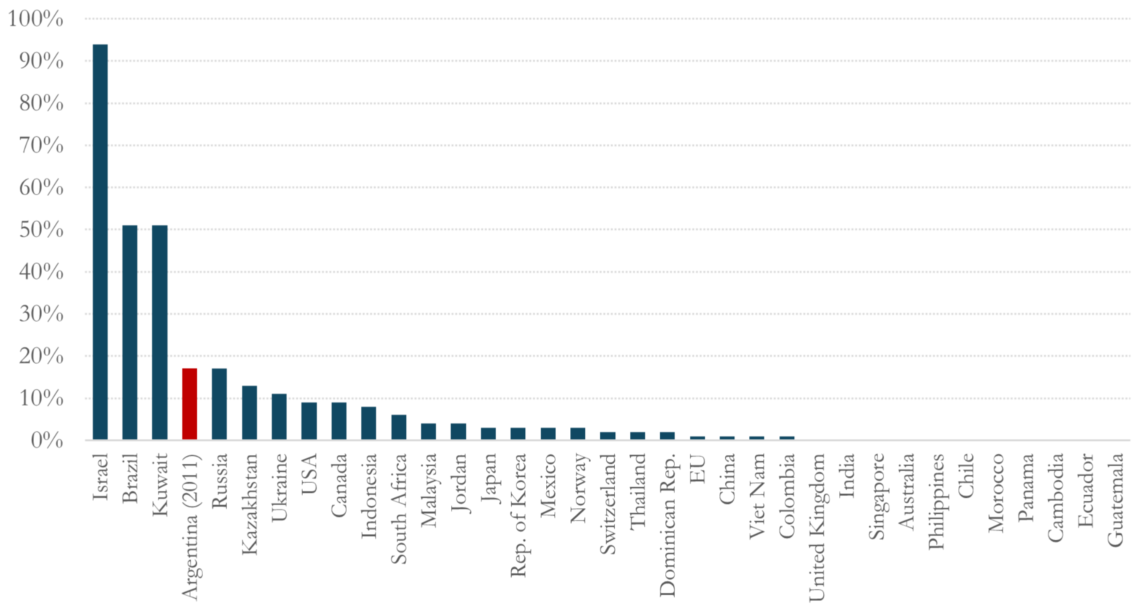
[11]Approval for import requets under Automatic Licenses are granted in all cases. By definition, (I) any person fulfilling the legal requirements should be equally eligible to apply for and obtain import licenses; and, (ii) the application shall be approved immediately on the receipt when feasible or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

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

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.

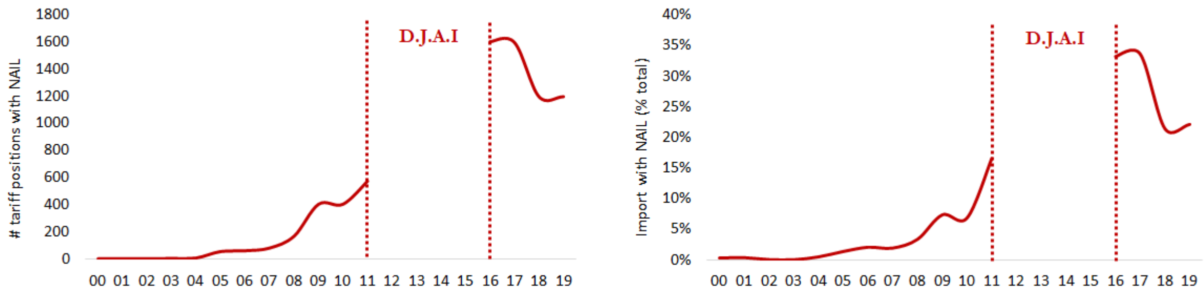
In 2012, after the Argentine government was elected for a second term, it introduced more restrictive import controls by replacing the NAILs regime with a new regime called "DJAI" in

[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.

which all products were subject to NAILs. These measures were further reinforced by stringent controls on foreign currency acquisition. After receiving approval for their import requests, importers were also required to obtain foreign currency from the central bank.[15] 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 allows to exploit the staggered implementation of the NAILs policy for identification purposes.

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.

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

[15] 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.

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.

37% were exposed to NAILs, meaning they imported at least one product during the base period that was subject to NAILs in 2011. [16] 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 Theoretical Framework

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. (2015b), Halpern et al. (2009)). Firms sell their products to k foreign markets, which differ in demand. We extend Atkeson and Burstein (2008) to allow for firm-by-destination specific variable markups. We abstract from extensive margin adjusments in 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. For brevity, we drop the subscripts s and t for sector and time in the theoretical framework. In particular, provided exporting to market k, sector s, a firm i faces the following demand:

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

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

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 $\rho > \eta > 1$ as varieties within sector are expected to have a higher degree of substitution.

Firms compete à la Cournot.[17] Combined with the demand structure, this setup endogenously generates variable markups that depend on each firm's market share in market k, defined as

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

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

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

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

$$\mathcal{M}_{ik} = \frac{\sigma_{ik}}{\sigma_{ik}-1} = \frac{1}{1-\frac{1}{\rho}(1-S_{ik}) - \frac{1}{\eta}S_{ik}} \tag{3.1}$$

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.

Unlike standard CES models, our framework allows markups to adjust in response to shocks. The magnitude of these adjustments is governed by the absolute value of the elasticity of markups with respect to prices. The absolute value of the markup elasticity is

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

Three key features emerge from the equations above. First, firms with a larger market share in market k charge higher markups in that market. Second, the elasticity of markups with respect to prices is negative -markups decline as prices rise due to cost shocks. Third, the negative of this elasticity increases with the firm's market share in a market. In other words, the super-elasticity, defined as the derivative of the absolute value of the markup elasticity with respect to market share, is positive: ($\S = \partial \log \Gamma_{ik} / \partial \log S_{ik} > 0$). Intuitively, larger firms with higher market shares maintain higher markups and can adjust them more in response to shocks, while maintaining prices and demand more stable. Smaller firms, by contrast, operate with lower markups and have limited space to adjust them, making them more likely to pass shocks through to prices.

[17] Appendix C.2 solve an alternative version with Bertrand competition.

We summarize these features in the following proposition.

PROPOSITION **1.**

1. *Markup of firm i ($\mathcal{M}_{ik}$) increases with a firm's market share in the market.*

2. *Increasing superelasticity (§): The absolute value of the elasticity of markup with respect to price is increasing in market share of the firm:* $\S = \frac{\partial \log \Gamma_{ik}}{\partial \log S_{ik}} > 0$.

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. Importing variety v involves a fixed cost (κ^m), which 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 to produce variety v) and a tariff or tariff-equivalent NTB (τ_v).

$$P_v = \frac{\tau_v}{A_v},$$

where $\tau_v \geq 1$. In the context of the NAILs, we interpret τ_v as the ad-valorem tariff equivalent of these measures. We model NAILs as a shock to unit costs rather than as a fixed cost because their primary effect arises through increased uncertainty in delivery times and the risk of shipment denial, frictions that tend to scale with the volume of imports. Firms placing larger or more frequent orders therefore face proportionally greater exposure to these costs. This approach is also consistent with the prevailing literature that interprets non-tariff measures as variable trade costs (Looi Kee et al. 2009) and with papers that model trade uncertainty as an increase in unit costs (Graziano et al. 2021, Handley 2014, Handley and Limao 2015).[18]

[18] Moreover, because our data are aggregated at the annual level, imports typically encompass multiple shipments, making a per-unit cost specification more appropriate.

3.3 Firm Import Behavior in Equilibrium

In this subsection, we analyze the firm's equilibrium behavior. We define a sourcing strategy Ω as the set of input varieties v for which the firm imports a positive amount. Our focus is on the firm's decisions, conditional on a given sourcing strategy Ω. Since the policy affects products regardless of their country of origin, we define imported varieties v independently of the specific source from which they are obtained.

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;

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

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

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

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

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

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

$$m_{iv}(\Omega) = \frac{\left(\frac{A_v}{\tau_v}\right)^{\theta-1}}{\left[\sum_{v\in\Omega}\left(\frac{A_v}{\tau_v}\right)^{\theta-1}\right]} \qquad \forall v \in \Omega;$$

$$m_{iv}(\Omega) = 0 \qquad \forall v \notin \Omega.$$

By Shepard's Lemma:

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

If the firm is impacted in several products, then the effect on unit costs is simply

$$dlog c_i = \sum_v m_{iv} dlog \tau_v \tag{3.8}$$

Note that the model predicts that the impact of an import barrier on a firm's costs increases with the share of the firm's expenditure allocated to the affected input. We will leverage this insight in the empirical section to construct the firm-level measure of exposure to the 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:

$$P_{ik} = \frac{\sigma_{ik}}{\sigma_{ik}-1} c_i(\Omega, \varphi) \tag{3.9}$$

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

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

With $\Gamma_{ik} = -\frac{\partial log \mathcal{M}_{ik}}{\partial log P_{ik}}$ 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. □

We hold constant P_k, as we do throughout the empirical section by including sector-destination-year fixed effects in every specification. If the markup is constant, then the effect of τ_v on an intermediate input on the firm's price is proportional to the initial expenditure share on that input, m_{iv}. In contrast, with variable markups, the impact is attenuated for larger firms that have higher markup elasticity, Γ. This mechanism is central to explaining the heterogeneous effects of (lack of) access to intermediate inputs on export performance, depending on a firm's relative position in the export market in Section 4.6 and will be central to identify the elasticities η and ρ.

