UNIVERSITY OF ALBERTA
FACULTY OF ARTS
Department of Economics

Working Paper No. 2020-10

Export Conditions in Small Countries and their Effects On Domestic Markets

Martin Alfaro
University of Alberta

Frederic Warzynski
Aarhus University

July 2020

Export Conditions in Small Countries and their Effects on Domestic Markets

Martin Alfaro*
University of Alberta

Frederic Warzynski†
Aarhus University

July 2020

Abstract

This paper studies the impact of better export access on the domestic economy of small countries, where firms of all sizes commonly export due to the limited size of the home market. We propose and estimate a model where small firms, characterized as in monopolistic competition, coexist with large granular firms making quality investments. In our framework, better export access benefits large firms by expanding their sales volume and, hence, reducing their average quality costs. Simultaneously, they are adversely affected by increased domestic competition following entry by small firms. Estimating the model for several Danish industries shows that, while some large firms benefit from better export access, others are severely hurt by the tougher competition at home. In some cases, the latter effect is so pronounced that domestic market share is reallocated towards small firms and total industry profits decrease.

Keywords: large firms, small firms, quality, export access, small economy, Denmark.
JEL codes: F12, F14, L11.

*University of Alberta, Department of Economics. 9-08 HM Tory Building, Edmonton, AB T6G 2H4, Canada; email: malfaro@ualberta.ca. Link to personal website. Funding from University of Alberta is acknowledged (Project RES0045975).

†Aarhus University, Department of Economics, Fuglesangs Allé 4, 8210 Aarhus V, Denmark; email: fwa@econ.au.dk. Link to personal website.

1 Introduction

Businesses in small countries are generally constrained by the size of their home market. Due to this, it is common for both small and large firms to export, which determines that better access to foreign markets affects firms of different sizes.[1] Given this, how does better export access differentially affect each firm's decisions? And, what is the impact that this has on the home market? In this paper, we address these questions using a framework with coexistence of small firms (SFs) and large firms (LFs), in the spirit of Shimomura and Thisse (2012) and Parenti (2018).

Relative to standard models with firm heterogeneity, partitioning firms enriches the analysis in several dimensions. First, it allows us to separate mechanisms by which an export shock affects the domestic market, according to how SFs and LFs are affected. In addition, it makes it possible to treat LFs as granular entities with idiosyncratic features, without imposing a specific model relation between productivity and exporting. In our model, this determines that an export shock might actually benefit or hurt LFs in equilibrium, entailing quite different consequences for the home market.

Formally, we posit a market structure where an exogenous number of heterogeneous non-negligible firms is embedded into a monopolistic-competition setup à la Melitz (2003). Thus, SFs are characterized as entrepreneurs that explore their possibilities in the industry and make entry decisions with uncertainty about their profitability. Eventually, they either do not succeed and exit the market, or survive and operate as negligible firms, with the most productive ones even exporting.

As for LFs, they are regarded as well-established businesses that know their efficiency, are leaders in their domestic industry, and earn positive profits. Moreover, consistent with a Schumpeterian view, we suppose that only these firms innovate.[2] In our framework, this takes the form of fixed sunk expenditures that shift a LF's demand outward in each country and increase the consumers' willingness to pay. Although we refer to these expenditures as investments on quality, they should be understood in a broad sense: they encompass outlays on a disparity of instruments such as product overhauls, after-sales services, and brand image. Thus, quality constitutes a shorthand for any appealing feature of a firm's variety that involves paying a fixed cost and affects all the countries served simultaneously.

Importantly, the assumption that quality investments require fixed outlays makes it possible

[1] In addition to the evidence that we present for Denmark, see Mayer and Ottaviano (2008) for patterns regarding several small European countries.

[2] This is in line with empirical studies showing that larger firms tend to innovate more. See, for instance, Blundell et al. (1999) and the survey on R&D expenditures by Cohen (2010).

to capture scale effects due to cost spreading. Specifically, a greater volume of sales spreads quality costs among more units and, hence, decreases the average cost of quality. This provides a LF with incentives to upgrade quality which, in turn, affects all the markets served by making its variety more appealing.[3]

In Section 3, we study the model mechanisms through which an export shock impacts a domestic industry. We begin by investigating the effects of reductions in export trade costs that affect only SFs or LFs. These shocks highlight how the model exhibits different adjustment mechanisms according to the type of firm that is affected.

First, a decrease in export trade costs applying solely to SFs fosters entry to the industry by affecting their expected profitability, thus creating tougher competitive conditions in the domestic market. This induces LFs to reduce their domestic prices and, also, to downgrade quality, since stiffer competition at home reduces their total sales and, hence, increases the costs per unit of quality. Overall, this shock determines that LFs lose profits and, simultaneously, generates a reallocation of domestic market share from LFs towards SFs.

Second, decreases in export trade costs that apply exclusively to LFs triggers effects through increases in the sales of each LF. By reducing average quality costs, this provides a LF with incentives to raise quality, which increases the appeal of its variety at home and, hence, allows it to charge higher domestic prices and markups. Relative to the previous shock, this one creates the opposite effect: LFs increase their domestic presence and earn greater profits, while SFs are crowded out from the market.

In addition, we consider an export shock to all firms, whose impact on the home market can be understood as a simultaneous combination of export shocks to each type of firm. Given that they lead to opposite effects on the decisions of LFs, the total impact is theoretically indeterminate and it constitutes an empirical matter to determine which effect dominates. Thus, after laying out the procedure to estimate the model in Section 4, in Section 5 we conduct an empirical assessment of how better export opportunities affect Danish manufacturing.

Denmark is a particularly suitable choice for several reasons. First, it constitutes a small highly-open economy where exporting is pervasive even among SFs: in manufacturing, about half of them are exporters and have an average export intensity of around 25%. Second, a market structure with coexistence of SFs and LFs is representative, with industries that display this feature accounting for more than 80% of the total manufacturing revenue. Finally, the country has undergone a process of reindustrialization since the 1980s, where product innovation has played an important role. Before this period, Danish firms were concentrated in sectors charac-

[3]There is a large literature that posits this mechanism, which goes back to, at least, Schmookler (1966). Moreover, it has also been corroborated empirically in several studies. In this respect, see in particular the seminal papers by Cohen and Klepper (1996a; 1996b), who empirically test the cost-spreading hypothesis.

terized by low technology and growth, which rendered businesses vulnerable to the emergence of new low-cost competitors. Since then, with the aim of avoiding cost competition, there has been a reorientation towards high-tech industries with knowledge-intensive activities. This has been characterized by firms deploying a product-differentiation strategy with specialization in niche markets (Schwartz 2001, Campbell and Pedersen 2007, Ornston 2012).

Our empirical analysis is performed by structurally estimating the model for a representative Danish manufacturing industry and some specific sectors. Moreover, the focus is on the empirical outcomes following better export access for all firms, given its indeterminate impact on LFs.

Empirically, we show that the magnitude of effects at home can be inferred through the export intensity of firms, which reflects the relative importance that domestic and export markets have for each firm. Specifically, regarding SFs, their export intensity determines the extent to which competition becomes tougher. This follows because the greater their export intensity, the greater the increase in a SF's expected profits due to an export shock; this, in turn, induces a more pronounced entry to the industry and, hence, a more marked decrease in the domestic price index. As for LFs, an export shock to all firms affects them through both tougher domestic conditions and better conditions to export. Therefore, when a LF has a greater export intensity, it benefits more from scale effects due to better export opportunities and, simultaneously, is more shielded from tougher domestic competition.

Our results for a representative Danish manufacturing industry indicate that, given the distribution of the firms' export intensities, an export shock to all firms make each LF increases its quality investments and, also, enjoys greater profits. Moreover, LFs as a group gain presence at home, although this masks the heterogeneity of LFs, where each is differentially impacted from better export access and tougher domestic competition. Thus, the top LF, which has a relatively higher export intensity, gains domestic market share and increases prices at home. On the contrary, the rest of LFs, which have a relatively greater home bias, end up with less presence domestically and are forced to charge lower domestic prices, in spite of their rise in quality.

Furthermore, we analyze the outcomes arising in some of Denmark's top sectors according to revenues, expenditures, and exports. The results for these cases highlight how the idiosyncratic features of LFs can lead to starkly different outcomes within and across industries.

First, we consider Food & Beverages. A representative Danish industry in this sector is characterized by LFs having a great home bias in their sales and SFs displaying high export intensity. This implies that an export shock to all firms creates a pronounced increase in domestic competition and, concurrently, that LFs do not substantially benefit from scale effects due to better export access. Due to this, even though LFs increase their quality investments (with the exception of one LF that slightly decreases them), they all lose domestic market share, which is reallocated towards SFs. In addition, the fact LFs are primarily affected by tougher domestic competition determines that the industry's total profits decrease.

Second, we obtain results for Chemicals. One of the distinctive features of this sector is that SFs are even more export-oriented than the other cases analyzed. In addition, LFs exhibit a high degree of heterogeneity in terms of their export intensities, precluding a general characterization of these firms and, hence, of how they are impacted by an export shock to all firms. This can be clearly demonstrated by comparing how the top two Danish firms of the sector. Regarding the top LF, its export revenues considerably surpass its domestic sales, determining that it substantially upgrades its quality. Consequently, this firm gains domestic market share, charges higher markups, and garners greater profits. Instead, the second top LF is mainly oriented to the local market. As a corollary, an export shock to all firms represents primarily tougher domestic competition for this firm, making it downgrade quality and charge lower markups. Thus, its domestic market share becomes lower and it ends up even losing profits.

Our paper is related to a vast literature analyzing the relation between exports and firms' decisions. First, it touches upon empirical studies exploring the heterogeneous responses of firms following an export shock, as in, for instance, Lileeva and Trefler (2010), Bustos (2011), and Bonfiglioli et al. (2018). Also, in terms of mechanisms, our model highlights that, in equilibrium, an export shock might trigger opposing effects on investments, as in Baldwin and Robert-Nicoud (2008), Aghion et al. (2018), and Grossman and Helpman (2018), among the most recent papers. Furthermore, it is related to structural estimations exploring the effects of an export shock on investments under firm heterogeneity, as in Costantini and Melitz (2008), Atkeson and Burstein (2010) and Impullitti and Licandro (2018), including models with granular firms, as in Eaton et al. (2012) and Gaubert and Itskhoki (2018).

Relative to these papers, and in particular regarding structural estimations, our approach has some key differences. Firstly, we follow Shimomura and Thisse (2012) and Parenti (2018) by partitioning firms according to their size. In this respect, we extend their setups to incorporate quality investments and, with the goal of estimating the model, we account for firm heterogeneity. Given the focus on a small country, where exporters encompass SFs and LFs, partitioning firms allows us to distinguish between mechanisms operating through firms that are affected differently by an export shock. In addition, it makes it possible to separately calibrate their features and, in particular, their export intensities. Thus, the calibration of the SFs' export intensity excludes that of LFs, which tends to be greater and would affect the predicted magnitude of entry following an export shock. In addition, the pronounced heterogeneity across each LF's export intensity determines that an export shock primarily represents an expansion of market size for some firms, and tougher domestic competition for others. Consequently, the framework allows for a range of possible outcomes across and within industries according to the distribution of the LFs' export intensities.

2 Setup

We consider a world economy with a set of countries $\mathcal{C}$ and suppose that there is an arbitrary number of them. Throughout this section, we describe the model by using countries indices $i, j \in \mathcal{C}$. In some cases, in order to avoid any confusion, we emphasize that i and j apply to all countries.

Regarding notation, any variable subscript ij refers to i as the origin country and j as the destination country. Furthermore, all the derivations and proofs of this paper are relegated to Appendix A.

2.1 Generalities of the Setup

In each country i, there is a unitary mass of identical agents that are immobile across countries. Moreover, labor is the only production factor and each agent offers a unit of labor inelastically. We suppose the existence of two sectors, where one of them consists of a differentiated good. The other comprises a homogeneous good that is produced and sold in each country under perfect competition. We take this as the numéraire and suppose that its technology of production determines wages w_i in each country i.

The differentiated industry comprises a set of single-product firms $\overline{\Omega}_i$ for each i that can potentially serve any country j with a unique variety. The coexistence of different types of firms is introduced into the model by partitioning each $\overline{\Omega}_i$ into a finite set $\overline{\mathscr{L}}_i$ and a real interval $\overline{\mathcal{N}}_i$. Each of these sets comprises firms of different size and their letters are mnemonics for "large" and "negligible", respectively. We refer to any firm $\omega \in \overline{\mathscr{L}}_i$ as a LF from i, and a firm $\omega \in \overline{\mathcal{N}}_i$ as a SF from i.

Formally, we partition firms by defining a measure μ over $\cup_{k \in \mathcal{C}} \overline{\Omega}_k$ that captures a firm's size. This is such that, for $\omega \in \overline{\Omega}_i$, either $\mu(\{\omega\}) > 0$, in which case $\omega \in \overline{\mathscr{L}}_i$, or $\mu(\{\omega\}) = 0$, in which case $\omega \in \overline{\mathcal{N}}_i$. Essentially, this measure indicates whether firm ω can influence the price index of a country or is negligible relative to the aggregate conditions of its industry.

Moreover, in terms of notation, we denote by Ω_{ji} the subset of varieties from j sold in i, with $\Omega_i := \cup_{k\in\mathcal{C}}\Omega_{ki}$ being the total varieties available in i. Likewise, $\Omega_{ji}^{\mathcal{N}} := \overline{\mathcal{N}}_j \cap \Omega_{ji}$ and $\Omega_{ji}^{\mathscr{L}} := \overline{\mathscr{L}}_j \cap \Omega_{ji}$ are, respectively, the subsets of varieties available in i that are produced by SFs and LFs from j.

2.2 Supply Side

Regarding SFs from i, they are ex-ante identical and do not know their productivity. By paying a sunk entry cost F_i, each receives a productivity draw φ and an assignation of a unique variety. We suppose that productivity is a continuous random variable that has non-negative support $\left[\underline{\varphi}_i^{\mathcal{N}}, \overline{\varphi}_i^{\mathcal{N}}\right]$ and a cumulative distribution function G_i. Besides, the mass of SFs that pay the entry cost is denoted by M_i^E.

As for LFs from i, there is an exogenous number of them, with each having assigned a unique variety $\omega \in \overline{\mathscr{L}}_i$ and productivity φ_ω that is common knowledge across the world. We suppose that $\varphi_\omega > \overline{\varphi}_i^{\mathcal{N}}$ for any $\omega \in \overline{\mathscr{L}}_i$, so that any LF from i is more productive than the most productive SFs from i. This implies that, since we consider equilibria with active SFs, each LF always serves its domestic market.

Regarding production costs, a firm ω with productivity φ_ω that serves j from i produces with constant marginal costs $c\left(\varphi_\omega, \tau_{ij}^\omega\right) := \frac{w_i}{\varphi}\tau_{ij}^\omega$, where τ_{ij}^ω are trade costs such that $\tau_{ii}^\omega := 1$, $\tau_{ij}^\omega := \tau^\omega\tau_{ij}$ if $j \neq i$, and where we allow for the possibility that $\tau^\omega = \infty$. Besides, for SFs from i, we suppose that τ^ω is symmetric and denote it $\tau^{\mathcal{N}_i}$, while τ_{ij}^ω is denoted by $\tau_{ij}^{\mathcal{N}}$.

This structure entails that trade costs for each type of firm can be decomposed into a firm-specific component (τ^ω) and a common component (τ_{ij}). This serves two purposes. First, by distinguishing between the trade costs of SFs and LFs, we are able to investigate the effects of export shocks that are specific to a group of firms. Specifically, it enables us to explore the impact of better export access that applies to only SFs (by varying $\tau^{\mathcal{N}_i}$), to only LFs (by varying τ^ω for each $\omega \in \overline{\mathscr{L}}_i$), or to all firms (by varying τ_{ij}). Second, the fact that the trade costs of LFs are firm-specific allows for scenarios where a LF has greater domestic sales relative to other domestic firms, without implying that its exports are greater too, or that it exports at all. In this way, we do not impose any restriction on the export intensity of LFs, which is crucial for results.

As for the market stage, LFs from i and the mass M_i^E of SFs decide whether to pay an overhead fixed cost f_{ij} and serve country j. Regarding SFs, we suppose that each firm sells a variety with some exogenous quality level $z_i^{\mathcal{N}}$. In contrast, each LF ω from i makes a decision on the quality of its variety, z_i^ω, which affects every market served and entails sunk expenditures $f_i^z z_i^\omega$. In addition, each firm ω sets a price p_{ij}^ω, where $p_{ij}^\omega = \infty$ captures that the firm does not serve $j \neq i$. We denote the mass of SFs from i that are active in j by M_{ij}, and define $\mathbf{x}_{ij}^{\omega} := \left(p_{ij}^{\omega}, z_i^{\omega}\right)$ and $\mathbf{x}_{ij} := \left(\mathbf{x}_{ij}^{\omega}\right)_{\omega \in \Omega_{ij}}$.

2.3 Demand Side

Preferences are identical for each country i and represented by a two-tier utility function, with an upper-tier that is quasilinear between the homogeneous and differentiated good. Denoting $\mathbb{Q}_i^0$ the quantity consumed of the homogeneous good and $\mathbb{Q}_i$ the quantity index of the differentiated good, this is given by

$$U_i := E_i \ln\left(\mathbb{Q}_i\right) + \mathbb{Q}_i^0$$

where $E_i > 0$. Moreover, the budget constraint is $Y_i = \mathbb{Q}_i^0 + \mathbb{P}_i \mathbb{Q}_i$, where Y_i is country i's income and $\mathbb{P}_i$ the price index of the differentiated good in i. Assuming that income is high enough that there is consumption of both goods, the optimal expenditure on the differentiated good is $\mathbb{P}_i \mathbb{Q}_i = E_i$. A corollary of this is that any variation in income is absorbed by the homogeneous sector.

In terms of preferences for the differentiated good, we suppose they are given by an augmented CES sub-utility function:

$$\mathbb{Q}_i := \left\{ \sum_{k \in \mathcal{C}} \left[\int_{\omega \in \overline{\Omega}_k} \left[\left(z_k^{\omega}\right)^{\frac{\delta}{\sigma - 1}} Q_{ki}^{\omega} \right]^{\frac{\sigma - 1}{\sigma}} \mathrm{d}\mu\left(\omega\right) \right] \right\}^{\frac{\sigma}{\sigma - 1}}, \tag{1}$$

where $\sigma > 1$, $\delta \in (0, 1)$, and Q_{ki}^{ω} is the quantity consumed of the variety ω produced in k and sold in i.

Next, we add some structure to μ such that expressions like (1) can encompass monopolistic and oligopolistic scenarios as special cases. This requires us to define μ so that $\mathbb{Q}_i$ can be expressed through an integral when there are no LFs, and through sums if there are no negligible firms. Formally, this can be accomplished by defining $\mu(\cdot) := \ell\left[\cdot \cap \left(\cup_{k \in \mathcal{C}} \overline{\mathcal{N}}_k\right)\right] + \#\left[\cdot \cap \left(\cup_{k \in \mathcal{C}} \overline{\mathscr{L}}_k\right)\right]$. where ℓ is the Lebesgue measure and $\#$ the counting measure. This definition implies that (1) is equivalent to the following expression:

$$\mathbb{Q}_i = \left\{ \sum_{k \in \mathcal{C}} \left[\int_{\omega \in \overline{\mathcal{N}}_k} \left[\left(z_k^{\mathcal{N}}\right)^{\frac{\delta}{\sigma - 1}} Q_{ki}^{\omega} \right]^{\frac{\sigma - 1}{\sigma}} \mathrm{d}\omega + \sum_{\omega \in \overline{\mathscr{L}}_k} \left[\left(z_k^{\omega}\right)^{\frac{\delta}{\sigma - 1}} Q_{ki}^{\omega} \right]^{\frac{\sigma - 1}{\sigma}} \right] \right\}^{\frac{\sigma}{\sigma - 1}}.$$

Routine calculations determine that the optimal demand in i of a firm ω from j is given by

$$Q_{ji}\left(\mathbf{x}_{ji}^{\omega}, \mathbb{P}_i, E_i\right) := E_i \left(\mathbb{P}_i\right)^{\sigma - 1} \left(p_{ji}^{\omega}\right)^{-\sigma} \left(z_j^{\omega}\right)^{\delta}, \tag{2}$$

where $\mathbb{P}_j$ is the price index in j. Equation (2) provides an interpretation for δ: for a given value of the price index, it constitutes the quality elasticity of demand. More generally, for a non-negligible firm, which has an impact on the price index, the quality elasticity becomes $\delta\left(1-s_{ij}^{\omega}\right)$.

As for the price-index function in j, this is formally defined by

$$\mathbb{P}_i\left[(\mathbf{x}_{ki})_{k\in\mathcal{C}}\right] := \left[\sum_{k\in\mathcal{C}}\int_{\omega\in\Omega_{ki}}\left(p_{ki}^{\omega}\right)^{1-\sigma}\left(z_k^{\omega}\right)^{\delta}\mathrm{d}\mu\left(\omega\right)\right]^{\frac{1}{1-\sigma}}. \tag{3}$$

Given the definition of μ, which enables us to translate expressions like (3) into sums and integrals, this is equivalent to

$$\mathbb{P}_i\left[(\mathbf{x}_{ki})_{k\in\mathcal{C}}\right] = \left\{\sum_{k\in\mathcal{C}}\left[\int_{\omega\in\Omega_{ki}^{\mathcal{N}}}\left(p_{ki}^{\omega}\right)^{1-\sigma}\left(z_k^{\mathcal{N}}\right)^{\delta}\mathrm{d}\omega+\sum_{\omega\in\Omega_{ki}^{\mathcal{L}}}\left(p_{ki}^{\omega}\right)^{1-\sigma}\left(z_k^{\omega}\right)^{\delta}\right]\right\}^{\frac{1}{1-\sigma}}.$$

Also, using the optimal quantity demanded, we can obtain expressions for expenditure-based market shares and the price elasticity of demand. As for the former, the market share in j of a firm ω from i is defined by $s_{ij}^{\omega} := \frac{R_{ij}^{\omega}}{E_j}$, where $R_{ij}^{\omega} := p_{ij}^{\omega}Q_{ij}^{\omega}$ are ω's sales in j. Notice that, given this definition, $R_{ij}^{\omega} = E_i s_{ij}^{\omega}$ and, so, it can be expressed as a function $R\left(E_i, s_{ij}^{\omega}\right)$. Moreover, using (2), s_{ij}^{ω} can be expressed as the following function:

$$s\left(\mathbf{x}_{ij}^{\omega},\mathbb{P}_j\right) := \frac{\left(p_{ij}^{\omega}\right)^{1-\sigma}\left(z_i^{\omega}\right)^{\delta}}{\mathbb{P}_j^{1-\sigma}}. \tag{4}$$

Regarding the price elasticity of demand in j of a firm ω from i, it is given by $\varepsilon_{ij}^{\omega} := \left|\frac{\mathrm{d}\ln Q_{ij}^{\omega}}{\mathrm{d}\ln p_{ij}^{\omega}}\right|$. This establishes that $\varepsilon_{ij}^{\omega}$ is $\varepsilon\left(s_{ij}^{\omega}\right) := \sigma + s_{ij}^{\omega}\left(1-\sigma\right)$ if ω is a LF, while $\varepsilon_{ij}^{\omega} = \sigma$ if ω is a SF.

Throughout the paper, we assume that $\varepsilon_{ij}^{\omega}\left(1-s_{ij}^{\omega}\right)-s_{ij}^{\omega} > 0$ for any $i, j \in \mathcal{C}$, which holds as long as s_{ij}^{ω} is not disproportionately large, as is the case in the Danish data for domestic firms.[4] This allows us to obtain some definite results when we perform comparative statics and, more generally, rules out some counterintuitive results that arise in models with LFs under a CES demand.

2.4 Equilibrium

In this section, we state the equilibrium conditions. They are expressed in a particular way so that we can exploit the existence of single sufficient statistics. Specifically, in terms of endogenous variables, we show that all optimal choices can be expressed as functions of market shares. In turn, market shares are a function of $\mathbf{P} := \left(\mathbb{P}_k\right)_{k\in\mathcal{C}}$ which, conditional on it, are

[4] For instance, given $\sigma := 3.53$, which is the value for our representative Danish manufacturing industry, it is satisfied as long as no firm has a market share greater than 70%.

independent of $\mathbf{M}^E := \left(M_k^E\right)_{k\in\mathcal{C}}$.

Throughout the paper, since our focus is on analyzing outcomes in a market structure where SFs and LFs coexist, we only consider equilibria in which there is always a positive mass of active SFs in i. Furthermore, we suppose that the parameters of the model are such that some SF are exporters and, additionally, there is selection into exporting. Consequently, only the most profitable SFs serve foreign markets. Finally, we also assume that any SF that exports also finds it profitable to serve its domestic market.

Consider a LF ω from i. Its total profits are given by

$$\pi_i^\omega := \sum_{k\in\mathcal{C}} \pi_{ik}^\omega = \sum_{k\in\mathcal{C}} \left\{ E_k \left(\mathbb{P}_k \left[\left(\mathbf{x}_{jk}\right)_{j\in\mathcal{C}} \right] \right)^{\sigma-1} \left(p_{ik}^\omega\right)^{-\sigma} \left(z_i^\omega\right)^\delta \left(p_{ik}^\omega - c_{ik}^\omega\right) - f_{ik} \right\} - f_i^z z_i^\omega,$$

and it chooses $(p_{ik}^\omega)_{k\in\mathcal{C}}$ and z_i^ω by maximizing π_i^ω. When it is active in j, its optimal price p_{ij}^ω satisfies

$$p_{ij}^\omega = m\left(s_{ij}^\omega\right) c_{ij}^\omega, \tag{5}$$

where $m\left(s_{ij}^\omega\right) := \frac{\varepsilon\left(s_{ij}^\omega\right)}{\varepsilon\left(s_{ij}^\omega\right)-1}$ is ω's markup in j. We denote the implicit solution to (5) by $p^\omega\left(s_{ij}^\omega; \tau_{ij}\right)$.

As for quality, z_i^ω affects all countries served by ω simultaneously, making quality decisions interdependent across markets. By maximizing π_i^ω and utilizing that $R_{ik}^\omega = 0$ when country k is not served, the optimal level of quality is

$$z\left(\mathbf{s}_i^\omega\right) := \delta \sum_{k\in\mathcal{C}} \frac{R_{ik}^\omega}{\varepsilon_{ik}^\omega} \frac{\left(1 - s_{ik}^\omega\right)}{f_i^z}, \tag{6}$$

where $\mathbf{s}_i^\omega := (s_{ik}^\omega)_{k\in\mathcal{C}}$. In turn, by defining $I_i^\omega := f_i^z z_i^\omega$, we obtain ω's optimal quality investments:

$$I\left(\mathbf{s}_i^\omega\right) := \delta \sum_{k\in\mathcal{C}} \frac{R_{ik}^\omega}{\varepsilon_{ik}^\omega} \left(1 - s_{ik}^\omega\right). \tag{7}$$

Equation (6) formalizes the *cost-spreading property of investments*: greater total sales spread out f_i^z between more units, thus reducing the average quality cost and providing LFs with more incentives to upgrade quality. Likewise, equation (7) indicates that optimal investments can be interpreted in the following way: if firm ω were negligible, (7) would become $\delta\left(\sum_{k\in\mathcal{C}} \frac{R_{ik}^\omega}{\sigma}\right)$, where $\frac{R_{ik}^\omega}{\sigma}$ correspond to the optimal variable profits that ω would obtain in k. Thus, it indicates that the firm invests a fixed proportion $\delta \in (0,1)$ of its optimal variable profits in quality. In the general case where ω is non-negligible, the interpretation is similar, although (7) takes into account that investments also affect price indices, which is captured through the terms ε_{ik}^ω and $(1 - s_{ik}^\omega)$.

Notice that the optimal choices of each LF ω, i.e. prices (5) and quality (6), are expressed in a way that, regarding endogenous variables, they only depend on market shares. Thus, market shares act as sufficient statistics for each LF's choice.

As for market shares of LF ω from i, by evaluating (4) at its optimal choices, we obtain its optimal market share in j:

$$s_{ij}^{\omega}=\frac{\left[p^{\omega}\left(s_{ij}^{\omega};\tau_{ij}^{\omega}\right)\right]^{1-\sigma}\left[z\left(\mathbf{s}_{i}^{\omega}\right)\right]^{\delta}}{\left(\mathbb{P}_{j}\right)^{1-\sigma}}. \tag{8}$$

For each LF ω from i, the system of market-share equations (8) for each j determines an implicit solution for s_{ij}^{ω}, which we denote by $s_{ij}^{\omega}\left[\mathbf{P};\left(\tau_{ik}^{\omega}\right)_{k\in\mathcal{C}}\right]$.