3.5 Revenues in equilibrium

Revenues for firm i in market k are given by:

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

Note that the elasticity of exports to market k with respect to τ_v corresponds to the elasticity of prices in that market, scaled by the within demand elasticity:

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

This implies that we can learn about price adjustments by looking at changes in exports volumes.

Total firm revenue is given by:

$$R_i = \frac{\varphi^{\rho-1}}{h_i^{\rho-1}} \sum_k \frac{1}{\mathcal{M}_{ik}^{\rho-1}} P_k^{\rho-\eta} D_k, \tag{3.11}$$

3.6 Predictions

The model yields two sets of predictions that guide our empirical analysis. The first set operates at the firm level, characterizing how trade barriers affect total export revenues and total imports. These predictions are central to identifying the overall impact of the policy on firms. The second set of predictions is firm-destination specific. They quantify the direct effect of increased trade barriers on a firm's exports to each destination k, and highlight how a multi-destination firm adjusts differently across markets, depending on its market share in each.

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.*

$$\frac{\partial \log R_i}{\partial \log \tau_v} = (1-\rho)\sum_k \frac{R_{ik}}{R_i}\left[\frac{1}{1+\Gamma_{ik}} m_{iv}\right] < 0 \tag{3.12}$$

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

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

$$\frac{\partial \log M_i}{\partial (\log \tau_v \partial m_{iv})} = -\left[\rho \sum_k \frac{Q_{ik}}{Q_k}\frac{1}{1+\Gamma_{ik}} - 1\right] \leq 0 \tag{3.14}$$

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,*

$$\mathcal{E}_{XM} = \frac{\frac{\partial \log R_i}{\partial \log \tau_v}}{\frac{\partial \log M_i}{\log \tau_v}} = \frac{\partial \log R_i}{\partial \log M_i} = \frac{(1-\rho)\sum_k \frac{R_{ik}}{R_i}\left[\frac{1}{1+\Gamma_{ik}}\right]}{1-\rho\left[\sum_k \frac{Q_{ik}}{Q_k}\frac{1}{1+\Gamma_{ik}}\right]} > 0 \tag{3.15}$$

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_v). In addition, the effect is larger (more negative), the higher is m_{iv}:*

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

$$\frac{\partial \log R_{ik}}{\partial \log \tau_v \partial m_{iv}} = (1-\rho)\left[\frac{1}{1+\Gamma_{ik}}\right] \leq 0 \tag{3.17}$$

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):*

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

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:*

$$\frac{\partial \log R_{ik}}{\partial(\log \tau_v \partial m_{iv})\partial S_{ik}} \geq 0 \tag{3.19}$$

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

In the following sections, we test the model's predictions and use it to guide the empirical and quantitative exercises. Section 4 outlines the firm-level empirical strategy, guided by the model's implications. Section 4.6 leverages the model's multi-destination predictions to develop a novel methodology for identifying η and ρ, based on how multi-destination exporters adjust exports across their various export markets.

4 Empirical Strategy

In this section, we combine the structure of the model with a supply shock to import costs—captured by τ_v—and firm-level import shares m_{iv}. We exploit exogenous variation in import costs resulting from the Argentine government's imposition of non-tariff barriers on specific products between

2005 and 2011. First, we outline the methodology used to construct firm-level exposure to the policy. Next, we show that the policy effectively reduced imports, and then analyze its consequences for downstream firms.

4.1 Firm-level exporsure to NAILs

We use the NAILs to construct a cost shock for a firm. Guided by the model, we use the import basket of the firm in the period 2003-2007 and calculate the share of the firm's expenditure on imported inputs that corresponds to each product v (m_{iv}). 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, following Equation , 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, the more a firm was spending on the affected product before the policy was introduced, the more exposed it is to the shock.

4.2 The effect of NAILs on firm exports: Event study design

We begin by evaluating the effect of the policy on downstream firms' exports, exploiting the staggered inclusion of products into the NAILs system. Our main identification assumption is that, conditional on sector-by-time effects, the timing of a product's entry into NAILs is unrelated to subsequent changes in a firm's export behavior. In other words, within a sector, the government did not target products used more intensively by firms whose exports were expected to decline.

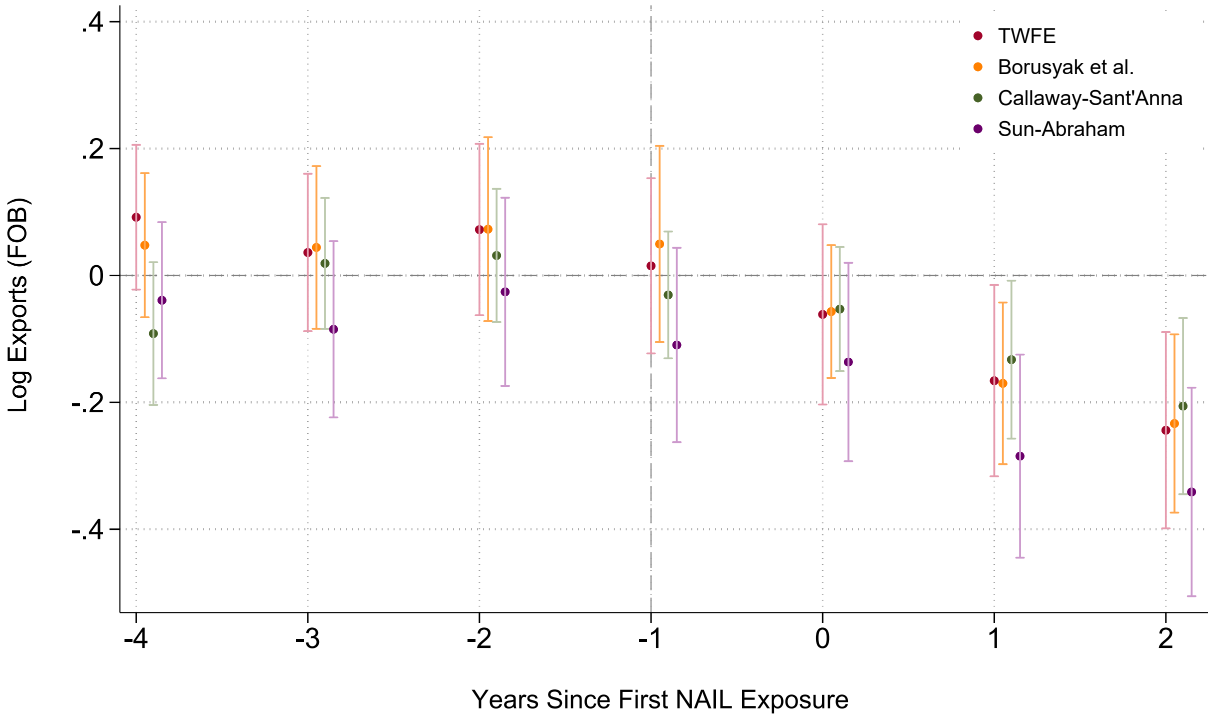
To do this exercise, we need to convert the exposure variable into binary indicators to run an event study, which allows us to test the identification assumption and provide initial evidence on export effects. The next section uses the continuous exposure measure, while Section 4.5 presents robustness checks addressing alternative mechanisms and identification threats."

To implement the event study, we define the event year $t = 0$ as the first year in which at least one of the firm's products is affected. We then plot the event study using differences in log exports between treated and control groups. All regressions include sector by year fixed effects to compare firms in the same sector. Formally, we estimate

$$\log(exports_{it}) = \sum_{j=-4}^{2} \beta_j 1[YearsSinceExposureToNAILs_{it} = j] + \alpha_i + \gamma_{st} + u_{it}. \tag{4.2}$$

Figure 3 plots the coefficients β_j under differnt difference in difference methods. Reassuringly, we find no systematic differences in firms' exports in the years prior to exposure to NAILs, supporting the plausibility of the parallel trends assumption. Moreover, the figure offers an early look at our main result: firms experience a significant decline in export values following exposure to NAILs.

Figure 3: Event study. The impact of Nonautomatic Import licenses on firms' exports (logs).



Notes: The figure shows the effect of exposure to non-automatic import licenses on firms' export values, from 4 years before to 2 years after exposure. A firm is considered exposed if at least one of its imported products was later subject to these licenses. Regressions include firm and sector-year fixed effects; standard errors are clustered at the firm level. The figure plots estimates and confidence intervals from alternative event study methods: Borusyak et al. (2024) (blue circles), Callaway and Sant'Anna (2021) (green circles), and Sun and Abraham (2021) (purple circles), all robust to treatment effect heterogeneity. For reference.

4.3 Results

In this section we present the main empirical 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 4.6 we use the model's predictions to estimate whether it is increasing on a firm's relative size in the market.

4.3.1 The effect of NAILs on imports and exports

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

$$Y^X_{ist} = \beta NAILexposure_{ist} + \gamma_i + \gamma_t + \gamma_{st} + \mu_{it}, \tag{4.3}$$

where Y_{ist}^X 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 4.4 are reported in Table 2.

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

	(1)	(2)	(3)	(4)
	$log(exports)_{it}$	$Exportstatus_{it}$	$\#Products$	$\#Destinations$
$NAILexposure_{it}$	-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:

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

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,

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.

which 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.

4.3.2 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 Notablythe 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.

4.4 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

$$log(employment)_{sit} = \beta NAILexposure_{it} + \gamma_i + \gamma_{st} + \mu_{sit}, \tag{4.4}$$

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.

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

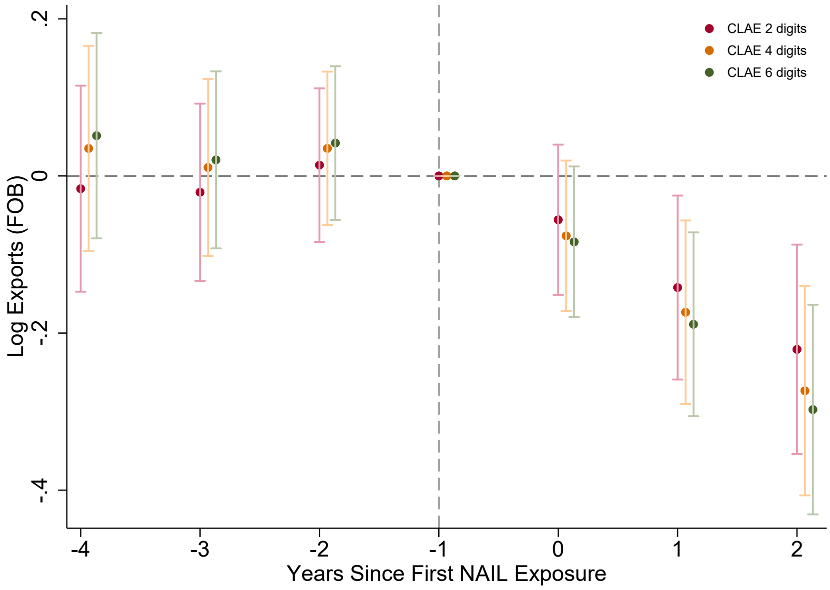
Notes: Clustered standard error at firm level in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. $NAILexposure_{it}$ represents the share of firms' imports from 2003-2005 affected by NAIL in year t. Column (1) outcome is the inverse hyperbolic sine transformation of the number of employees of firm i in 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.

4.5 Alternative Explanations: Selection and Exposure

Potential Bias of Government Selecting Sectors. A potential concern is that the government may have targeted NAILs toward specific sectors. To address this, all regressions include detailed dissagregated sector-by-year fixed effects, which absorb sector-specific shocks and macroeconomic trends. This ensures that identification comes from variation in NAILs exposure across firms within the same sector and year.

To further test whether the government targeting specific sectors drives our results, we re-estimate our main specification including sector-year fixed effects at varying levels of sector disaggregation: 2-digit, 4-digit, and 6-digit CLAE codes. If government targeting were influential, we would expect the estimated coefficient to vary across these specifications. Reassuringly, Figure 4 shows that the coefficient remains stable regardless of the level of sector aggregation.

Figure 4: Robustness to sector aggregation



Notes: This figure shows the event study estimates of log exports around the first NAIL exposure, comparing different sectoral aggregation levels (CLAE 2-, 4-, and 6-digit). Confidence intervals are shown except for the baseline period, highlighting consistent effects across aggregations.

Potential Bias due to Government Selection of Firms. Given that sector-by-year fixed effects address the concern that the government may have targeted specific sectors, the remaining concern is that it may have strategically chosen to put NAILs on inputs used intensively by firms whose exports were going to decline.

We address this concern in two steps. First, the absence of differential pre-trends provides indirect evidence that the government lacked the capacity to selectively target inputs used intensively by firms whose export performance was likely to decline. Second, in Table 6, we control more directly for potential targeting by including interactions between year and firm-level baseline characteristics. Column (1) shows our baseline specification with firm and sector-by-year fixed effects. Column (2) adds interactions with firms' 2003–2007 exports and imports. Column (3) further includes interactions with other pre-treatment firm characteristics—such as employment, number of export destinations, and number of products—to flexibly account for differential trends by size, complexity, and market scope. Reassuringly, the main coefficient remains negative and stable across all specifications.

Table 6: Testing for Bias in Government Targeting of Firms

	(1) Exports	(2) Exports	(3) Exports
Independent Variable	-0.3494***	-0.4720***	-0.4532***
	(0.1058)	(0.1018)	(0.1012)
Observations	162,981	162,981	162,981
R-squared	0.7297	0.7354	0.7358
Sector-Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Pre-treatment Exports×Year	No	Yes	Yes
Pre-treatment Imports×Year	No	Yes	Yes
Pre-treatment Products×Year	No	No	Yes
Pre-treatment Destinations×Year	No	No	Yes
Pre-treatment Employees×Year	No	No	Yes

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

Potential Firms' Responses through Bribes. Another potential concern is that some firms may have circumvented the restrictions imposed by NAILs through informal mechanisms such as bribes or off-the-record payments. While such behavior would imply heterogeneous enforcement of the policy, it does not invalidate the interpretation of NAILs as a trade friction. These informal payments constitute a form of implicit tariff or rent extraction, increasing the effective cost of importing for firms engaged in such practices. As a result, even firms that successfully navigated the licensing process informally would still face elevated import costs, which can distort input usage and export performance. Thus, whether the friction arises through formal denial or informal rent-seeking, the mechanism of trade disruption remains consistent with our empirical framework that will capture the average effect of the policy.

4.6 Multi-destination Exporters and Variable Markups Across Destinations

After establishing the average effect of the policy on downstream firms, we turn to examine how market power and variable markups shape firms' responses across export destinations.

This estimation serves three main purposes. First, the methodology allows to learn new facts about multi-destination exporters: how a multi-destination exporter adjusts its markups in different destinations in response to a firm-level cost shocks. These firms are particularly relevant, as they represent more than 90% of our sample. Second, it provides a model-based qualitative test of whether the elasticity of markups increases or decreases with market share. Third, in the next section, we use the estimated coefficients to identify the two key structural parameters of the model: the across-sector demand elasticity, η, and the within-sector demand elasticity, ρ.

Recall from Proposition 4 that the negative effect of a cost shock on exports to destination k is attenuated in markets where the firm holds a larger market share:

$$\frac{\partial \log R_{ik}}{\partial(\log \tau_v \partial m_{iv})\partial S_{ik}} \geq 0 \tag{4.5}$$

In other words, firms adjust their exports less in response to a cost shock in destinations where they have greater market presence. This result provides a basis for estimating how the elasticity of markups varies with market share by comparing export responses of a given firm across destinations.

Guided by the model, we estimate a first-order approximation of the equation in Proposition 4, which characterizes how the effects of NAILs vary with a firm's market share in each destination.

$$\Delta \log Expo_{iskt} = \beta_1 \Delta Nailexp_{it} + \beta_2 \Delta Nailexp_{it} * S_{iskt-1} + \gamma S_{iskt-1} + \gamma_{it} + \gamma_{skt} + \Delta e_{iskt} \tag{4.6}$$

where

$$S_{iskt} = \frac{ExportValues_{iskt}}{\sum_{i \in s} ExportValues_{iskt}} \times 100 \tag{4.7}$$

Equation 4.6 presents our benchmark empirical specification. In this section, we exploit a more disaggregated version of the data—at the firm–product–destination–year level—to capture heterogeneity in responses across markets. The identification strategy relies on within-firm variation, comparing how a given firm responds to a cost shock across its different destinations, as a function of its market share in each market. Market share is defined as the ratio between the export value of firm i of HS8 product s to destination k and the total exports of all firms in market sk, as shown in equation 4.7.

Since we focus on markups, we restrict our attention to firm-destinations with positive revenues in t and $t-1$ and restrict the firm's main export product. Our preferred specification includes firm-by-year fixed effects and sector-by-destination fixed effects, where a sector is defined at the CLAE4 level. To address the possibility that firms import from the same destinations to which they export—potentially influencing the pass-through of cost shocks—we include a control for firm-level imports from destination k in all specifications.[19]

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 $\beta_2 > 0$. [20]

Table 7 reports the results. The first row reports the average effect, while the second row shows the effect interacting with the 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. 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.

Column (2) includes firm-year fixed effect to effectively compare a given firm in the same year

[19] Albornoz and Garcia-Lembergman (2022) and Amiti et al. (2015) document that import activity from export destinations can affect cost pass-through.

[20] 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.

across their destinations. 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, the results in Column (2) imply that a firm facing a 10% exposure in its import basket reduces its export value by 5.3% in a destination where it holds nearly zero market share, compared to a smaller decline of 3.3% in a market where its share is 20%.

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 interacted with the firm's exposure to LNA and included as an additional control in the regression. Column (3) presents the results. Notably, 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.

Evidence in this section suggests that the elasticity of markups increases with market share. As a result, larger firms are more likely to absorb trade cost shocks by compressing their markups, thereby keeping prices and exports relatively stable. In the next section, we use these estimates to recover the key structural elasticities and feed them into the quantitative model to evaluate the aggregate impact of NAILs under various scenarios.

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.

5 Quantitative Analysis

Having analyzed the firm-level effects of NAILs, we next examine how market power and market concentration shape the aggregate impact of the policy on exports.

5.1 Parameter Estimates

We begin by estimating the key structural parameters, ρ and η. To identify them, we exploit the estimation of the elasticity of markups with respect to firm size that we obtained using multi-destination exporters. We then outline the procedure used to recover the remaining parameters of the model.