As for a SF ω from i, it has profits in j given by

$$\pi_{ij}^{\omega}:=E_{j}\left(\mathbb{P}_{j}\right)^{\sigma-1}\left(p_{ij}^{\omega}\right)^{-\sigma}\left(z_{i}^{\mathcal{N}}\right)^{\delta}\left(p_{ij}^{\omega}-\frac{\tau_{ij}^{\mathcal{N}}w_{i}}{\varphi}\right)-f_{ij},$$

which determines that the optimal prices for SFs with productivity φ are also given by (5), but with constant markups $\frac{\sigma}{\sigma-1}$. We denote them by $p^{\mathcal{N}}\left(\varphi;\tau_{ij}^{\mathcal{N}}\right):=\frac{\sigma}{\sigma-1}\frac{\tau_{ij}^{\mathcal{N}}w_{i}}{\varphi}$. Therefore, the optimal profits in j of a SF from i with productivity φ become

$$\pi^{\mathcal{N}}\left(\mathbb{P}_{j},\varphi;\tau_{ij}^{\mathcal{N}}\right):=\frac{r\left(\mathbb{P}_{j},\varphi;\tau_{ij}^{\mathcal{N}}\right)}{\sigma}-f_{ij}.$$

where $r\left(\mathbb{P}_{j},\varphi;\tau_{ij}^{\mathcal{N}}\right):=E_{j}\left(\mathbb{P}_{j}\right)^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\frac{\tau_{ij}^{\mathcal{N}}w_{i}}{\varphi}\right)^{1-\sigma}\left(z_{i}^{\mathcal{N}}\right)^{\delta}$.

The survival productivity cutoff in j of SFs from i, denoted by φ_{ij}^{*}, is the solution to $\pi^{\mathcal{N}}\left(\mathbb{P}_{j},\varphi_{ij}^{*};\tau_{ij}^{\mathcal{N}}\right)=0$. Thus, it is given by the following function

$$\varphi^{\mathcal{N}}\left(\mathbb{P}_{j};\tau_{ij}^{\mathcal{N}}\right):=\frac{\left(z_{i}^{\mathcal{N}}\right)^{\frac{\delta}{1-\sigma}}\sigma w_{i}\tau_{ij}^{\mathcal{N}}}{\left(\sigma-1\right)\mathbb{P}_{j}}\left(\frac{\sigma f_{ij}}{E_{j}}\right)^{\frac{1}{\sigma-1}}. \tag{9}$$

Substituting the survival productivity cutoff in, the total revenues in j of SFs from i, denoted by $R_{ij}^{\mathcal{N}}$, are a function

$$R_{ij}^{\mathcal{N}}\left(\mathbb{P}_{j},M_{i}^{E};\tau_{ij}^{\mathcal{N}}\right):=M_{i}^{E}\int_{\varphi^{\mathcal{N}}\left(\mathbb{P}_{j};\tau_{ij}^{\mathcal{N}}\right)}^{\overline{\varphi}_{i}}r\left(\mathbb{P}_{j},\varphi;\tau_{ij}^{\mathcal{N}}\right)\,\mathrm{d}G_{i}\left(\varphi\right).$$

Likewise, the market share in j of SFs from i is given by a function

$$s_{ij}^{\mathcal{N}}\left(\mathbb{P}_{j},M_{i}^{E};\tau_{ij}^{\mathcal{N}}\right):=M_{i}^{E}\int_{\varphi^{\mathcal{N}}\left(\mathbb{P}_{j};\tau_{ij}^{\mathcal{N}}\right)}^{\overline{\varphi}_{i}}\frac{\left[p^{\mathcal{N}}\left(\varphi;\tau_{ij}^{\mathcal{N}}\right)\right]^{1-\sigma}\left(z_{i}^{\mathcal{N}}\right)^{\delta}}{\left(\mathbb{P}_{j}\right)^{1-\sigma}}\,\mathrm{d}G_{i}\left(\varphi\right).$$

Market clearing requires that the sum of optimal market shares in each country sums to one.

Formally, this is captured as follows. Let

$$S_i^{\mathcal{N}}\left[\mathbb{P}_i, \mathbf{M}^E; \left(\tau_{ki}^{\mathcal{N}}\right)_{k\in\mathcal{C}}\right] := \sum_{k\in\mathcal{C}} s_{ki}^{\mathcal{N}}\left(\mathbb{P}_i, M_k^E; \tau_{ki}^{\mathcal{N}}\right),$$
$$S_i^{\mathcal{L}}\left(\mathbf{P}; \boldsymbol{\omega}_{\cdot i}^{\mathcal{L}}\right) := \sum_{k\in\mathcal{C}} \sum_{\omega\in\Omega_{ki}^{\mathcal{L}}} s_{ki}^{\omega}\left(\mathbf{P}; \left(\tau_{kj}^{\omega}\right)_{j\in\mathcal{C}}\right),$$

where $\boldsymbol{\omega}_{\cdot i}^{\mathcal{L}}$ is the vector composed of each element in $\cup_{k\in\mathcal{C}}\Omega_{ki}^{\mathcal{L}}$, which reflects that the market share of each LF active in j depends on its idiosyncratic features. Using these definitions, the market-clearing condition in each i is

$$S_i^{\mathcal{N}}\left[\mathbb{P}_i, \mathbf{M}^E; \left(\tau_{ki}^{\mathcal{N}}\right)_{k\in\mathcal{C}}\right] + S_i^{\mathcal{L}}\left(\mathbf{P}; \boldsymbol{\omega}_{\cdot i}^{\mathcal{L}}\right) = 1, \tag{MS}$$

where "MS" is a mnemonic for "market stage", since it constitutes the equilibrium condition after industry entry decisions are made.

As for free entry, let $\pi_{ij}^{\mathbb{E},\mathcal{N}}$ denote the optimal expected profits in j of a SF from i. Substituting the survival productivity cutoff in, $\pi_{ij}^{\mathbb{E},\mathcal{N}}$ can be expressed as

$$\pi_{ij}^{\mathbb{E},\mathcal{N}}\left(\mathbb{P}_j; \tau_{ij}^{\mathcal{N}}\right) := \int_{\varphi^{\mathcal{N}}\left(\mathbb{P}_j;\tau_{ij}^{\mathcal{N}}\right)}^{\overline{\varphi}_i} \left[\pi^{\mathcal{N}}\left(\mathbb{P}_j, \varphi; \tau_{ij}^{\mathcal{N}}\right) - f_{ij}\right] \mathrm{d}G_i\left(\varphi\right).$$

Thus, the free-entry condition in i is

$$\pi_i^{\mathbb{E},\mathcal{N}}\left[\mathbf{P}; \left(\tau_{ik}^{\mathcal{N}}\right)_{k\in\mathcal{C}}\right] := \sum_{k\in\mathcal{C}} \pi_{ik}^{\mathbb{E},\mathcal{N}}\left(\mathbb{P}_k; \tau_{ik}^{\mathcal{N}}\right) = F_i. \tag{FE}$$

In summary, the equilibrium conditions have been expressed in a way that we can exploit separability properties and the existence of sufficient statistics. Specifically, all the equilibrium values can be obtained by pinning down $\left(\mathbf{P}^*, \mathbf{M}^{E*}\right)$ through the systems of equations comprising (MS) and (FE) for each $i \in \mathcal{C}$. In particular, $\mathbf{P}^*$ can be identified through (FE) with independence of $\mathbf{M}^{E*}$. Likewise, once that $\mathbf{P}^*$ is obtained, it is possible to solve for the system (8) and obtain solutions $s_{ij}^{\omega}\left[\mathbf{P}^*; (\tau_{ik}^{\omega})_{k\in\mathcal{C}}\right]$ for each LF ω. This allows us to determine optimal prices and quality investments by LFs, which are given by (5) and (7) respectively.

2.5 Small-Economy Assumption

We conclude the description of the equilibrium conditions by adding some structure to the country under analysis. Specifically, we denote it by H and suppose it is a small economy in the sense of Demidova and Rodríguez-Clare (2009; 2013). This definition establishes that changes in the domestic conditions of H and the actions of its firms do not affect the aggregate conditions of any foreign country. Formally, it implies that $\left(\mathbb{P}_j^*, M_j^{E*}\right)_{j\in\mathcal{C}\backslash\{H\}}$ is not impacted by a trade shock in H.[5] Notice that, even though the mass of incumbents for each foreign country is fixed, this does not rule out extensive-margin adjustments, since the survival productivity cutoff of foreign firms in H is still endogenous.

Regarding equilibrium conditions, the fact that H is a small country does not affect the optimal choices of any foreign LF or SF from any country. However, the optimal choices by LFs from H need to be modified relative to the baseline setup. This follows because no LF from H is capable of affecting the market conditions of any foreign country.

Consistent with the model we take to the data, from now on consider a framework with $\mathcal{C} := \{H, F\}$. Thus, F constitutes a composite country that represents the rest of the world. By incorporating that H is a small economy, investments in quality of a firm ω from H become

$$I_H^{\omega}\left(s_{HH}^{\omega}, s_{HF}^{\omega}\right) := \frac{R\left(s_{HH}^{\omega}\right)}{\varepsilon\left(s_{HH}^{\omega}\right)}\delta\left(1 - s_{HH}^{\omega}\right) + \frac{R\left(s_{HF}^{\omega}\right)}{\sigma}\delta. \tag{10}$$

Furthermore, while each LF ω's optimal domestic price is still given by (5), any LF from H behaves in F as if it were a SF, so that $p_{HF}^{\omega} = \frac{\sigma}{\sigma-1}c_{HF}^{\omega}$.

Finally, for future reference, we obtain an expression for $\overline{\pi}_H^{\omega}$, which we refer to as ω's gross profits. They correspond to ω's total profits net of quality costs but gross of market fixed costs, and are given by

$$\overline{\pi}_H^{\omega}\left(s_{HH}^{\omega}, s_{HF}^{\omega}\right) := \frac{R\left(s_{HH}^{\omega}\right)\left[1 - \delta\left(1 - s_{HH}^{\omega}\right)\right]}{\varepsilon\left(s_{HH}^{\omega}\right)} + \frac{R\left(s_{HF}^{\omega}\right)(1-\delta)}{\sigma}. \tag{11}$$

In addition, we define a measure of the industry's total gross profits:

$$\overline{\Pi}_H^{\mathscr{L}} := \sum_{\omega \in \overline{\mathscr{L}}_H} \overline{\pi}_H^{\omega}\left(s_{HH}^{\omega}, s_{HF}^{\omega}\right).$$

3 Mechanisms: Results and Illustrations

In this section, we investigate the consequences of better export access on the domestic market, focusing on the choices made by domestic firms. Specifically, we analyze the impact on the price index of H and several variables related to LFs from H: their domestic prices, quality investments, domestic market shares, and gross profits.

We consider export shocks to (i) all firms, (ii) only SFs, and (iii) only LFs. In particular, (ii) and (iii) lay bare the different mechanisms of adjustment according to the type of firm that is affected.

With the goal of providing clear explanations of the operating mechanisms, throughout this section we consider infinitesimal export shocks. Instead, when we estimate the model, we allow

[5] The small-country assumption can be rationalized through a framework where each country has a continuum of trading partners and H is part of it (see Alfaro 2019).

for arbitrary changes. The only difference between the two approaches lies in that, to estimate the model, large changes in export trade costs require assuming a productivity distribution for SFs. Nonetheless, all the results and explanations we provide also hold in that framework. In fact, given the productivity distribution we consider subsequently, the necessary information to take the model to the data is identical.

3.1 Partial Effects

In this part, we show how partial effects can be computed. In subsequent sections, we utilize these results to calculate the total effects due to export shocks as a sum of different partial effects. Furthermore, we demonstrate how the different effects can be expressed in terms of observables. This has the goal of gaining some intuition regarding the empirical approach, which is quite similar even when it is performed considering large export shocks.

Formally, we suppose infinitesimal variations of $\tau_{HF}^{\mathcal{N}}$ and τ_{HF}^{ω}, and express the impact on each variable in elasticity terms. Notice that, by determining the effects of these variables, we are also obtaining results for each export trade cost component, since $\frac{\partial \ln \tau_{HF}^{\mathcal{N}}}{\partial \ln \tau^{\mathcal{N}}{}_{H}} = \frac{\partial \ln \tau_{HF}^{\mathcal{N}}}{\partial \ln \tau_{HF}} = 1$ and $\frac{\partial \ln \tau_{HF}^{\omega}}{\partial \ln \tau^{\omega}} = \frac{\partial \ln \tau_{HF}^{\omega}}{\partial \ln \tau_{HF}} = 1$.

Regarding the domestic price index, we exploit that $\mathbb{P}_H$ is pinned down by (FE) for H, without the need to utilize any other equation or solve for any other endogenous variable. This also determines that, unlike what occurs with domestic decisions made by LFs, we are able to directly obtain the total variation of the price index rather than a partial effect.

By inspection of (FE) for H, it is revealed that $\mathbb{P}_H$ is not impacted by variations in τ_{HF}^{ω} for any LF ω. As we explain in more detail when we study total effects, this reflects that changes in decisions by LFs are offset by extensive-margin adjustments of SFs, leaving the competitive conditions unaltered.

On the other hand, changes in $\tau_{HF}^{\mathcal{N}}$ affect $\mathbb{P}_H$. Thus, differentiating (FE) for H establishes that:

$$\frac{\mathrm{d} \ln \mathbb{P}_H^*}{\mathrm{d} \ln \tau_{HF}^{\mathcal{N}}} = -\left(\frac{\mathrm{d} \ln \pi_{HH}^{\mathbb{E},\mathcal{N}}}{\mathrm{d} \ln \mathbb{P}_H} \right)^{-1} \frac{\mathrm{d} \ln \pi_{HF}^{\mathbb{E},\mathcal{N}}}{\mathrm{d} \ln \tau_{HF}^{\mathcal{N}}} = \frac{e_H^{\mathcal{N}}}{d_H^{\mathcal{N}}}, \tag{12}$$

where $d_H^{\mathcal{N}} := \frac{R_{HH}^{\mathcal{N}}}{R_{HH}^{\mathcal{N}} + R_{HF}^{\mathcal{N}}}$ and $e_H^{\mathcal{N}} := 1 - d_H^{\mathcal{N}}$ are the domestic and export intensities of SFs from H, respectively.

As for the partial effects of LF ω from H, we proceed in two steps for their characterization. First, notice that we have expressed ω's optimal prices and investments, (5) and (10), as functions of its market shares exclusively. In other words, conditional on a LF's market shares, its optimal choices do not depend on the endogenous variables $\left(\mathbb{P}_H, M_H^E\right)$. Thus, we characterize the partial effects of optimal choices in terms of endogenous variables through the changes in market shares. Second, regarding market shares (4), they only depend on $\mathbb{P}_H$ in terms of endogenous variables. Thus, conditional on a value for it, they are independent of M_H^E. Therefore, we characterize the partial effects on each market share through variations in the domestic price index. In all cases, we also describe the partial effect due to changes in export trade costs.