5.1.1 Indirect Indiference: Steps to estimate η and ρ

In our model exporters' markups and the elasticity of markups are 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 4.6.

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:

$$(\hat{\rho}, \hat{\eta}) = \arg\min_{\rho,\eta} \left\{ \left\| \hat{\beta}_1 - \beta_1(\rho, \eta) \right\| + \left\| \hat{\beta}_2 - \beta_2(\rho, \eta) \right\| \right\}. \tag{5.1}$$

To implement the estimation strategy we require a baseline calibration of other model parameters. Table 8 summarizes the core assumptions and empirical targets that anchor our simulation environment. This includes the size of the simulated economy, moments of the cost and productivity distributions derived from customs data, and the reduced-form regression coefficients used as targets in the Simulated Method of Moments. Appendix D.4 provides more details on these parameters.

Table 8: Baseline calibration and data targets

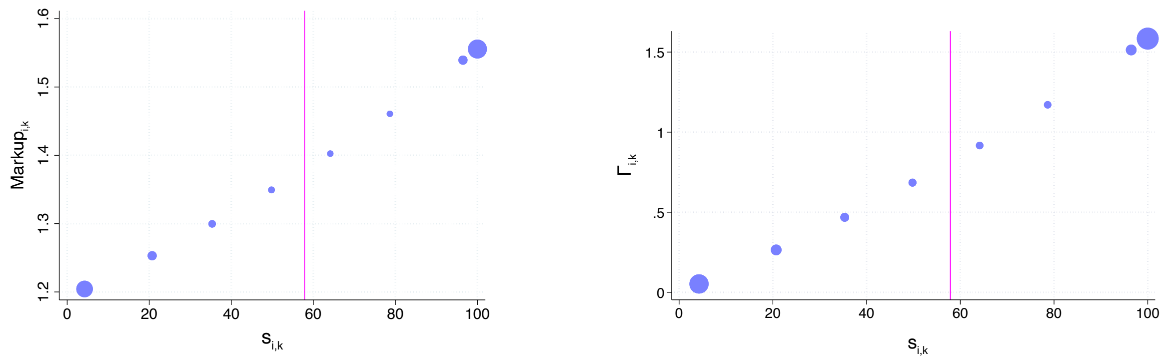
Parameter / symbol	**Value**	**Source / notes**
Model size		
Cost (log-normal) distribution		
Mean cost $\bar{c}$	693	Sample mean of CIF unit costs, Arg. Customs Data†
Std. dev. cost σ_c	1 181	Sample mean of CIF unit costs, Arg. Customs Data†
Cost-shock distribution		
Mean shock $\bar{\varepsilon}$	0.035	Pre-licence cost change, firm panel†
Std. dev. shock σ_ε	0.137	Pre-licence cost change, firm panel†
Productivity / taste shocks (Type-I Pareto)		
Tail index α	4	Literature benchmark
Lower bound $x_{\min}$	0.75	Literature benchmark
Policy shock scale		
Import-licence factor	0.12	
Empirical regression targets		
Slope β_1 on Δcost	-0.5357	Table 7
Interaction β_2 on $(\Delta\text{cost}) \times s_{ik}$	0.0065	Table 7

Notes: † Exact moment calculated from Argentina's customs micro-data; see Online Appendix D.4.

5.1.2 Results: ρ, η, and Implied Markups

The estimation yields $\hat{\rho} = 6.2$ and $\hat{\eta} = 2.8$. Each panel in Figure 5 maps the markup and the implied elasticity of markups predicted by the model as a function of firms' market shares in the data. The size of each circle reflects the number of firms in the data with a given market share. Panel A displays the markup, while Panel B shows Γ_i, the elasticity of markups with respect to marginal cost. The model implies an average firm-level markup of $\bar{\mu}_i = 1.35$ and an average elasticity $\bar{\Gamma}_i = 0.7$, corresponding to an average pass-through rate of 60%.

Figure 5: Estimated Markup and Markup Elasticity



(a) Markup by market share (b) Markup elasticity

Notes: The unit of observation is firm-by-destination. Estimated markups and markup elasticities are derived from the model using observed market shares. Larger firms charge higher markups and exhibit larger markup elasticity. The size of the circles reflects the density of firms with corresponding market shares.

5.2 Quantitive Analysis: Results

We use the model for two main objectives. First, we analyze the aggregate effects of the policy on Argentinian exports under a set of counterfactual scenarios that vary firms' market power and market structure. Second, we assess the extent to which the decline in aggregate exports by downstream firms limit the policy's effectiveness in reducing trade imbalances.

5.2.1 Counterfactual Scenarios

To understand the role of market structure in shaping the aggregate response to NAILs, we conduct two counterfactual exercises that modify the allocation of market shares or the market structure.

Counterfactual 1: Equalized Export Shares $S_{ik} = 1/N_k$
In this counterfactual, we eliminate firm size heterogeneity within each product market by assigning equal market shares to all active exporters. The number of firms and their cost draws are preserved, but endogenous equilibrium shares are replaced by a uniform allocation. This removes variation in exposure and pricing power across firms, flattening the distribution of markups.

This exercise assesses how much of the aggregate export response to NAILs stems from initial export concentration.

Counterfactual 2: Constant Elasticity of Substitution (CES)
In the second counterfactual, we impose a constant elasticity of substitution across varieties by fixing all firms' markups at a level Notablystandard CES demand. This eliminates endogenous variation in markups, allowing us to isolate their role in attenuating the effects of NAILs on aggregate exports.

5.2.2 Counterfactual Results

Table 9 summarizes the aggregate effects of NAILs on exports and imports across counterfactual scenarios. Panel A considers all firms, while Panel B restrict the sample to firms that were exposed to NAILs.

Focusing on Panel A, the baseline model indicates that total Argentinian exports fall by 3.3%. Equalizing firm market shares increases the decline to 3.9%, indicating that market concentration dampens the aggregate effects. Under CES preferences, where markups are fixed, exports drop by 5.1%. This represents a 55% larger decline relative to the baseline, which highlights the role of variable markups in mitigating the effects of import barriers.

Imports show a similar pattern: the baseline model yields a 10.4% decline, compared to 12.9% under CES preferences. The sharper drop under CES reflects larger reductions in output when markups cannot adjust. Importantly, the 10.4% fall in imports is accompanied by a 3.3% drop in exports, indicating that the decline in imports affect downstream export activity and partially offsets the intended improvement in the trade balance.

When focusing on firms with positive exposure to NAILs (Panel B), we observe a similar pattern, though the percentage declines are naturally larger since unaffected firms are excluded.

Table 9: Impact of NAILs under Alternative Market Structures

	Full Model	$S_{ik} = 1/N_k$	CES ($\rho = \eta = 6.2$)
Panel A: All firms			
Δ log Exports	-3.3%	-3.9%	-5.1%
Δ log Imports	-10.4%	-10.7%	-12.9%
Panel B: Firms with positive exposure			
Δ log Exports	-6.7%	-8.6%	-10.6%
Δ log Imports	-16.1%	-16.5%	-20.1%

Notes: The table reports aggregate changes in log exports and imports. Panel A shows results for all Argentinian firms, while Panel B restricts to those affected by the policy. Column (1) presents the baseline results with variable markups. Column (2) also allows for variable markups but equalizes market shares within each market. Column (3) reports results from a CES model with constant markups.

5.3 Aggregation: Market Level Concentration

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):

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

Substituting the markup-market-share relationship 3.1 under Cournot competition, we can express the sectoral markup, M_k, as a simple function of the sector's Herfindahl-Hirschman index, $HHI_{kt} = \sum_i S_{ik}^2$: [21]

$$\mathcal{M}_k = \frac{\sigma_{ik} - 1}{\sigma_{ik}} = \left[1 + \frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta} HHI_k \right]^{-1} \tag{5.2}$$

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

$$R_k = \frac{1}{\mathcal{M}_k^{\rho-1}} \frac{\varphi^{\rho-1}}{h^{\rho-1}} P_k^{\rho-\eta} D_k$$

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

$$R = \frac{\varphi^{\rho-1}}{h^{\rho-1}} \sum_k \frac{1}{\left(\left[1 + \frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta} HHI_k \right]^{-1} \right)^{\rho-1}} P_k^{\rho-\eta} D_k \tag{5.3}$$

Given equation 5.2 and 5.3, 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 importing varieties, highlighting the relationship between trade costs and import volumes. Lastly, we establish a positive relationship between exports and imports within a sector, empha-

[21] 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.

sizing 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.

5.4 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 5.3, 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 4.6. 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. [22] 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.

$$\Delta Log(Expo_{iskt}) = \hat{\beta}_0 + \hat{\beta}_1 \Delta Exposure_{it} + \hat{\beta}_2 S_{iskt-1} + \hat{\beta}_3 \Delta Exposure_{it} S_{iskt-1} + \Phi(\cdot) \tag{5.4}$$

where $\Phi(\cdot)$ corresponds to the terms in 4.6 related to the fixed effects. [23] 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:

$$\Delta \text{Exposure}_{sk,t} = \sum_i \Delta \text{Exposure}_{iskt} S_{iskt-1} \tag{5.5}$$

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.

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

[22]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

[23]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.

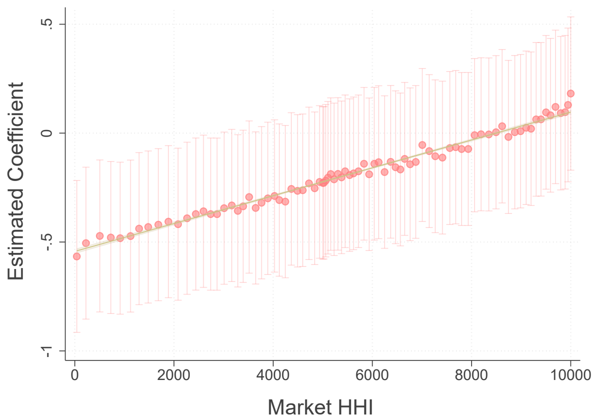
Note that if there is no heterogeneity across firms in a sector's exposure to NAILs, there is a linear relationship between the sector's HHI and the effect of sector exposure:

$$\frac{\sum_i S_{iskt-1} \Delta \log(\text{Expo}_{iskt})}{\Delta \text{Exposure}_{skt}} = \hat{\beta}_1 + \hat{\beta}_3 HHI_{skt} \tag{5.6}$$

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 Herfindahl-Hirschman index ranges from 0 to 10000. Results are shown in Figure 6. [24] 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 6: 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

6 Conclusion

Non-Automatic Import Licenses (NAILs), applied in Argentina between 2005 and 2011, provide a unique setting to examine the broader consequences of non-tariff trade barriers. This paper studies how these import restrictions affected downstream firms and shows how market power shapes the overall impact of trade barriers.

[24] The standard errors were computed as the mean standard errors by bin, where the standard errors are defined as $Var(Coefficient_{skt}) = Var(\hat{\beta}_1) + Var(\hat{\beta}_3)\left(\sum_i f_{iskt} S^2_{iskt})\right)^2 + 2\sum_i f_{iskt} S^2_{iskt} cov(\hat{\beta}_1, \hat{\beta}_3)$.

We find that NAILs significantly reduced firm-level imports, leading to declines in both exports and employment for firms reliant on imported inputs. Restricting access to foreign inputs weakens firm performance and limits their ability to compete abroad.

To interpret these results in the aggregate, we develop a model of international trade with oligopolistic competition in export markets. In the model, firms with greater market power—particularly those exporting to concentrated markets—respond to cost shocks from NAILs by adjusting their markups rather than fully passing the cost increase to prices. This adjustment dampens the sales impact of trade restrictions, making their effects smaller in markets dominated by a few firms.

We estimate that the total effect of NAILs on exports would have been 55% larger had markups remained constant. This highlights that differences in market power across firms play a central role in shaping the aggregate consequences of trade restrictions.

Finally, we show that the decline in exports caused by import restrictions undermines the policy's stated objective of reducing trade imbalances. Overall, the evidence suggests that non-tariff barriers on intermediate inputs are a costly and inefficient policy tool. While firms with substantial market power may partially absorb the shock, many others cannot, leading to aggregate losses in exports and employment. Policymakers should weigh these unintended consequences when deciding to implement these policies.

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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 [25] and were active for at least 1 year in our sample [26].

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

[25]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.

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

and Finance (MECON) co-ordinates the collection and updating of national legislation, its rules of interpretation and background.

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 Resolución 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 7: 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.

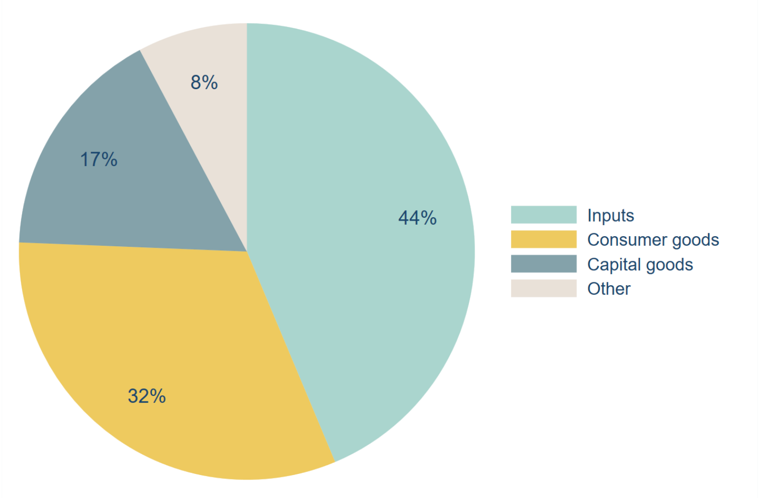
Notes: The figure shows an example of one of the digitalized decretes.

Source: InfoLEG

B Appendix: Empirical Part

B.1 Broad economic categories affected by NAILs

Figure 8: Imports with NAIL by broad economic categories



Notes: This graph corresponds to all countries with NAILs.

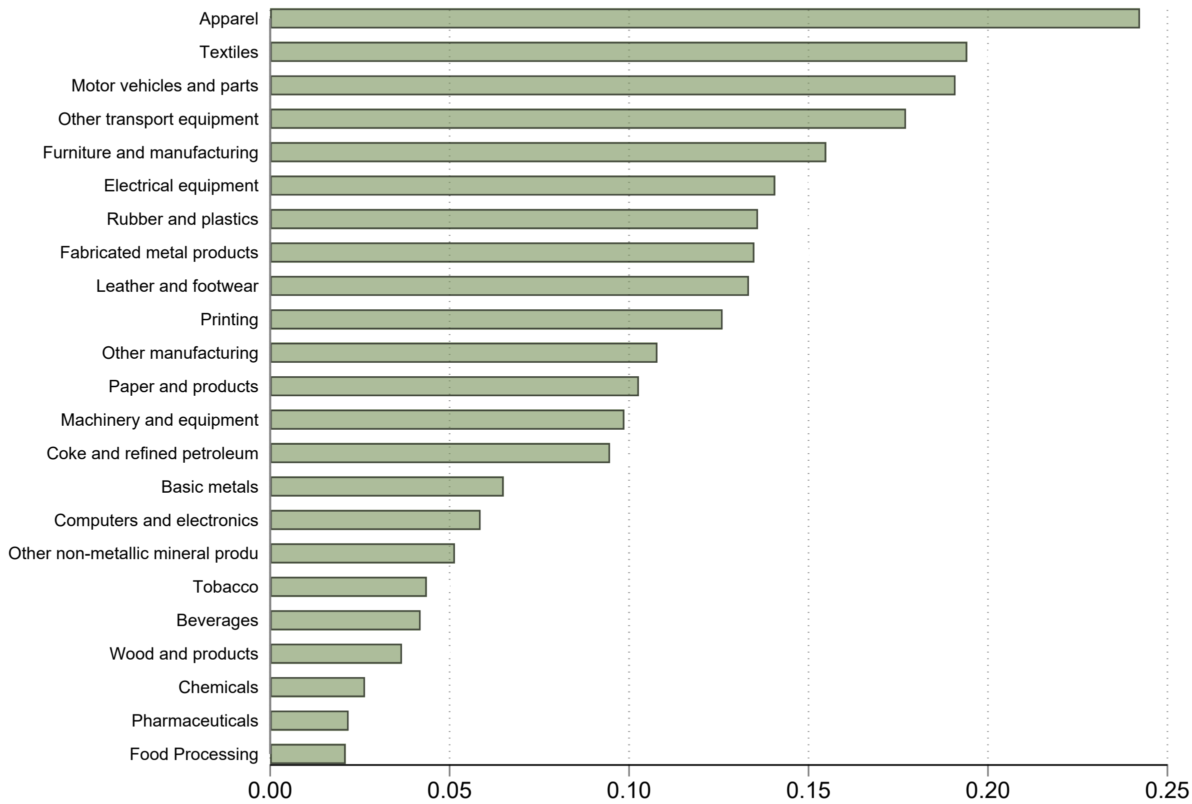
B.2 Value of inputs affected by NAILs each year

Year	Cost of imports (millions)		Prop. of affected goods (%)
	No NAILs	NAILs	
2004	12,735	18	0.14
2005	16,211	71	0.44
2006	19,514	209	1.06
2007	25,359	277	1.08
2008	32,897	281	0.85
2009	19,830	1,157	5.51
2010	31,178	1,789	5.43
2011	36,255	6,575	15.35

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

B.3 NAILs by sector

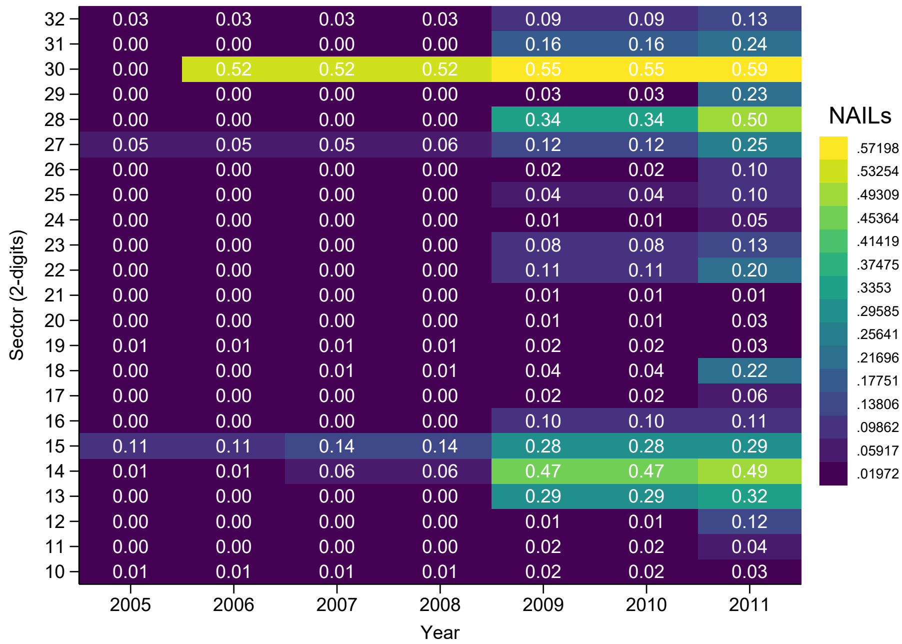
Figure 9: Average firm's share of imports corresponding to affected inputs (2011)



Notes: Average share of affected imports per firm: The mean percentage of each firm's total import value (CIF) originating from policy-affected products (LNA=1), calculated at firm level then averaged by sector. It reflects typical firm exposure intensity. Source: Centre of Documentation and Information (CDI) in Argentina.