We start by describing how optimal choices are affected by market shares. Regarding quality investments of LF ω, conditional on its market shares, they do not depend directly on export trade costs. As for the effect due to variations in market shares, it can be computed in the following way:

$$\frac{\partial \ln I_H^\omega}{\partial \ln s_{HH}^\omega} = \frac{\partial \ln z_H^\omega}{\partial \ln s_{HH}^\omega} = \rho_{HH}^\omega \frac{\varepsilon_{HH}^\omega \left(1 - s_{HH}^\omega\right) - s_{HH}^\omega}{\varepsilon_{HH}^\omega \left(1 - s_{HH}^\omega\right)}, \tag{13a}$$

$$\frac{\partial \ln I_H^\omega}{\partial \ln s_{HF}^\omega} = \frac{\partial \ln z_H^\omega}{\partial \ln s_{HF}^\omega} = \rho_{HF}^\omega, \tag{13b}$$

where $\rho_{HH}^\omega := \frac{R_{HH}^\omega \left(1-s_{HH}^\omega\right)/\varepsilon_{HH}^\omega}{R_{HH}^\omega \left(1-s_{HH}^\omega\right)/\varepsilon_{HH}^\omega + R_{HF}^\omega/\sigma}$ and $\rho_{HF}^\omega := \frac{R_{HF}^\omega/\sigma}{R_{HH}^\omega \left(1-s_{HH}^\omega\right)/\varepsilon_{HH}^\omega + R_{HF}^\omega/\sigma}$, and, since we rule out extremely large market shares so that $\varepsilon_{HH}^\omega \left(1 - s_{HH}^\omega\right) - s_{HH}^\omega > 0$, it follows that $\frac{\partial \ln I_H^\omega}{\partial \ln s_{HH}^\omega} = \frac{\partial \ln z_H^\omega}{\partial \ln s_{HH}^\omega} > 0$.

The terms ρ_{HH}^ω and ρ_{HF}^ω satisfy $\rho_{HH}^\omega + \rho_{HF}^\omega = 1$ and represent the relative importance of market H and F in ω's total investments, respectively. To express them in terms of observables, define the domestic intensity of LF ω by $d_H^\omega := \frac{R_{HH}^\omega}{R_{HH}^\omega + R_{HF}^\omega}$ and its export intensity by $e_H^\omega := 1 - d_H^\omega$. Thus, we can reexpress ρ_{HH}^ω as

$$\rho_{HH}^\omega = \frac{d_H^\omega \left(1 - s_{HH}^\omega\right)/\varepsilon_{HH}^\omega}{d_H^\omega \left(1 - s_{HH}^\omega\right)/\varepsilon_{HH}^\omega + e_H^\omega/\sigma}, \tag{14}$$

and obtain ρ_{HF}^ω through $\rho_{HF}^\omega = 1 - \rho_{HH}^\omega$, which gives $\rho_{HF}^\omega = \frac{e_H^\omega/\sigma}{d_H^\omega \left(1-s_{HH}^\omega\right)/\varepsilon_{HH}^\omega + e_H^\omega/\sigma}$.

As for optimal domestic prices and markups, variations in domestic market shares affect them in the following way:

$$\frac{\partial \ln p_{HH}^\omega}{\partial \ln s_{HH}^\omega} = \frac{\partial \ln m_{HH}^\omega}{\partial \ln s_{HH}^\omega} = \frac{s_{HH}^\omega}{\left(1 - s_{HH}^\omega\right) \varepsilon_{HH}^\omega}, \tag{15}$$

while export trade costs only affect the prices set abroad, where specifically $\frac{\partial \ln p_{HF}^\omega}{\partial \ln \tau_{HF}^\omega} = 1$.

Given the relation between optimal choices of LF ω and market shares, now we proceed to characterize how a LF's market shares depend on export trade costs and the domestic price index. Since optimal investments affect all markets simultaneously, to accomplish this it is necessary to work with the system of market shares (4) of ω. Differentiating it, we obtain the following:

$$\begin{pmatrix} \frac{\left(\sigma-\varepsilon_{HH}^{\omega}s_{HH}^{\omega}\right)-\delta\rho_{HH}^{\omega}\left[\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}\right]}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)} & -\delta\rho_{HF}^{\omega} \\ -\delta\rho_{HH}^{\omega}\left[\frac{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}\right] & 1-\delta\rho_{HF}^{\omega} \end{pmatrix} \begin{pmatrix} \mathrm{d}\ln s_{HH}^{\omega} \\ \mathrm{d}\ln s_{HF}^{\omega} \end{pmatrix} = \begin{pmatrix} 0 & \sigma-1 \\ 1-\sigma & 0 \end{pmatrix} \begin{pmatrix} \mathrm{d}\ln \tau_{HF}^{\omega} \\ \mathrm{d}\ln \mathbb{P}_{H} \end{pmatrix},$$

where we define the matrix on the left-hand side as J_H^{ω}, which satisfies $\det J_H^{\omega} > 0$. Solving the system determines that

$$\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \mathbb{P}_H} = \frac{(\sigma-1)\left(1-\delta\rho_{HF}^{\omega}\right)}{\det J_H^{\omega}}, \tag{16a}$$

$$\frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \mathbb{P}_H} = \frac{(\sigma-1)\,\delta\rho_{HH}^{\omega}}{\det J_H^{\omega}}\left[\frac{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}\right], \tag{16b}$$

while, for export trade costs,

$$\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \tau_{HF}^{\omega}} = \frac{(1-\sigma)\,\delta\rho_{HF}^{\omega}}{\det J_H^{\omega}}, \tag{16c}$$

$$\frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \tau_{HF}^{\omega}} = \frac{(1-\sigma)}{\det J_H^{\omega}}\frac{\left(\sigma-\varepsilon_{HH}^{\omega}s_{HH}^{\omega}\right)-\delta\rho_{HH}^{\omega}\left[\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}\right]}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}, \tag{16d}$$

where it can be shown that (16a) and (16b) are positive, and (16c) and (16d) are negative.

Finally, we can also obtain expressions for partial effects on the optimal gross profits of LF ω. They are given by

$$\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \mathbb{P}_H} = \phi_{HH}^{\omega}\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \mathbb{P}_H}\left(\frac{\sigma-\delta\left[\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}\right]}{\varepsilon_{HH}^{\omega}\left[1-\delta\left(1-s_{HH}^{\omega}\right)\right]}\right)+\phi_{HF}^{\omega}\frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \mathbb{P}_H}, \tag{17a}$$

$$\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \tau_{HF}^{\omega}} = \phi_{HH}^{\omega}\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \tau_{HF}^{\omega}}\left(\frac{\sigma-\delta\left[\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}\right]}{\varepsilon_{HH}^{\omega}\left[1-\delta\left(1-s_{HH}^{\omega}\right)\right]}\right)+\phi_{HF}^{\omega}\frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \tau_{HF}^{\omega}}, \tag{17b}$$

where

$$\phi_{HH}^{\omega} := \frac{d_H^{\omega}\left[1-\delta\left(1-s_{HH}^{\omega}\right)\right]/\varepsilon_{HH}^{\omega}}{d_H^{\omega}\left[1-\delta\left(1-s_{HH}^{\omega}\right)\right]/\varepsilon_{HH}^{\omega}+e_H^{\omega}\left(1-\delta\right)/\sigma} \tag{18}$$

with $\phi_{HF}^{\omega} := 1-\phi_{HH}^{\omega}$, and it can be shown that $\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \mathbb{P}_H} > 0$ and $\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \tau_{HF}^{\omega}} < 0$. The terms ϕ_{HH}^{ω} and ϕ_{HF}^{ω} represent, respectively, the relative importance of market H and F in ω's gross profits.

Moreover, regarding the total gross profits of LFs in H as a group, they are given by

$$\frac{\partial \ln \overline{\Pi}_H^{\mathscr{L}}}{\partial \ln \mathbb{P}_H} = \sum_{\omega\in\mathscr{L}_H}\psi_H^{\omega}\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \mathbb{P}_H}, \tag{19a}$$

$$\sum_{\omega\in\overline{\mathscr{L}}_H}\frac{\partial \ln \overline{\Pi}_H^{\mathscr{L}}}{\partial \ln \tau_{HF}^{\omega}} = \sum_{\omega\in\overline{\mathscr{L}}_H}\psi_H^{\omega}\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \tau_{HF}^{\omega}}, \tag{19b}$$

where $\psi_H^{\omega} := \frac{\overline{\pi}_H^{\omega}}{\overline{\Pi}_H^{\mathscr{L}}}$ is the proportion of gross profits in H that corresponds to ω and it can be computed by

$$\psi_H^{\omega} := \frac{\widetilde{s}_{HH}^{\omega}\left[1-\delta\left(1-s_{HH}^{\omega}\right)\right]/\varepsilon_{HH}^{\omega}+\widetilde{s}_{HF}^{\omega}\left(1-\delta\right)/\sigma}{\sum_{\omega\in\overline{\mathscr{L}}_H}\left[\widetilde{s}_{HH}^{\omega}\left[1-\delta\left(1-s_{HH}^{\omega}\right)\right]/\varepsilon_{HH}^{\omega}+\widetilde{s}_{HF}^{\omega}\left(1-\delta\right)/\sigma\right]}, \tag{20}$$

where $\widetilde{s}^{\omega}_{Hj} := \frac{R^{\omega}_{Hj}}{Y^{\text{ind}}_{H}}$, with Y^{ind}_{H} defined as the industry's income in H (i.e., the sum of domestic and exports sales by domestic firms from H). In words, the term $\widetilde{s}^{\omega}_{Hj}$ represents the industry-revenue share coming from sales by ω in country $j \in \{H, F\}$. Thus, through these terms for each j, it is possible to capture the importance of domestic and export sales of ω in terms of H's industry income.

3.2 Export Shock to Small Firms

Next, we study the impact of better export access in H on some key domestic variables: the price index in H and several variables of LFs from H, i.e., their domestic prices, quality investments, domestic market shares, and profits. The computation of total effects combines the partial effects given by (12), (13), (15), (16), (17), and (19).

We begin by considering a scenario with an export shock to SFs exclusively. Formally, this is captured by a decrease in $\tau^{\mathcal{N}_H}$.

Proposition 1: Export Shock to SFs

Suppose a small reduction in $\tau^{\mathcal{N}_H}$. Then, $\mathbb{P}^{*}_{H}$ decreases, and

- *regarding SFs from H: there are increases in M^{E*}_{H}, their domestic survival productivity cutoff, and domestic market share,*
- *regarding LFs from H: each invests less in quality, decreases its domestic prices and markups, garners lower total profits, and loses domestic market share.*

Under this scenario, the effects on the domestic economy are triggered by the increase in each SF's expected profits. This entails that more SFs are willing to enter the industry, which is reflected by an increase in M^{E}_{H}. Eventually, even though not all of the firms survive, some of them do and end up serving the domestic market, generating tougher competitive conditions in the home country. Formally, this is captured through a reduction in the price index.

This mechanism implies that the domestic market share of SFs is impacted in two opposing ways. On the one hand, it becomes greater due to the increase in M^{E}_{H}. Simultaneously, tougher competitive conditions at home determine that there is an increase in the survival productivity cutoff, thus causing losses of domestic market share for SFs. Overall, Proposition 1 establishes that the increase in M^{E}_{H} dominates, thus generating a transfer of domestic market share towards SFs, which comes at the expense of both importers and LFs.

As for LFs, the impact on LF ω from H can be computed as follows:

$$\mathrm{d}\ln s_{HH}^{\omega} = \left(\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}_H^*}{\mathrm{d}\ln \tau_{HF}^{\mathcal{N}}} \right) \mathrm{d}\ln \tau^{\mathcal{N}_H} < 0, \tag{21a}$$

$$\mathrm{d}\ln I_H^{\omega} = \left(\frac{\partial \ln z_H^{\omega}}{\partial \ln s_{HH}^{\omega}} \frac{\mathrm{d}\ln s_{HH}^{\omega}}{\mathrm{d}\ln \tau_{HF}^{\mathcal{N}}} + \frac{\partial \ln z_H^{\omega}}{\partial \ln s_{HF}^{\omega}} \frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}_H^*}{\mathrm{d}\ln \tau_{HF}^{\mathcal{N}}} \right) \mathrm{d}\ln \tau^{\mathcal{N}_H} < 0, \tag{21b}$$

$$\mathrm{d}\ln p_{HH}^{\omega} = \left(\frac{\partial \ln p_{HH}^{\omega}}{\partial \ln s_{HH}^{\omega}} \frac{\mathrm{d}\ln s_{HH}^{\omega}}{\mathrm{d}\ln \tau_{HF}^{\mathcal{N}}} \right) \mathrm{d}\ln \tau^{\mathcal{N}_H} < 0, \tag{21c}$$

$$\mathrm{d}\ln \overline{\pi}_H^{\omega} = \left(\frac{\partial \ln \overline{\pi}_H^{\omega}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}_H^*}{\mathrm{d}\ln \tau_{HF}^{\mathcal{N}}} \right) \mathrm{d}\ln \tau^{\mathcal{N}_H} < 0, \tag{21d}$$

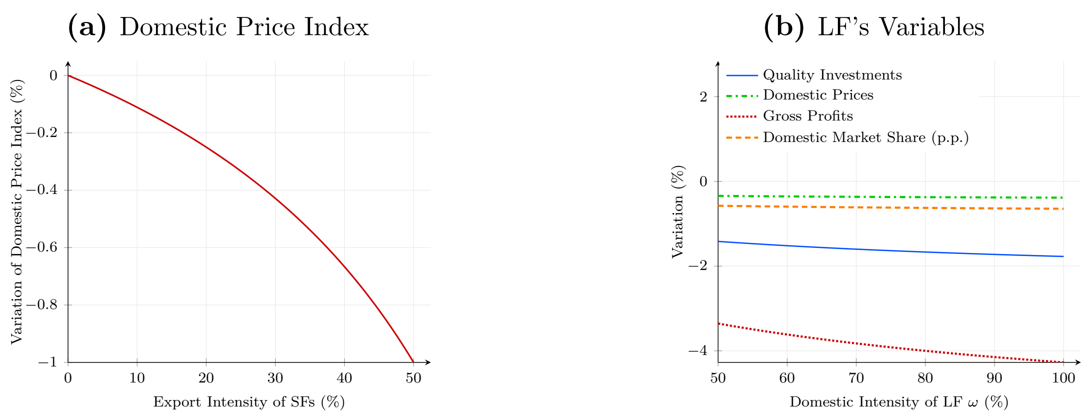
where we have used that $\frac{\partial \ln \tau_{HF}^{\mathcal{N}}}{\partial \ln \tau^{\mathcal{N}_H}} = 1$ and the signs of the effects are due to Proposition 1.

Inspection of (21) reveals that, in this scenario, LFs are impacted exclusively through tougher domestic competition, which reduces their total sales and market power. Consequently, each LF ends up supplying domestically a cheaper but lower-quality variety and earning lower profits. As a corollary, this shock generates gains for consumers through reductions in the price index, but also losses for firms through decreases in the LFs' profits.

In order to gain some insight into the empirical analysis, next we show how we can infer the magnitude of these effects through observables. We do this by making use of domestic and export intensities of SFs and of each LF.

To see this, first notice that the magnitude of the decrease in $\mathbb{P}_H$ is given by (12), which is obtained by differentiating the free-entry condition in H. Thus, $\mathrm{d}\ln \mathbb{P}_H^* = \frac{e_H^{\mathcal{N}}}{d_H^{\mathcal{N}}} \mathrm{d}\ln \tau^{\mathcal{N}_H}$, where we have defined $e_H^{\mathcal{N}}$ and $d_H^{\mathcal{N}} := 1 - e_H^{\mathcal{N}}$ as the export and domestic intensities of SFs as a group. Given $\mathrm{d}\ln \tau^{\mathcal{N}_H} < 0$, this expression implies an inverse relation between $\mathbb{P}_H$ and $e_H^{\mathcal{N}}$, as is illustrated in Figure 3a.

Figure 1. *1% Decrease in Export Trade Costs of SFs*



The fact that a greater $e_H^{\mathcal{N}}$ is associated with a lower $\mathbb{P}_H$ reflects that better export opportunities have a greater impact on their expected profits, which induces a more pronounced entry of SFs and, thereby, a more marked increase in domestic competition.

As for the impact on each LF's variables, their magnitudes can also be captured by their export intensity or, equivalently, their domestic intensity. To demonstrate this, in Figure 3b we compute (21) for a LF, given a reduction in the domestic price index. The graph depicts the relation between the impact on each variable and a LF's domestic intensity.

The negative slope of each curve is explained by the fact that greater domestic intensity of a LF is associated with greater exposure to changes in the domestic competitive conditions. The mechanism is as follows. Stiffer domestic competition reduces a LF's domestic market power and, hence, its domestic prices and markups. In addition, the reduction in $\mathbb{P}_H$ also reduces its total revenues, which decreases the benefits obtained per unit of quality and makes it invest less. Intuitively, the magnitude of this last effect depends on how important the domestic market is for the total sales of a LF: the lower its domestic intensity, the greater its diversification of sales between markets and, hence, the less its total revenues are impacted by changes in the conditions at home.

3.3 Export Shock to Large Firms

Next, we analyze a scenario where there is an export shock that affects LFs exclusively. We begin by stating the effects that this has on the domestic market.

Proposition 2: Export Shock to LFs

Suppose a small reduction in τ^{ω} for each $\omega \in \overline{\mathscr{L}}_H$. Then, $\mathbb{P}_H^*$ remains the same, and

- *regarding SFs from H: M_H^{E*} decreases, their domestic survival productivity cutoff remains the same, and they lose domestic market share,*
- *regarding LFs from H: each invests more in quality, increases its domestic prices and markups, garners greater total profits, and gains domestic market share.*

Relative to an export shock that affects SFs exclusively, this scenario impacts the domestic market through a different mechanism: the expansion of effective market size for LFs. By allowing them to spread out the fixed costs of quality across more units, this creates more favorable conditions to invest in quality. Consequently, since quality affects all markets simultaneously and also increases the consumer's willingness to pay, each LF increases its domestic sales and is able to raise its prices and markups at home.

Formally, the effects on the variables of LF ω from H can be calculated as follows:

$$d\ln s^{\omega}_{HH} = \left(\frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \tau^{\omega}_{HF}}\right) d\ln \tau^{\omega} > 0, \tag{22a}$$

$$d\ln I^{\omega}_{H} = \left(\frac{\partial \ln z^{\omega}_{H}}{\partial \ln s^{\omega}_{HH}}\frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \tau^{\omega}_{HF}} + \frac{\partial \ln z^{\omega}_{H}}{\partial \ln s^{\omega}_{HF}}\frac{\partial \ln s^{\omega}_{HF}}{\partial \ln \tau^{\omega}_{HF}}\right) d\ln \tau^{\omega} > 0, \tag{22b}$$

$$d\ln p^{\omega}_{HH} = \left(\frac{\partial \ln p^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}}\frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \tau^{\omega}_{HF}}\right) d\ln \tau^{\omega} > 0, \tag{22c}$$

$$d\ln \overline{\pi}^{\omega}_{H} = \left(\frac{\partial \ln \overline{\pi}^{\omega}_{H}}{\partial \ln \tau^{\omega}_{HF}}\right) d\ln \tau^{\omega} > 0, \tag{22d}$$

where we have used that $\frac{\partial \ln \tau^{\omega}_{HF}}{\partial \ln \tau^{\omega}} = 1$ and the signs of each expression follow by Proposition 2.

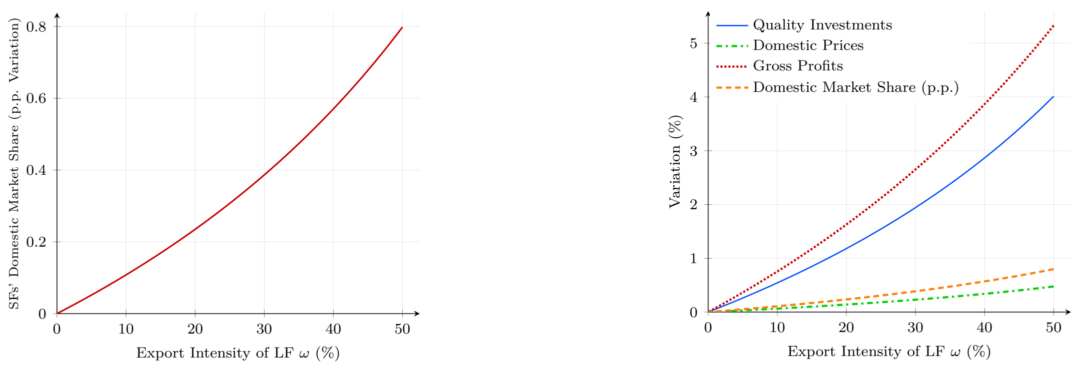
One feature of this export shock is that, unlike better export opportunities for SFs, it does not affect the domestic price index. This is because, initially, the heavier investment by LFs creates a tougher competitive environment. This, in turn, reduces the expected profits of SFs, thus crowding out SFs from the industry and softening competition. In the long run, both effects exactly offset, leaving the price index unaltered. As a corollary, this shock creates gains only for LFs, through the increase in their profits.

Regarding the impact on each variable, their magnitudes can be inferred in terms of observables through the export intensity of each LF. The intuition for this is that, when a LF has greater export intensity, the impact of an export shock on the benefits per unit of investment is bigger, since it implies greater sales and, hence, a more pronounced cost-spreading effect.

We illustrate this in Figure 2, where we consider a given reduction in the export trade costs of LFs. Figure 2b depicts the positive relation between the domestic intensity of a LF and each of its variables. The graph captures that greater export intensity of a LF is associated with larger increases in its total sales and, therefore, heavier investments in quality. Likewise, Figure 2a demonstrates how this mechanism translates into a more marked crowding out of SFs.

Figure 2. *1% Decrease in Export Trade Costs of LFs*

(a) Domestic Market Share of SFs **(b)** LF's Variables

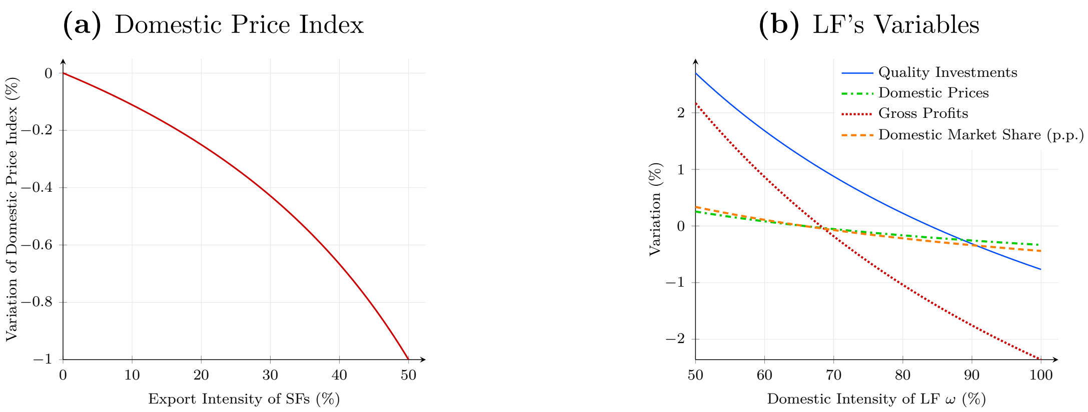


3.4 Export Shock to All Firms

We now proceed to examine the total impact of an export shock to all firms in H. The results are easy to grasp since they can be understood as a combination of export shocks to each type of firm.

Thus, as in the case of better export access for SFs, the variation in the price index is given by (12), which captures the impact of the shock on zero expected profits. As demonstrated in Figure 3b, this determines that, the greater the export intensity of SFs is, the more pronounced the decrease in $\mathbb{P}_H$ is.

Figure 3. *1% Decrease in Export Trade Costs of All Firms*



Furthermore, regarding LFs, the total effects are:

$$\mathrm{d}\ln s^{\omega}_{HH} = \left(\frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}^{*}_{H}}{\mathrm{d}\ln \tau^{\mathcal{N}}_{HF}} + \frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \tau^{\omega}_{HF}} \right) \mathrm{d}\ln \tau_{HF} \lesseqgtr 0, \tag{23a}$$

$$\mathrm{d}\ln I^{\omega}_{H} = \left[\frac{\partial \ln z^{\omega}_{H}}{\partial \ln s^{\omega}_{HH}} \frac{\mathrm{d}\ln s^{\omega}_{HH}}{\mathrm{d}\ln \tau^{\mathcal{N}}_{HF}} + \frac{\partial \ln z^{\omega}_{H}}{\partial \ln s^{\omega}_{HF}} \left(\frac{\partial \ln s^{\omega}_{HF}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}^{*}_{H}}{\mathrm{d}\ln \tau^{\mathcal{N}}_{HF}} + \frac{\partial \ln s^{\omega}_{HF}}{\partial \ln \tau^{\omega}_{HF}} \right) \right] \mathrm{d}\ln \tau_{HF} \lesseqgtr 0, \tag{23b}$$

$$\mathrm{d}\ln p^{\omega}_{HH} = \left(\frac{\partial \ln p^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}} \frac{\mathrm{d}\ln s^{\omega}_{HH}}{\mathrm{d}\ln \tau^{\omega}_{HF}} \right) \mathrm{d}\ln \tau_{HF} \lesseqgtr 0, \tag{23c}$$

$$\mathrm{d}\ln \overline{\pi}^{\omega}_{H} = \left(\frac{\partial \ln \overline{\pi}^{\omega}_{H}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}^{*}_{H}}{\mathrm{d}\ln \tau^{\mathcal{N}}_{HF}} + \frac{\partial \ln \overline{\pi}^{\omega}_{H}}{\partial \ln \tau^{\omega}_{HF}} \right) \mathrm{d}\ln \tau_{HF} \lesseqgtr 0, \tag{23d}$$

where we have used that $\frac{\partial \ln \tau^{\mathcal{N}}_{HF}}{\partial \ln \tau_{HF}} = \frac{\partial \ln \tau^{\omega}_{HF}}{\partial \ln \tau_{HF}} = 1$.

The system (23) establishes that the total impact on each variable is a combination of the effects arising by a reduction in export trade costs of SFs (i.e., Proposition 1) and of LFs (i.e., Proposition 2). In fact, when export shocks are infinitesimal, (21) and (22) constitute an exact decomposition of (23). A corollary of this is that the impact on LFs is indeterminate, since there are opposing effects at play: LFs face tougher domestic competition but, also, better export access. Overall, the magnitude of these effects can be inferred through the domestic intensity of a LF, since this reflects the relative importance that domestic and export markets have for a firm.

In Figure 3b, we illustrate this by plotting the impact on each variable of a LF according to its domestic intensity. This graph captures that, the lower a LF's domestic intensity (and, so, the greater its export intensity), the more the LF is impacted by tougher domestic competition and the less it benefits from better export access. Based on this, the figure allows us to distinguish between two scenarios. First, for low values of a LF's domestic intensity, the impact on a LF is akin to an export shock to LFs exclusively. Thus, a LF upgrades quality and charges higher domestic markup, while its domestic market share and profits become greater. On the other hand, if a LF has high domestic intensity, it is impacted in a similar way as when only SFs have better export access. This entails that the domestic price index decreases and, hence, a LF downgrades quality, charges lower domestic prices, and loses domestic market share and profits.

4 Data Description and Empirical Approach

In this section, we describe the approach to conduct the empirical analysis. We begin by showing how to estimate the model when large changes in export trade costs are considered. After this, we describe the data at our disposal, along with the approach to construct variables and calibrate parameters.

4.1 Arbitrary Changes in Export Trade Costs

We keep considering the setup where the world economy comprises countries H and F, with the former being a small economy. Our focus is on the quantification of the effects on the price index in H and variables regarding LFs from H, including their domestic market shares, exports, quality investments, and total gross profits.

We consider a scenario where export trade costs in H are initially given by $\left(\tau_{HF}^{\mathcal{N}}\right)'$ for SFs and by $\left(\tau_{HF}^{\omega}\right)'$ for each LF ω, with common component τ_{HF}'. In addition, we suppose a counterfactual scenario where export trade costs become $\left(\tau_{HF}^{\mathcal{N}}\right)''$ for SFs and $\left(\tau_{HF}^{\omega}\right)''$ for each LF ω, with common component τ_{HF}''.

For the computation of results, we utilize the "hat algebra" procedure, as in for instance Dekle et al. (2008). Specifically, for any variable x, denote its equilibrium value under each set of export trade costs by x' and x'', respectively, and its proportional change by $\widehat{x} := \frac{x''}{x'}$. Then, for some proportional changes in export trade costs $\widehat{\tau}_{HF}^{\mathcal{N}}$ and $\widehat{\tau}_{HF}^{\omega}$ for each LF ω, we compute the proportional changes in each variable of interest.

Different values for $\widehat{\tau}_{HF}^{\mathcal{N}}$ and $\widehat{\tau}_{HF}^{\omega}$ for each LF ω allow us to encompass the different export shocks we have considered. For instance, for a 10% decrease in export trade costs, an export shock that only applies to SFs is equivalent to $\widehat{\tau}_{HF}^{\mathcal{N}} = 0.9$ and $\widehat{\tau}_{HF}^{\omega} = 1$ for each $\omega \in \overline{\mathscr{L}}_H$; when it only applies to LFs, this is captured by $\widehat{\tau}_{HF}^{\mathcal{N}} = 1$ and $\widehat{\tau}_{HF}^{\omega} = 0.9$ for each $\omega \in \overline{\mathscr{L}}_H$; and, finally, if it applies to all firms, this corresponds to $\widehat{\tau}_{HF}^{\mathcal{N}} = 0.9$ and $\widehat{\tau}_{HF}^{\omega} = 0.9$ for each $\omega \in \overline{\mathscr{L}}_H$.