Notes: Sector-wide import exposure: Percentage of total sectoral import value (CIF) coming from affected products (LNA=1). Measures aggregate economic dependence on targeted inputs across all firms in the sector.While the firm-level measure shows average firm vulnerability, the sector-level estimate captures the policy's overall economic footprint. Both use import values (CIF), not product counts, ensuring economic weighting. Source: Centre of Documentation and Information (CDI) in Argentina.

Figure 10: Adjusted prevalence of NAILs on imported products, 2005-2011



Notes: This figure shows the share of sectoral imports (measured by CIF values) affected by NAILs over time. Unlike a simple count of products, it reflects the economic importance of the affected goods within each sector. A higher share indicates that a greater proportion of the sector's imported value was subject to NAIL restrictions.

B.4 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.

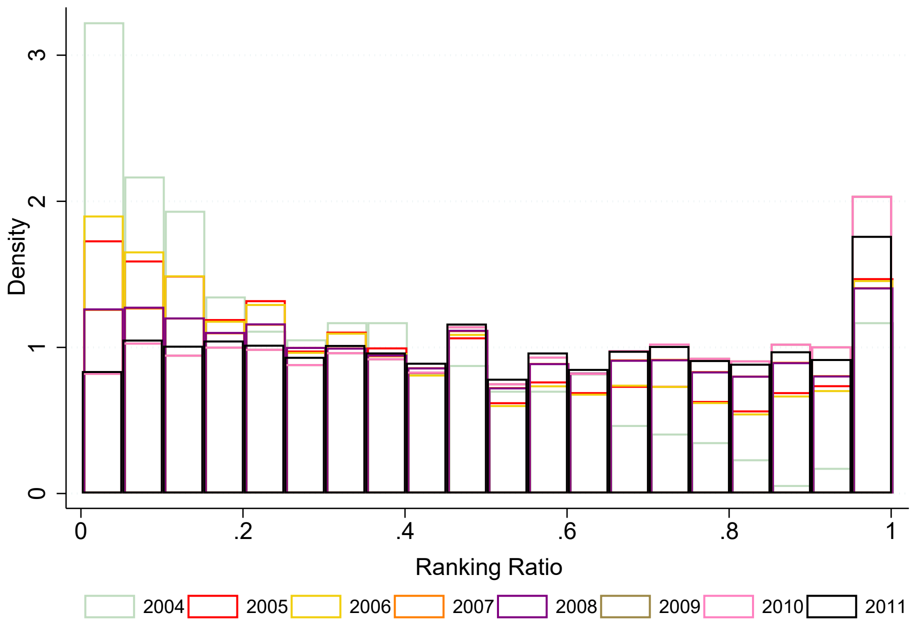


Figure 11: Histogram of Relative Importance Ranking for Affected Products

From Figure 11, 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.5 Robustness Checks

In Table 10 we show that other factors do not explain results. In Column (1) we present the results for our benchmark regression. A concern is that the market share might be correlated with income of the destination country. Hence, we are capturing changes in exports due to the interaction between the cost shock and characteristics of the destination country. In Column (2), we control for the interaction between exposure to NAILs and GDP per capita in the destination. The main coefficient remains almost unchanged. A second concern is that firms might import more from destinations that they export more. Hence, a shock to imports might affect diferentially destinations where the firm is large. In Column (4), we control for imports of the firm from the destination market. Similarly, in Column (5) we exclude China from the sample. Reassuringly, the coefficient remains stable throughout the different specifications.

Table 10: Robustness Check: Elasticity of markup and relation with market share

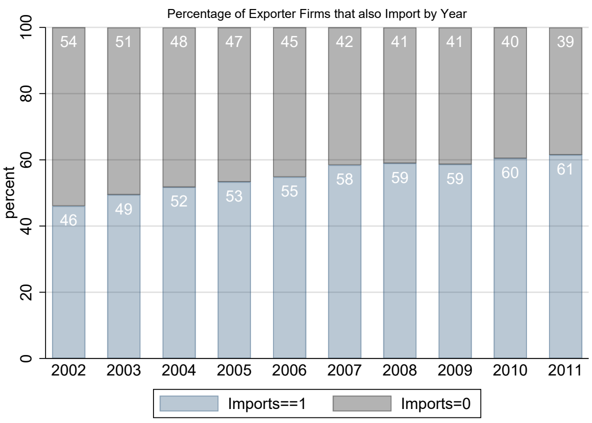
	(1)	(2)	(3)	(4)	(5)
			$\Delta log(Exports_{iskt})$		
$\Delta NAILexposure_{it} * S_{ikt-1}$	0.0070**	0.0071**	0.0079**	0.0059*	0.0070**
	(0.0034)	(0.0035)	(0.0033)	(0.0035)	(0.0034)
$\Delta NAILexposure_{it} * log(gdppc)_{kt-1}$		-0.0116			
		(0.1607)			
$\Delta NAILexposure_{it} * ShareWithinFirm_{ikt-1}$				0.0002	
				(0.0049)	
Observations	178,040	176,156	178,040	178,040	176,528
R-squared	0.8332	0.8337	0.8651	0.8795	0.8342
Destination FE	Yes	Yes	Yes	Yes	Yes
Firm-Product-Year FE	Yes	Yes	Yes	Yes	Yes
Imports from k	No	No	Yes	Yes	No
Excluded China	No	No	No	No	Yes

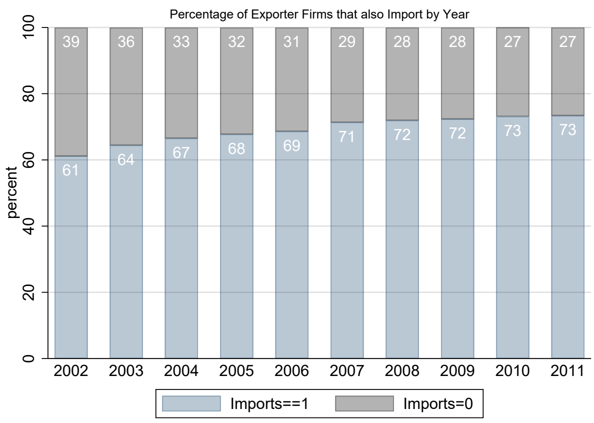
Notes: Clustered standard errors at firm level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B.6 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 proportion—consistently 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.



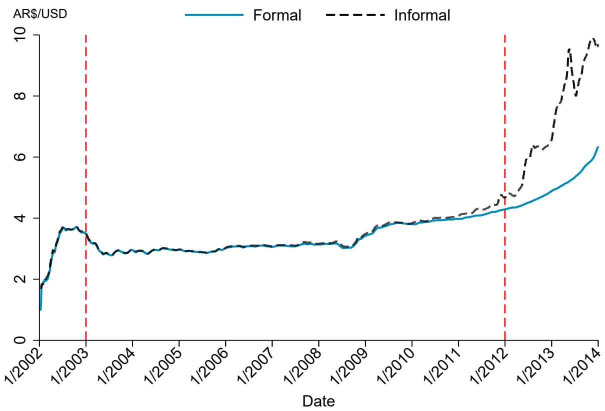


Notes: In the first pane, a firm is considered an importer if, in the corresponding year, it makes at least one import operation. In the second panel, a firm is considered an importer if between 2002-2012 makes at least one import operation.

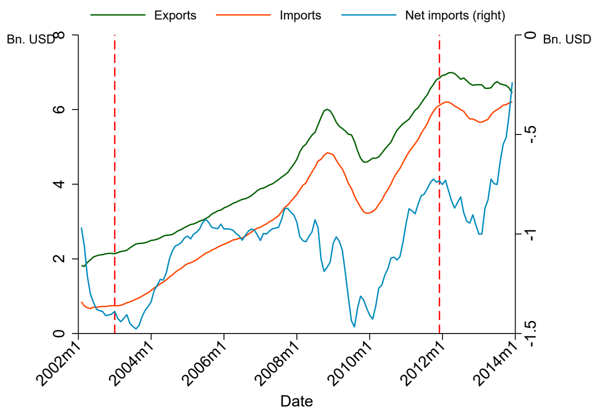
B.7 Other trends on the studied period

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.