Unlike the case of a small change in export trade costs, now the quantification of results requires specifying a productivity distribution for SFs from H. Our choice in this respect is based on the goal of keeping the estimation procedure parsimonious and in line with the interpretation of results provided for the case of infinitesimal shocks. To accomplish this, we suppose that the productivity of SFs is a random variable with support $\left\{\varphi^I, \varphi^D, \varphi^X\right\}$ such that $\varphi^I < \varphi^D < \varphi^X$. The superscripts are, respectively, mnemonics for "inactive", "domestic", and "exporters" due to the role that we ascribe to them. Specifically, in equilibrium, a SF from H that obtains φ^I does not serve any country; if it gets φ^D, it is efficient enough to produce with positive profits at home, but not to serve any foreign country; and, finally, the draw φ^X is obtained by the most productive SFs, which enables them to serve both the domestic and foreign market.

As we show in Appendix A.4, given $\widehat{\tau}_{HF}^{\mathcal{N}}$ and $\widehat{\tau}_{HF}^{\omega}$ for each LF ω, the computation of effects can be obtained by solving the following system for each $\omega \in \overline{\mathscr{L}}_H$:

$$\widehat{\mathbb{P}}_H = \left\{1 - \frac{\left(e_H^{\mathcal{N}}\right)'}{\left(d_H^{\mathcal{N}}\right)'}\left[\left(\widehat{\tau}_{HF}^{\mathcal{N}}\right)^{1-\sigma} - 1\right]\right\}^{\frac{1}{\sigma-1}}, \tag{24a}$$

$$\widehat{p}_{HH}^{\omega} = \widehat{m}_{HH}^{\omega} = \widehat{\varepsilon}_{HH}^{\omega} \frac{\left(\varepsilon_{HH}^{\omega}\right)' - 1}{\widehat{\varepsilon}_{HH}^{\omega}\left(\varepsilon_{HH}^{\omega}\right)' - 1}, \tag{24b}$$

$$\widehat{I}_H^{\omega} = \widehat{z}_H^{\omega} = 1 + \left(\rho_{HH}^{\omega}\right)'\left[\frac{\widehat{s}_{HH}^{\omega}}{\widehat{\varepsilon}_{HH}^{\omega}}\frac{1 - \widehat{s}_{HH}^{\omega}\left(s_{HH}^{\omega}\right)'}{1 - \left(s_{HH}^{\omega}\right)'} - 1\right] + \left(\rho_{HF}^{\omega}\right)'\left[\widehat{s}_{HF}^{\omega} - 1\right], \tag{24c}$$

$$\widehat{s}_{HH}^{\omega} = \frac{\left(\widehat{m}_{HH}^{\omega}\right)^{1-\sigma}\left(\widehat{z}_H^{\omega}\right)^{\delta}}{\left(\widehat{\mathbb{P}}_H\right)^{1-\sigma}}, \tag{24d}$$

$$\widehat{s}_{HF}^{\omega} = \widehat{R}_{HF}^{\omega} = \left(\widehat{\tau}_{HF}^{\omega}\right)^{1-\sigma}\left(\widehat{z}_H^{\omega}\right)^{\delta}, \tag{24e}$$

where $\widehat{\varepsilon}_{HH}^{\omega} = 1 + \left(1 - \widehat{s}_{HH}^{\omega}\right)\frac{\left(s_{HH}^{\omega}\right)'(\sigma-1)}{\sigma - \left(s_{HH}^{\omega}\right)'(\sigma-1)}$, and ρ_{HH}^{ω}, ρ_{FH}^{ω}, $e_H^{\mathcal{N}}$, $d_H^{\mathcal{N}}$ are defined as in the case of an infinitesimal shock. Specifically, ρ_{HH}^{ω} is given by (14), $\rho_{FH}^{\omega} := 1 - \rho_{HH}^{\omega}$, $d_H^{\mathcal{N}} := \frac{R_{HH}^{\mathcal{N}}}{R_{HH}^{\mathcal{N}} + R_{HF}^{\mathcal{N}}}$ and $e_H^{\mathcal{N}} := 1 - d_H^{\mathcal{N}}$.

In addition, results for gross profits can be obtained by computing the following:

$$\widehat{\widetilde{\pi}}_H^\omega = 1 + (\phi_{HH}^\omega)' \left\{ \frac{\widehat{s}_{HH}^\omega}{\widehat{\varepsilon}_{HH}^\omega} \frac{1 - \delta \left(1 - \widehat{s}_{HH}^\omega (s_{HH}^\omega)'\right)}{1 - \delta \left(1 - (s_{HH}^\omega)'\right)} - 1 \right\} + (\phi_{HF}^\omega)' \left(\widehat{s}_{HF}^\omega - 1\right), \tag{24f}$$

$$\widehat{\widetilde{\Pi}}_H^{\mathscr{L}} = \sum_{\omega \in \overline{\mathscr{L}}_H} \psi_H^\omega \widehat{\widetilde{\pi}}_H^\omega, \tag{24g}$$

where ϕ_{HH}^ω, ϕ_{HF}^ω, and ψ_H^ω are defined in the same way as we did for an infinitesimal shock. That is, ϕ_{HH}^ω is given by (18), with $\phi_{HF}^\omega := 1 - \phi_{HH}^\omega$, and ψ_H^ω by (20).

The computation of effects requires the same set of information as for calculations following an infinitesimal shock. Specifically, regarding parameters, it is necessary to have estimations of σ and δ. In addition, concerning information of SFs and LFs, it requires knowledge of $d_H^{\mathcal{N}}$ for SFs, and s_{HH}^ω, $\widetilde{s}_{HH}^\omega$ and $\widetilde{s}_{HF}^\omega$ for each LF ω. Given values for these variables, we can recover $e_H^{\mathcal{N}}$, and d_H^ω and e_H^ω for each LF ω through $e_H^{\mathcal{N}} = 1 - d_H^{\mathcal{N}}$, $d_H^\omega = \frac{\widetilde{s}_{HH}^\omega}{\widetilde{s}_{HH}^\omega + \widetilde{s}_{HF}^\omega}$, and $e_H^\omega = 1 - d_H^\omega$.

Notice that, given the definitions of ρ_{HH}^ω, ρ_{HF}^ω, ϕ_{HH}^ω, and ϕ_{HF}^ω, we can compute all the terms in (24), except (24g), with information on domestic market shares s_{HH}^ω and domestic intensities d_H^ω for each LF ω, and domestic intensities of SFs, $d_H^{\mathcal{N}}$. Instead, information of revenue shares are not necessary. They only need to be utilized for (24g) through ψ_H^ω.

4.2 Data Description and Construction of Variables

To conduct the empirical analysis, we utilize two datasets compiled by Statistics Denmark that provide information on Danish manufacturing for the year 2005. Both are presented at the firm-product level and disaggregated at the 8-digit level according to the Combined Nomenclature (CN). This classification is commonly utilized in European datasets and its first six digits coincide with the Harmonized System. Throughout the analysis, we refer to a *sector* as a 2-digit industry and reserve the term *industry* to a 4-digit industry, according to the NACE classification.

The first dataset consists of the Prodcom survey, from which we obtain information on total turnover for each firm. This survey covers any production unit with at least ten employees that has manufacturing as its main activity. Moreover, it features high coverage, ensuring that at least 90% of the total production value in each industry is covered. Making use of this dataset, we consider any firm that is included in it as domestic, which determines that its definition is given by the existence of production activities in Denmark.

Additionally, we draw on a dataset collected by Danish customs that contains trade data. This covers transactions by both manufacturing and non-manufacturing firms. For trading partners in the EU, it has a coverage of 95% for imports and 97% for exports while, for non-EU countries, the universe of transactions is covered.

To perform the quantitative analysis, we assemble the data in a way consistent with how our model is specified. This requires us to translate variables at the industry level. To accomplish this, we gather the data such that turnover, exports, and imports at the 8-digit CN level are aggregated at the 4-digit NACE level. With the information expressed at the firm-industry level, we distinguish between LFs and SFs in each industry by defining the latter as those top four firms according to a firm's industry revenue share.

To estimate the model, we need to compute $d_H^{\mathcal{N}}$ for SFs, and s_{HH}^{ω}, $\widetilde{s}_{HH}^{\omega}$ and $\widetilde{s}_{HF}^{\omega}$ for each LF ω. As we have shown above, these values allow us to compute every other variable necessary to estimate the model. Next, we describe how each of these variables is calculated. The procedure is akin to those utilized in studies based on similar European datasets (e.g., Amiti et al. 2018 and Gaubert and Itskhoki 2018).

Regarding the domestic market share of LF ω, s_{HH}^{ω}, it is expressed relative to total industry expenditures, which are defined as the sum of all domestic sales and imports. A firm's domestic sales are computed as the difference between a firm's total turnover and its export revenues. As for imports, they comprise goods of the industry that are either acquired by non-manufacturing firms (i.e., firms not belonging to the Prodcom dataset, such as retailers) or manufacturing firms from other industries. This allows us to allocate each good imported to a specific industry and, hence, define an accurate measure of import penetration in the industry.

In order to obtain the domestic intensities and revenues shares, we take turnover as income and, for each firm, we split it into domestic and export sales. Based on this, we compute the domestic intensity of SFs (i.e., $d_H^{\mathcal{N}}$) as the total domestic sales of the group relative to the SFs' income. Furthermore, we calculate the domestic and export shares of LF ω (i.e., $\widetilde{s}_{HH}^{\omega}$ and $\widetilde{s}_{HF}^{\omega}$) as its domestic and export sales relative to the industry revenue.

As for the parameters of the model, only two are necessary to estimate the effects of export shocks: σ and δ. Regarding the former, we make use of the estimates by Soderbery (2015), which are based on the methodology by Broda and Weinstein (2006) but improve upon it by accounting for small-sample biases. Averaging these estimates across industries using industry-revenue weights, we obtain $\sigma := 3.53$, which we use throughout the paper.

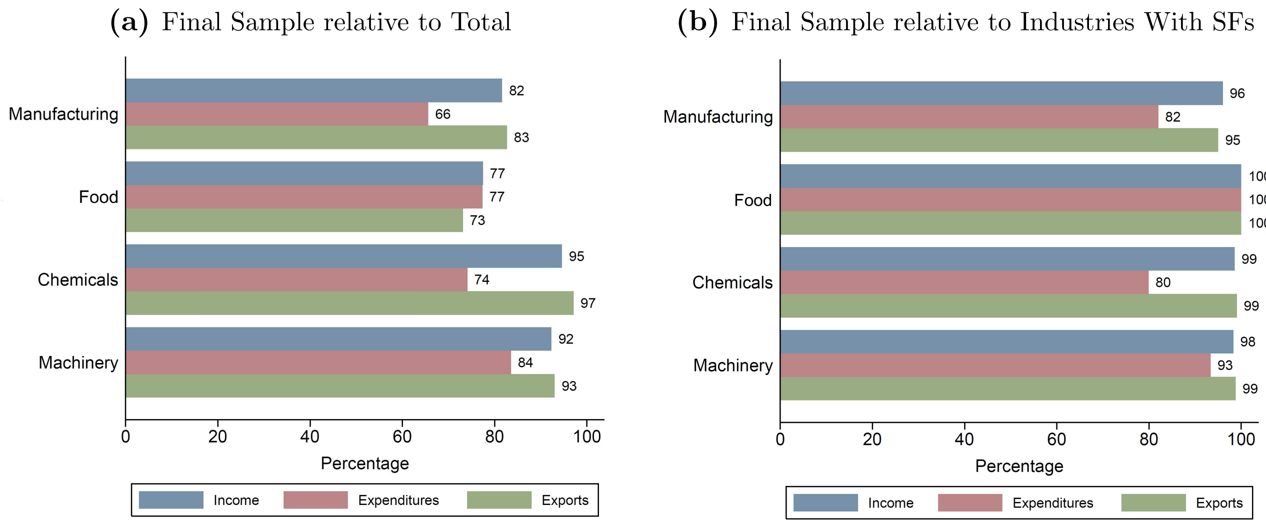
As for δ, we calibrate its value by fitting, as close as possible to the model, each LF's domestic market share variation not explained by prices. Next, we provide some intuition about the procedure, while a detailed description is included in Appendix B. The approach is based on the same logic of how quality is usually estimated and, in particular, resembles the methodology of Berry et al. (2016) to estimate the impact of quality on sales when this is not observable. Consistent with our broad definition of quality (i.e., any non-price choice that affects the appeal of a variety), it consists of obtaining a measure of quality by netting out the effect of prices on domestic market shares given by (4). After this, the residuals are fitted to the structural equation for investments, (10). Proceeding in this fashion, we obtain $\delta := 0.68$, which we use throughout the analysis.

4.3 Sample of Industries

To perform the empirical analysis, it is necessary to define the sample of industries that are consistent with our model. We do this by discarding those industries that do not fit the description of our setup, i.e., those where there is no coexistence of LFs and a pool of SFs. Specifically, with the goal of avoiding issues related to a definition of LFs based on revenue shares, we employ domestic market share instead. Empirically, this turns to be a somewhat more stringent condition than utilizing revenue shares.[6]

In Figure 4a we indicate how representative our final sample of industries is relative to the original dataset, according to income, expenditure, and exports. We do it for manufacturing and for three specific sectors we analyze: Chemicals, Machinery, and Food & Beverages. The results point out that, overall, the coverage is quite high, especially in terms of income and exports. As for expenditures, this is somewhat lower, which reflects that some industries are served exclusively through imports.

Figure 4. *Final Sample of Industries*



[6]This is to avoid scenarios where firms accumulate high shares of revenue in the industry, but the total revenue relative to expenditures is negligible. In these cases, a firm having a large fraction of the total industry's revenues is not equivalent to having market power or being relevant to the whole sector; rather, it is a reflection of the low level of operation by domestic firms in the industry. Specifically, our criterion for incorporating an industry to the final sample is that there is at least one firm with a domestic market share greater than 3%, and that there is a pool of SFs operating. For the latter, we ensure that SFs are actually negligible by checking that in each industry there are at least 10 firms, and removing any industry where the 10 firms or 20% of the firms with the lowest domestic market share accumulate more than 6% of total domestic market share.

Moreover, Figure 4b is presented to characterize the industries not covered, in order to determine whether they are excluded due to an absence of a pool of SFs or for not having any LFs. The graph depicts the percentage of industries in our final sample relative to industries that contain a pool of SFs, irrespective of whether there are LFs. Since the coverage is almost complete (i.e., almost 100% in each dimension, and never less than 80%), it reveals that most industries not included in our final sample are due to the absence of a pool of SFs, rather than the lack of at least one LF. As a corollary, industries with a set of negligible firms operating are better described by a coexistence of SFs and LFs, rather than a pure monopolistic-competition market structure.