Panel A: exchange rates over time



Panel B: Trade over time



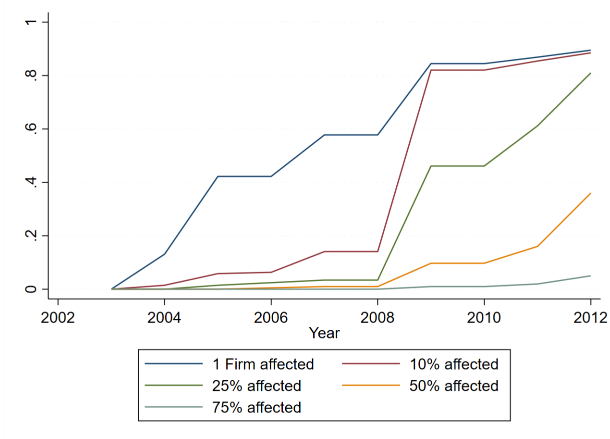
Notes: Panel A shows the exchange rates (ARS/USD) over time, distinguishing between formal (solid line) and informal (dashed line) rates. The red dashed vertical lines indicate the periods during which non-automatic import licenses (NAILs) were applied. Panel B depicts trade over time, with exports (green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

B.8 Inputs affected per sector

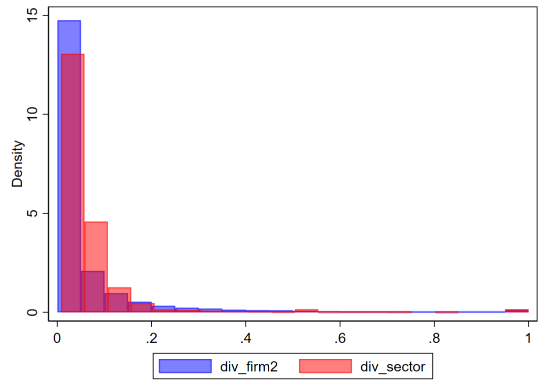
Panel A of Figure 12 shows the average number of firms per sector affected each year, indicating that only closer to 2012 did 80% of firms in a sector receive LNA. Also, it is important to notice firms within the same sector may use different inputs. To illustrate this, we compute the ratio of unique 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

Panel A: Percentage of affected sectors



Panel B: Similitud de las firmas

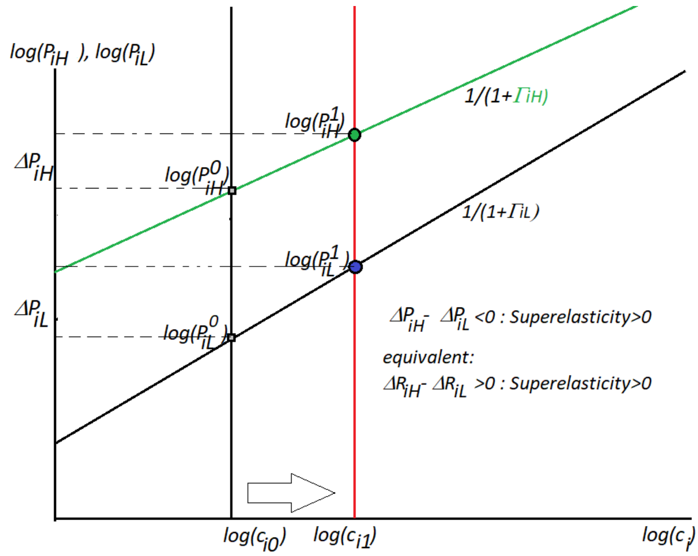


C Appendix: Theory

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

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

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

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

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

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

C.4 Proof of Proposition III

C.4.1 Lemma 1: Proof

$$R_k = \frac{1}{\mathcal{M}_k^{\rho-1}} \frac{\phi^{\rho-1}}{h_s^{\rho-1}} P_k^{\rho-\eta} D_K$$

Taking logs,

$$\begin{aligned}
logR_k &= (1-\rho) log\mathcal{M}_k + (1-\rho) logh \\
\frac{dlogR_k}{dlog\tau_v} &= (1-\rho)\left[\frac{dlog\mathcal{M}_k}{dlog\tau_v} + \frac{dlogh_s}{dlog\tau_v}\right] = \\
&= (1-\rho)\left[\frac{dlog\mathcal{M}_k}{dlogP_k}\frac{dlogP_k}{dlog\tau_v} + m_v\right] = \\
&= (1-\rho)\left[-\frac{\Lambda_k}{1+\Lambda_k} m_v + m_v\right] = \\
&= (1-\rho)\frac{1}{1+\Lambda_k} m_{sv} \leq 0
\end{aligned}$$

Now, given $R = \sum_k R_k$. Applying logs

$$logR = log\Big(\sum_k R_k\Big)$$

Then,

$$\frac{dlogR}{dlog\tau_v} = \sum_k \frac{1}{\sum_k R_k} R_k \frac{dlogR_k}{dlog\tau_v} =$$
$$= (1-\rho)\sum_k \frac{R_k}{R}\frac{1}{1+\Lambda_k} m_v \leq 0$$

C.4.2 Lemma 2: Proof

First, we prove that the elasticity of imports with respect to τ_v 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 $log(\tau_v)$ is equal to m_{iv}. Then,

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

The adjustment in quantities is given by,

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

so

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

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 3.16 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,

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

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

Firm level revenues (R_k) can be expressed as:

$$R_{i,k} = P_{i,k} Q_{i,k}$$

If we define the sectoral revenues as:

$$R_k = \sum_i R_{i,k}$$

We have

$$R_k = P_k^{\rho-\eta} D_k \sum_i \gamma_{i,k} P_{i,l}^{1-\rho}$$

Also, by definition:

$$P_{k,i} = \left(\sum_i \gamma_{i,k} P_{i,k}^{1-\rho} \right)^{\frac{1}{1-\rho}}$$

Then, sectorial revenues are:

$$R_k = P_k^{1-\eta} D_k$$

C.6.2 Demonstration of $m_{k,v}$

Remember that:

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

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

$$M_k(\Omega) = \frac{Q_k}{\phi} \sum_{i=1}^{N_k} \left(\sum_{v \in \Omega} \left(\frac{A_v N_k}{\tau_{k,v}} \right)^{\theta-1} \right)^{-\frac{1}{\theta-1}}$$

Expenditure share of market k on imported variety v is given by (**assumption**):

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

By Shepard's Lemma:

$$\frac{\partial log c_k}{\partial log \tau_{k,v}} = m_{k,v}$$

Alternatively, from $P_k = \mathcal{M}_k(P_k) c_k(\Omega, \phi)$

$$
\begin{aligned}
logP_k &= log\mathcal{M}_k(\cdot) + logc_k(\cdot) \\
\frac{dlogP_k}{dlog\tau_{k,v}} &= \frac{dlog\mathcal{M}_k}{dlogP_k}\frac{dlogP_k}{dlog\tau_{k,v}} + \frac{dlogc_k}{dlog\tau_{kv}} = \\
\frac{dlogP_k}{dlog\tau_{k,v}}\Big[1+\Lambda_k\Big] &= \frac{dlogc_k}{dlog\tau_{k,v}}
\end{aligned}
$$

Where:

$$
\Lambda_k \equiv -\frac{dlog\mathcal{M}_k}{dlogP_k}
$$

Then, by Sheppard's Lemma.

$$
\frac{dlogP_k}{dlog\tau_{k,v}} = \frac{1}{1+\Lambda_k} m_{k,v}
$$

C.6.3 Formal Proposition on Super-elasticity

Definition 2
Super-elasticity of sectoral markup ($\S_k$): The derivative of the absolute value of the elasticity of markup with respect to HHI in sector s, destination k. Formally, ($\S_k = \partial \log \Lambda_k / \partial \log HHI_k$).

PROPOSITION **5.**

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

2. *The elasticity of markup with respect to price ($-\Lambda_k$) is negative.*

$$
\frac{\partial \log \mathcal{M}_k}{\partial \log P_k} = -\Lambda_k = \frac{\left(\frac{1}{\eta} - \frac{1}{\rho}\right)\frac{\partial HHI_k}{\partial P_k}}{1 + \frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta}HHI_k} < 0 \tag{C.1}
$$

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 $\sum_{i=1}^{N_k} = S_{i,k}^2 = HHI_{s,k}$:

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

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

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

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

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

Now, taking logs:

$$\frac{\partial \log \mathcal{M}_k}{\partial \log P_k} = \frac{\left(\frac{1}{\eta} - \frac{1}{\rho}\right)\frac{\partial HHI_k}{\partial P_k}}{1 + \frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta}HHI_k}$$

Since $\rho > \eta > 1$:

$$\frac{\frac{1}{\eta} - \frac{1}{\rho}}{1 + \frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta}HHI_k} > 0$$

Therefore, to determine $\frac{\partial \log \mathcal{M}_k}{\partial \log P_k}$ all we need is the sign of $\frac{\partial HHI_k}{\partial P_k}$

$$HHI_k = \sum_{i=1}^{N_k}\left(\gamma_{i,k}\frac{P_{i,k}^{1-\rho}}{P_k^{1-\rho}}\right)^2$$

$$\rightarrow \frac{\partial HHI_k}{\partial P_k} = 2(\rho-1)P_k^{2\rho-3}\sum_{i=1}^{N_k}\left(\gamma_{i,k}P_{i,k}^{1-\rho}\right)^2 > 0$$