Finally, in Table 1, we describe the features of our final sample of industries, with information aggregated at the sector level and sorted by their contribution to total exports in manufacturing. From this table, we can infer that exporting is a widespread activity, consistent with typical patterns of small countries.[7] This can be appreciated by the percentage of exporters among SFs, which on average is almost 50%. Thus, it provides evidence that the conditions to access foreign markets are of relevance for all firms, and not only the largest ones.

In addition, the table reveals that Chemicals, Machinery, and Food & Beverages rank among the top three sectors according to their contribution to total manufacturing exports, income, and expenditures. This constitutes the basis for selecting these specific sectors to conduct the empirical analysis.

Table 1. *Final Sample of Industries - Information in %*

	Exports	Income	Expenditure	Exporters	SFs Exporters	LFs Exporters
Chemicals	28.3	17.1	11.9	73	70	90
Machinery	16.6	12.7	13.0	53	51	85
Food & Beverages	16.0	18.4	16.8	63	60	84
Medical Equipment	7.1	4.8	4.1	67	66	83
Electrical/Machinery	7.0	7.3	6.7	55	52	85
Other Manufactures	6.2	5.8	4.8	59	57	96
Rubber & Plastic	5.8	5.5	5.8	62	61	65
Metal Products	3.0	8.6	8.4	31	30	82
Glass & Cement	2.2	3.1	2.2	40	40	44
Media Equipment	1.9	1.7	3.7	59	56	88
Wood	1.7	4.0	5.1	32	29	70
Basic Metals	1.4	1.5	5.7	44	40	69
Paper	1.1	2.7	3.9	38	35	75
Textiles	0.8	0.8	1.7	60	57	88
Printing	0.6	5.1	4.6	26	25	63
Motor Vehicles	0.3	0.8	1.4	37	34	75
Average of Sectors	6.2	6.2	6.2	50	48	78

Note: Exports, income, and expenditures calculated as a % relative to the total. Exporters, SFs exporters, and LFs exporters correspond to the number of firms that export relative to the total firms of each sector. In all cases, values are calculated based on the final sample of industries that we utilize.

[7]For stylized facts regarding exporters across European countries, including small ones, see Mayer and Ottaviano (2008). See also Bernard et al. (2012) to compare it with patterns emerging in a large country like the USA.

5 Empirical Results

In this section, we estimate the model for Danish manufacturing and perform a quantitative assessment of the effects following an export shock.

We begin by describing several reforms in the last decades in Denmark. This documents that, consistent with the investments we consider, there has been a shift in the economy towards a product differentiation strategy with a focus on high-value niches. After this, we present the results for Manufacturing, Food & Beverages, Chemicals, and Machinery.

5.1 Characterization of Danish Manufacturing

In the early 1980s, the Danish economy was facing a deep economic crisis, marked by growth stagnation and unemployment levels approaching double digits. The situation was unveiling not only macroeconomic issues but, also, fundamental problems in the economy and its industrial structure. Danish firms were concentrated in sectors characterized by low technology and growth, e.g. agriculture and food processing, which rendered businesses vulnerable to the emergence of new low-cost competitors such as Japan, Korea and, Taiwan (Porter 1990, Schwartz 2001, Ornston 2012). To address the social consequences of this, the government incurred a massive deficit by absorbing workers in the public sector and increasing its welfare expenditure. This led to a scenario where the country accumulated massive external debt, along with a fiscal policy that revealed itself unsustainable.

In this context, structural reforms were initiated with the aim of making firms develop new capabilities. They were coordinated with the different actors of the economy and had a pro-market orientation. These various policies made a new industrial profile arise, with two salient features: exposing Danish firms to global competition and reskilling the country's labor force.

Specifically, the government exposed firms to market competition through significant budget cuts, with sharp reductions in public employment and aid to firms, and tighter monetary policy, by pegging the exchange rate to the Euro. It also adopted a policy for the labor market denominated "flexicurity": low levels of employment protection within a comprehensive social safety net for the unemployed workers.[8] This gave firms more latitude to adjust their labor force while, concurrently, decentralized collective wage bargaining. Additionally, trade unions accepted labor-market deregulation in exchange for worker-training measures, including education and vocational training. These measures endowed workers with adaptive and innovative capacities, and facilitated the redistribution of resources between industries and firms.

[8] For a review of Danish labor market with an emphasis on the "flexicure" system, see, for instance, Madsen (2017).

Some evidence of the success of the reforms lies in that, in the last decade, Denmark has been consistently among the first top 10 countries worldwide and 5 first top EU countries regarding innovation and competitiveness.[9] Overall, traditional Danish industries have been modernized (e.g., Food & Beverages and Machinery) and, concurrently, the country has developed competencies in high-tech industries with knowledge-intensive activities (e.g., Chemicals and, in particular, the pharmaceutical industry).[10] In all cases, the firms' success has been based on a product-differentiation strategy with a focus on high-value niches (Schwartz 2001, Campbell and Pedersen 2007, Ornston 2012).

5.2 A Representative Manufacturing Industry

We begin the quantitative analysis by considering a representative manufacturing industry. This is constructed by averaging variables using industry-revenue weights and taking the top four Danish firms by total revenue as LFs. The characterization of it is as follows.

Table 2. *A Representative Manufacturing Industry - Information in %*

Firm	Domestic Market Share	Domestic Intensity	Export Intensity	Domestic Revenue as % of Industry Income	Export Revenue as % of Industry Income
Top 1	16.31	53.41	46.59	17.46	15.23
Top 2	7.28	64.42	35.58	8.11	4.48
Top 3	4.89	67.76	32.24	5.38	2.56
Top 4	3.38	64.45	35.55	3.68	2.03
SFs		75.82	24.18		

This representative industry captures the pervasiveness of international transactions in small countries. Specifically, regarding imports, the table implies that they accrue almost 40% of the total expenditure.[11] Thus, it reveals that accounting for import penetration in small countries is crucial to obtain domestic market shares that can be interpreted as a measure of market power. In addition, the export intensity of firms reinforces the point established above regarding the importance of exporting in small economies. This is appreciated in the export intensity of SFs, which is almost 25%.

[9] The statement regarding competitiveness is based on The Global Competitiveness Report that is prepared annually by the World Economic Forum (see http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf for the 2019 report). The fact that Denmark is among the most innovative countries is due to the Global Innovation Index computed by the World Bank as part of The Global Economy database (see https://www.theglobaleconomy.com/rankings/GII_Index/).

[10] Evidence of this is reflected in the emergence of biotechnological activities in Denmark. In 2003, among firms with ten or more employees, they represented 24% of the total private sector in R&D, with more than 40% concentrated in Food & Beverages and Chemicals (Bloch 2006).

[11] After some algebraic manipulation, the share of imports in expenditure equals $1 - \left(\sum_{\omega \in \overline{\mathscr{L}}_H} s^{\omega}_{HH}\right) \left[1 + \frac{1 - \sum_{\omega \in \overline{\mathscr{L}}_H} (\tilde{s}^{\omega}_{HH} + \tilde{s}^{\omega}_{HF})}{\sum_{\omega \in \overline{\mathscr{L}}_H} \tilde{s}^{\omega}_{HH}} d^{\mathcal{N}}_{H}\right]$.

By making use of the information in Table 2, next we provide estimations for exports shock to SFs, LFs, and all firms by solving and computing the system given by (24). The results are presented in Table 3 and Figure 5.

From these results, we can establish several conclusions. First, Table 3 determines that, as indicated in Proposition 1, an export shock to SFs impacts LFs negatively, since it entails a reduction in the domestic price index. On the contrary, as established in Proposition 2, an export shock to LFs affects them positively, given that this benefits LFs by expanding their effective market size. As for an export shock to all firms, we have shown that the results are theoretically indeterminate for LFs, since they are impacted concurrently through both channels. Consistent with this fact, the empirical outcomes of this case reveal that LFs are not affected in a uniform way. Due to this, next we proceed to analyze this scenario in more detail.

The results in Table 3a point out that, following an export shock to all firms, each LF increases its export revenues, upgrades its quality, and ends up garnering higher profits. Moreover, Table 3b indicates that, overall, total profits increase. Thus, this shock creates gains for Danish consumers through the decrease in the price index, but also for the domestic LFs, through an increase in their profits.

Table 3. *Impact of a 10% Reduction in Export Trade Costs - Representative Manufacturing Industry*

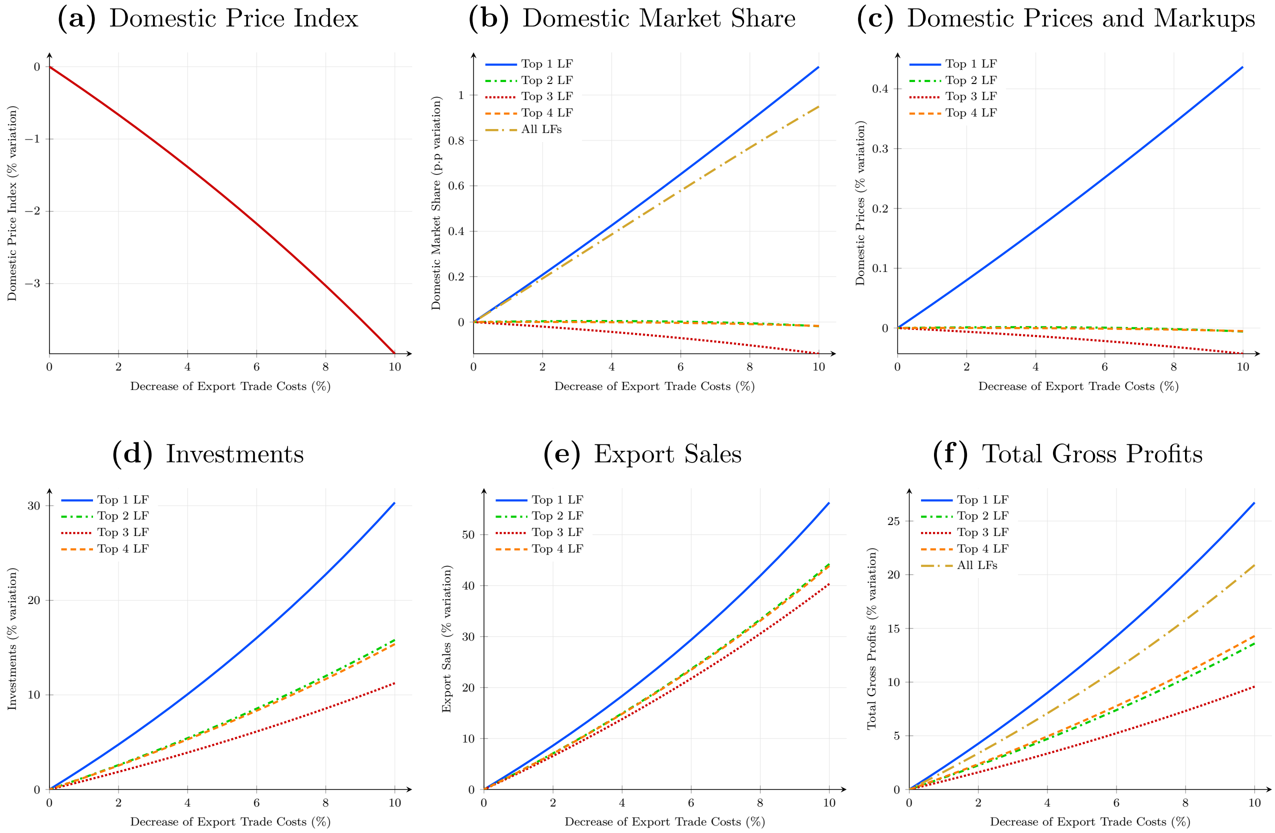
(a) Impact on each LF

Better Export Access	**Firm**	**Domestic Market Share** Change (p.p.)	**Domestic Prices/Markups** Change (%)	**Quality Investments** Change (%)	**Export Revenues** Change (%)	**Total Gross Profits** Change (%)
For All Firms	Top 1	1.12	0.44	30.34	56.32	26.73
	Top 2	-0.02	-0.01	15.81	44.25	13.60
	Top 3	-0.14	-0.04	11.24	40.36	9.58
	Top 4	-0.02	-0.01	15.38	43.88	14.30
Only For LFs	Top 1	3.69	1.48	42.54	66.13	45.54
	Top 2	1.51	0.49	34.39	59.60	36.16
	Top 3	0.96	0.30	31.79	57.50	33.02
	Top 4	0.77	0.23	36.25	61.11	37.24
Only For SFs	Top 1	-2.37	-0.88	-10.75	-7.44	-14.99
	Top 2	-1.37	-0.43	-15.74	-11.00	-18.31
	Top 3	-0.98	-0.30	-17.36	-12.16	-19.25
	Top 4	-0.68	-0.20	-17.14	-12.00	-18.41

(b) Impact on LFs as Group

Better Export Access	**Domestic Market Share** Change (p.p.)	**Total Gross Profits** Change (%)
For All Firms	0.95	20.90
Only For LFs	6.93	41.39
Only For SFs	-5.41	-16.48

Figure 5. *Representative Manufacturing Sector - Decrease in Export Trade Costs for all Firms*



In addition, LFs as a group gain presence in the domestic market. Nonetheless, this result masks stark heterogeneity across LFs, as it can be appreciated in Figure 5. Even though LFs differ in terms of domestic market share, these differences respond primarily to their levels of export intensity.[12] Specifically, the top LF has a higher export intensity relative to the rest of LFs, simultaneously determining that it is more shielded from tougher domestic competition and benefits more from better export access. Thus, its investments in quality are more pronounced relative to the rest of the firms, explaining the better performance in the different variables observed in Figure 5. In particular, this explains its increases in domestic market share and domestic prices. On the contrary, the rest of LFs have a greater domestic intensity, causing that they are more impacted by stiffer domestic competition and less benefited from an export shock. Due to this, even when they upgrade their varieties' quality, each of these LFs loses presence in the domestic market and reduces its domestic prices.

[12]We have replicated the results assuming that each LF has the export intensity of the top LF, but allowing them to have different domestic market shares. In that case, the signs of all the effects would be the same as those of the top firm. The results are available upon request.

5.3 Specific Sectors

In the following, we provide results for specific sectors. Based on Table 1, we do this for the top three sectors in terms of contribution to exports, income, and expenditures: Food & Beverages, Chemicals, and Machinery. Moreover, the analysis is performed for representative industries of each sector, which are constructed in the same fashion as we did for manufacturing.