Therefore,

$$\frac{\partial \log \mathcal{M}_k}{\partial \log P_k} = \frac{\left(\frac{1}{\eta} - \frac{1}{\rho}\right)\frac{\partial HHI_k}{\partial P_k}}{1 + \frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta}HHI_k} > 0$$

We can define Λ_k as:

$$\Lambda_k = \frac{\partial \log \mathcal{M}_k}{\partial \log p_{s,k}} = -\frac{(\frac{1}{\rho} - \frac{1}{\eta})\frac{\partial \log HHI_k}{\partial \log p_k}}{\left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta}HHI_k\right]} < 0$$

$$\mathcal{M}_k = 1 + \left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta}HHI_k\right]^{-1} \tag{C.7}$$

Taking logs:

$$\log \mathcal{M}_k = \log \left(1 + \left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta} HHI_k \right]^{-1} \right) \approx \log \left(\left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta} HHI_k \right]^{-1} \right)$$

$$\log \mathcal{M}_k = -\log \left(\left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\rho} HHI_k \right] \right)$$

Differentiating

$$\partial \log \mathcal{M}_k = -\partial \log \left(\left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta} HHI_k \right] \right) = -\frac{(\frac{1}{\rho} - \frac{1}{\eta}) \frac{\partial \log HHI_k}{\partial \log p_k} \partial \log p_k}{\left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\eta} HHI_k \right]}$$

$$\Lambda_k = \frac{\partial \log \mathcal{M}_k}{\partial \log p_k} = -\frac{(\frac{1}{\rho} - \frac{1}{\eta}) \frac{\partial \log HHI_k}{\partial \log p_k}}{\left[\frac{1}{\rho}(HHI_k - 1) - \frac{1}{\rho} HHI_k \right]} < 0$$

□

C.6.4 Market Level Outcomes

$$R_k = P_k^{1-\eta} D_k$$

$$\frac{\partial \log R_k}{\partial \log \tau_v} = m_{v,k} \frac{1}{1 + \Lambda_k} (1 - \eta)$$

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

$$R_k = \frac{1}{\mathcal{M}_k^{\rho-1}} \frac{\varphi^{\rho-1}}{h^{\rho-1}} P_k^{\rho-\eta} D_k, \tag{C.8}$$

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

$$\frac{\partial \log R_k}{\partial \log \tau_k} = (\rho - 1) \sum_k \frac{R_k}{R} \frac{1}{1 + \Lambda_k} m_v > 0, \tag{C.9}$$

which is positive if $\rho > 1$. The Λ_k 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.

$$\frac{\partial \log M}{\partial \log \tau_v} = -m_v \left[\rho \sum_k \frac{Q_k}{Q} \frac{1}{1 + \Lambda_k} - 1 \right] \leq 0, \tag{C.10}$$

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.

$$\Sigma_{X,M} = \frac{\frac{\partial \log R_{sk}}{\partial \log \tau_k}}{\frac{\partial \log M}{\partial \log \tau_v}} = \frac{\partial \log R_k}{\partial \log M} = \frac{(1-\rho)\sum_k \frac{R_k}{R}\left[\frac{1}{1+\Lambda_k}\right]}{(1-\rho)\left[\sum_k \frac{Q_k}{Q_k}\frac{1}{1+\Lambda_k}\right]} > 0, \tag{C.11}$$

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.*

$$R_k = \frac{1}{\mathcal{M}_k^{\rho-1}}\frac{\varphi^{\rho-1}}{h^{\rho-1}} P_k^{\rho-\eta} D_k \tag{C.12}$$

$$\frac{\partial \log R_k}{\partial \log \tau_k} = (\rho - 1)\sum_k \frac{R_k}{R}\frac{1}{1+\Lambda_k} m_v > 0 \tag{C.13}$$

If $\rho > 1$ that equation is positive. Inside the Λ_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.*

$$\frac{\partial \log M}{\partial \log \tau_v} = -m_v\left[\rho\sum_k \frac{Q_k}{Q}\frac{1}{1+\Lambda_k} - 1\right] \leq 0 \tag{C.14}$$

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,*

$$\Sigma_{X,M} = \frac{\frac{\partial \log R_k}{\partial \log \tau_k}}{\frac{\partial \log M}{\partial \log \tau_v}} = \frac{\partial \log R_k}{\partial \log M} = \frac{(1-\rho)\sum_k \frac{R_k}{R}\left[\frac{1}{1+\Lambda_k}\right]}{(1-\rho)\left[\sum_k \frac{Q_k}{Q_k}\frac{1}{1+\Lambda_k}\right]} > 0$$

D Appendix: Quantitative

D.1 Simulation Setup and Theoretical Mapping

In this section, we outline the steps to reproduce regression 6.2 from the paper within a theoretical simulation framework. The regression of interest is given by:

$$\Delta \log(Expo_{i,s,k,t}) = \beta_1 \Delta CostShock_{i,t} + \beta_2 \Delta CostShock_{i,t} \cdot s_{i,k,t-1} + \gamma s_{i,k,t-1} + \gamma_{i,t} + \gamma_{s,k,t} + \Delta e_{i,s,k,t}$$

This empirical specification captures how firm-level export growth responds to cost shocks, interacting with market share to account for heterogeneity in exposure and pricing behavior. In the simulation, we map the core elements of the regression as follows: firm-level exports correspond to $R_{i,k}$, defined as revenue from exports by firm i to market k; the cost shock is given by Δh_i, representing a change in marginal cost; and market share is denoted by $s_{i,k}$, capturing firm i's share of total sales in market k.

D.2 Equilibrium Conditions and Variables

To simulate the model and obtain the required variables, we rely on the following system of equations that characterizes the equilibrium outcome for prices, revenues, and market shares. Firm-level exports relative to total market demand are determined by:

$$\frac{R_{i,k}}{D_k} = \left(\frac{1}{\mu_{i,k}^{\rho-1}}\right)\left(\frac{\varphi_i}{h_i}\right)^{\rho-1} P_k^{\rho-\eta} \tag{D.1}$$

The markup of firm i in market k is defined as:

$$\mu_{i,k} = 1 + \left(\frac{1}{\rho}(s_{j,k} - 1) - \frac{1}{\eta}s_{i,k}\right)^{-1} \tag{D.2}$$

The price index in market k is a CES aggregator:

$$P_k = \left(\sum_i \gamma_{i,k} P_{i,k}^{1-\rho}\right)^{\frac{1}{1-\rho}} \tag{D.3}$$

Firm i's market share in market k is given by:

$$s_{i,k} = \gamma_{i,k}\left(\frac{P_{i,k}}{P_k}\right)^{1-\rho} \tag{D.4}$$

Firm-level prices relate to markups and marginal cost:

$$P_{i,k} = \frac{\sigma_{i,k}}{\sigma_{i,k} - 1} c_i \tag{D.5}$$

The demand elasticity faced by firm i in market k is:

$$\sigma_{i,k} = \left(\frac{1}{\rho}(1 - s_{i,k}) + \frac{1}{\eta}s_{i,k}\right)^{-1} \tag{D.6}$$

Marginal cost is defined as:

$$c_i = \frac{h_i}{\varphi_i} \tag{D.7}$$

The variable $\mu_{i,k}$ captures firm-level markup behavior. Note that $s_{j,k}$ refers to the average or residual market share held by all other firms in market k.

D.3 Solving the System

The simulation iteratively solves the system above to compute equilibrium values. Equations (D.7) and related expressions involving h_i and φ_i are exogenously defined. The remaining equations form a nonlinear system dependent on market shares and prices.

The model is solved by initializing a guess for either $P_{i,k}$ or $s_{i,k}$ and iterating until convergence. Once convergence is reached, we compute all endogenous variables—revenues, prices, markups, and market shares. These values are then used to simulate regression outcomes under alternative parameterizations and to compare with empirical coefficients β_1 and β_2 in estimation exercises.

This approach allows us to structurally interpret the regression coefficients through the lens of model fundamentals and perform robust counterfactuals by manipulating the distribution of productivity, costs, and market shares.

D.4 Simulation Parameters

Model Size. We define each market as the unique combination of (1) calendar year, (2) six-digit product code (HS6), and (3) destination country. Applying this definition to our dataset yields 4,346 distinct markets. We then compute the mean number of sellers per market, which is 200.

Costs Distribution. To characterize the distribution of unit export costs, we compute for each shipment the ratio of cost, insurance, and freight (CIF) value to the free-on-board (FOB) value. We then calculate the sample mean and standard deviation of this unit-cost measure, obtaining a mean of 693 and a standard deviation of 1,181.

Productivity and Taste Shocks. We draw productivity and taste shocks from a Pareto distribution to capture the heavy tails observed in data at the firm level, reflecting the coexistence of a few large and very productive firms alongside many small ones. We set the Pareto shape parameter $\alpha = 4$ based on the estimates in Head et al. (2014), Melitz and Redding (2013), and Nigai (2017).

D.5 Simulation steps

1. Guess a vector of shares for market k (first guess is equal shares)
2. Find prices given that vector of shares
3. Update shares and compare with guessed ones
4. Repeat until shares converge

D.6 Indirect Inference steps

1. Guess a pair of ρ and η
2. Solve the model before and after the shock
3. Get betas from regression with simulated data
4. Compare with the actual beta values

5. Repeat until the coefficients converge