For confidentiality purposes, we only describe the features of the representative industries verbally. Furthermore, since the estimations for Machinery yield similar qualitative results to the manufacturing case, we relegate this case to Appendix C. Instead, we focus on Food & Beverages and Chemicals, whose results underscore different patterns in outcomes depending on the features of SFs and LFs of the sector.

5.3.1 Food & Beverages

Food & Beverages constituted the largest export sector in Denmark until the 1960s and, as we have shown, still remains as one of the most important contributors to the country's exports. Moreover, its industries constitute an example of traditional activities that were modernized in recent decades through an emphasis on quality aspects.[13]

There are two salient characteristics that distinguish Food & Beverages from manufacturing. First, SFs have greater export intensity, determining that an export shock induces more entry of SFs and, hence, a more marked decrease in the domestic price index. Second, LFs have greater domestic market shares and a more pronounced home bias in sales, which implies that LFs benefit less from better export access and, simultaneously, are more exposed to tougher competition at home. Both facts explain the results presented in Table 4.

In particular, the results for an export shock to all firms indicate that, albeit LFs invest more (with the exception of the second top LF that slightly decreases its investments), these firms are heavily impacted by tougher domestic competition. Due to this, each LF loses presence in the domestic market and the top two LFs, which are the firms with the greatest home bias among LFs, even end up losing profits. Overall, Table 4b indicates that the sector causes losses to the country due to a decrease in total profits.

The case of Food & Beverages serves as an example of the detrimental effects that an export shock can have on LFs. This occurs when the shock mainly represents stiffer domestic competition for a LF, without generating large benefits through better export access. For

[13] For instance, there has been a reskilling of farmers, which is reflected in the requirement of up to four years of formal technical training to operate a farm. Also, there has been an emerging development of specialty food, with a special emphasis on organic products. For more about quality-related aspects of the sector, see Halkier et al. (2017) and Asmild (2019).

Table 4. *Impact of a 10% Reduction in Export Trade Costs - Food and Beverages*

(a) Impact on each LF

Better Export Access	**Firm**	**Domestic Market Share** Change (p.p.)	**Domestic Prices/Markups** Change (%)	**Quality Investments** Change (%)	**Export Revenues** Change (%)	**Total Gross Profits** Change (%)
For All Firms	Top 1	-1.76	-0.77	6.17	35.97	-2.60
	Top 2	-1.02	-0.33	-0.25	30.33	-4.21
	Top 3	-0.50	-0.15	6.26	36.05	3.67
	Top 4	-0.07	-0.02	18.52	46.53	17.23
Only For LFs	Top 1	2.54	1.18	21.41	48.96	23.04
	Top 2	1.26	0.42	25.02	51.95	26.53
	Top 3	1.12	0.35	32.31	57.92	33.70
	Top 4	0.88	0.27	44.13	67.39	45.22
Only For SFs	Top 1	-4.26	-1.80	-14.62	-10.19	-22.92
	Top 2	-2.10	-0.67	-22.31	-15.78	-26.18
	Top 3	-1.44	-0.44	-21.99	-15.54	-24.55
	Top 4	-0.80	-0.24	-20.22	-14.24	-21.56

(b) Impact on LFs as Group

Better Export Access	**Domestic Market Share** Change (p.p.)	**Total Gross Profits** Change (%)
For All Firms	-3.44	-0.61
Only For LFs	5.81	26.61
Only For SFs	-8.60	-23.57

instance, this is the case if LFs are primarily local leaders, rather than global ones, or when LFs encompass foreign-owned firms that set operations in the country through horizontal foreign direct investment, so that their goal is serving the local market exclusively rather than using it as an export platform.

5.3.2 Chemicals

Danish Chemicals constitutes a dynamic industry, characterized by its pharmaceuticals and its biotechnological activities. This sector has benefited from the qualified labor force available in Denmark, allowing them to achieve high levels of innovation. Moreover, it has mainly succeeded by operating on a global scale and specializing in niche markets of high value.[14]

One of the distinctive features of Chemicals is the high export intensity of its SFs. This is around 40%, which is higher than both Manufacturing and Food & Beverages, determining that an export shock to SFs triggers an even more marked increase in domestic competition relative to these cases.

Furthermore, the concentration of market and income shares accrued by LFs in Chemicals is higher than any of the other sectors studied so far and, additionally, LFs feature substantial heterogeneity in terms of their export intensity. The latter determines starkly dissimilar responses of these firms following an export shock. This can be observed in Table 5.

[14]For more details about Danish Chemicals, see Dolk et al. (2008), Pålsson and Gregersen (2011), and, in particular, Sin et al. (2013).

Table 5. *Impact of a 10% Reduction in Export Trade Costs - Chemicals*

(a) Impact on each LF

Better Export Access	**Firm**	**Domestic Market Share** Change (p.p.)	**Domestic Prices/Markups** Change (%)	**Quality Investments** Change (%)	**Export Revenues** Change (%)	**Total Gross Profits** Change (%)
For All Firms	Top 1	2.11	0.94	58.17	78.31	50.70
	Top 2	-2.33	-0.79	-7.84	23.50	-14.59
	Top 3	-0.40	-0.12	19.34	47.22	16.47
	Top 4	-0.82	-0.25	-5.65	25.49	-8.21
Only For LFs	Top 1	7.13	3.41	70.11	87.36	73.20
	Top 2	1.60	0.57	24.35	51.40	26.12
	Top 3	1.66	0.53	50.26	72.20	52.08
	Top 4	0.79	0.24	31.92	57.61	32.96
Only For SFs	Top 1	-4.55	-1.87	-10.68	-7.39	-16.49
	Top 2	-3.67	-1.22	-28.74	-20.58	-34.77
	Top 3	-1.71	-0.52	-24.08	-17.08	-26.56
	Top 4	-1.42	-0.43	-31.34	-22.56	-33.58

(b) Impact on LFs as Group

Better Export Access	**Domestic Market Share** Change (p.p.)	**Total Gross Profits** Change (%)
For All Firms	-1.44	35.04
Only For LFs	11.19	62.33
Only For SFs	-11.35	-20.95

In Table 5b, we can observe that, following an export shock to all firms, the domestic market share of LFs as a group decrease, while the total profits in the industry increase. However, in industries like Chemicals where LFs are quite dissimilar, aggregate outcomes of this sort hide the idiosyncratic responses of LFs that generate them.

This disparity of effects can be appreciated by describing the characteristics of the first two top LFs. On the one hand, the top firm is heavily oriented to foreign markets, with sales abroad greater than those at home. Thus, when there is a reduction in the export trade costs of all firms, this firm has incentives to invest more, determining increases in its domestic market share, prices, and profits. On the other hand, the second top firm features the opposite characteristics: its revenue comes mainly from sales in Denmark, whereas its exports are even lower than the third top firm. Due to this, following an export shock to all firms, tougher domestic competition affects this firm to such an extent that it reduces its quality investments, which lowers its domestic market share, prices, and profits.

6 Conclusion

In this paper, we have studied the effects of better export access on domestic markets. Our analysis focused on small countries, where both small and large firms are usually export-oriented, due to the limitations imposed by the size of the home market.

The analysis has been carried out through a structural model that captures two mechanisms following an export shock. They operate differently depending on the type of firm that is affected. First, it increases the expected profitability of small firms, which induces the entry of firms and, hence, creates tougher domestic competition. Concurrently, it expands a firm's sales, which, by reducing average quality fixed costs, provides each large firm with incentives to upgrade quality. By doing this, large firms increase the appeal of their varieties at home and are able to raise their domestic prices.

Empirically, we have shown that the magnitude of each channel can be captured parsimoniously through the export intensity of small firms and each large firm. Estimating the model for Denmark, this determines that different distributions of export intensities give rise to different effects across and within industries.

One conclusion that can be derived from our study is in relation to the idiosyncratic features of large firms. We have shown that, even within industries, it is not always possible to have a uniform characterization of them. Therefore, one insight from our results, which goes beyond this paper, is that their dissimilar responses can lead to completely different conclusions. This is because, due to their size, these firms can affect aggregate outcomes at both the industry and country level.

References

Aghion, P., A. Bergeaud, M. Lequien, and M. J. Melitz (2018). The heterogeneous impact of market size on innovation: Evidence from french firm-level exports. Working Paper 24600, National Bureau of Economic Research. 1

Alfaro, M. (2019). The Microeconomics of New Trade Models. *Mimeo*. 5

Amiti, M., O. Itskhoki, and J. Konings (2018). International shocks, variable markups, and domestic prices. *The Review of Economic Studies*. 4.2, B

Amiti, M. and A. K. Khandelwal (2013). Import Competition and Quality Upgrading. *The Review of Economics and Statistics 95*(2), 476–490. B

Asmild, M. (2019). Landbrugsbarometer 2019: En vurdering af dansk landbrugs relative konkurrenceevne udtrykt ved forskelle i produktionsmuligheder og i udnyttelsen af disse. 13

Atkeson, A. and A. T. Burstein (2010). Innovation, firm dynamics, and international trade. *Journal of political economy 118*(3), 433–484. 1

Baldwin, R. E. and F. Robert-Nicoud (2008). Trade and growth with heterogeneous firms. *Journal of International Economics 74*(1), 21–34. 1

Bernard, A., J. Jensen, S. Redding, and P. Schott (2012). The Empirics of Firm Heterogeneity and International Trade. *Annual Review of Economics 4*(1), 283–313. 7

Berry, S., A. Eizenberg, and J. Waldfogel (2016). Optimal product variety in radio markets. *The RAND Journal of Economics 47*(3), 463–497. 4.2, B

Bloch, C. (2006). Biotechnology in denmark 2005. Technical report, Working Paper 2006/4, The Danish Centre for Studies in Research and Research. 10

Blundell, R., R. Griffith, and J. Van Reenen (1999). Market share, market value and innovation in a panel of british manufacturing firms. *The Review of Economic Studies 66*(3), 529–554. 2

Bonfiglioli, A., R. Crinò, and G. Gancia (2018). Betting on exports: trade and endogenous heterogeneity. *The Economic Journal 128*(609), 612–651. 1

Broda, C. and D. E. Weinstein (2006). Globalization and the Gains From Variety. *The Quarterly Journal of Economics 121*(2), 541–585. 4.2

Bustos, P. (2011). Trade liberalization, exports, and technology upgrading: Evidence on the impact of mercosur on argentinian firms. *American economic review 101*(1), 304–40. 1

Campbell, J. L. and O. K. Pedersen (2007). The varieties of capitalism and hybrid success: Denmark in the global economy. *Comparative Political Studies 40*(3), 307–332. 1, 5.1

Cohen, W. M. (2010). Fifty years of empirical studies of innovative activity and performance. In *Handbook of the Economics of Innovation*, Volume 1, pp. 129–213. Elsevier. 2

Cohen, W. M. and S. Klepper (1996a). Firm size and the nature of innovation within industries: the case of process and product r&d. *The review of Economics and Statistics*, 232–243. 3

Cohen, W. M. and S. Klepper (1996b). A reprise of size and r & d. *The Economic Journal 106*(437), 925–951. 3

Costantini, J. and M. Melitz (2008). The dynamics of firm-level adjustment to trade liberalization. *The organization of firms in a global economy 4*, 107–141. 1

Dekle, R., J. Eaton, and S. Kortum (2008). Global rebalancing with gravity: Measuring the burden of adjustment. *IMF Staff Papers 55*(3), 511–540. 4.1

Demidova, S. and A. Rodríguez-Clare (2009). Trade Policy under Firm-Level Heterogeneity in a Small Economy. *Journal of International Economics 78*(1), 100–112. 2.5

Demidova, S. and A. Rodríguez-Clare (2013). The Simple Analytics of the Melitz Model in a Small Economy. *Journal of International Economics 90*(2), 266–272. 2.5

Dolk, T., S. Gestrelius, and A. Sandström (2008). National and regional cluster profiles–companies in biotechnology, pharmaceuticals and medical technology in denmarkin comparison with sweden. *VINNOVA–Swedish Agency for Innovation Systems 4*. 14

Eaton, J., S. S. Kortum, and S. Sotelo (2012). International Trade: Linking Micro and Macro. Working Paper 17864, National Bureau of Economic Research. 1

Gaubert, C. and O. Itskhoki (2018). Granular comparative advantage. Technical report, National Bureau of Economic Research. 1, 4.2

Grossman, G. M. and E. Helpman (2018). Growth, trade, and inequality. *Econometrica 86*(1), 37–83. 1

Halkier, H., L. James, and E. P. Straete (2017). Quality turns in nordic food: a comparative analysis of specialty food in denmark, norway and sweden. *European Planning Studies 25*(7), 1111–1128. 13

Impullitti, G. and O. Licandro (2018). Trade, firm selection and innovation: The competition channel. *The Economic Journal 128*(608), 189–229. 1

Lileeva, A. and D. Trefler (2010). Improved access to foreign markets raises plant-level productivityâŠ for some plants. *The Quarterly journal of economics 125*(3), 1051–1099. 1

Madsen, P. K. (2017). The danish model of flexicurity: a paradiseâwith some snakes. In *Labour Market and Social Protection Reforms in International Perspective*, pp. 243–265. Routledge. 8

Mayer, T. and G. Ottaviano (2008). The Happy Few: The Internationalisation of European Firms. *Intereconomics- Review of European Economic Policy 43*(3), 135–148. 1, 7

Melitz, M. J. (2003). The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity. *Econometrica 71*(6), 1695–1725. 1

Ornston, D. (2012). *When small states make big leaps: Institutional innovation and high-tech competition in Western Europe*. Cornell University Press. 1, 5.1

Pålsson, C. M. and B. Gregersen (2011). Biotechnology in denmark and sweden. *Biotechnology and Innovation Systems*, 245. 14

Parenti, M. (2018). Large and small firms in a global market: David vs. Goliath. *Journal of International Economics 110*, 103–118. 1

Piveteau, P. and G. Smagghue (2019). Estimating firm product quality using trade data. *Journal of International Economics 118*, 217–232. B

Porter, M. (1990). *The Competitive Advantage of Nations*. Free Press. 5.1

Schmookler, J. (1966). Invention and economic growth. 3

Schwartz, H. M. (2001). The danish âmiracle: luck, pluck, or stuck? *Comparative Political Studies 34*(2), 131–155. 1, 5.1

Shimomura, K.-I. and J.-F. Thisse (2012). Competition among the big and the small. *The RAND Journal of Economics 43*(2), 329–347. 1

Sin, G., R. Gani, and K. Dam-Johansen (2013). Denmark's chemicals industry: Progress and challenges. *Chemical Engineering Progress 109*(2), 54–59. 14

Soderbery, A. (2015). Estimating import supply and demand elasticities: Analysis and implications. *Journal of International Economics 96*(1), 1 – 17. 4.2, B, B, B

Online Appendix - not for publication

A Proofs and Derivations

In order to make this appendix self-contained, some of the equations included in the main part of the paper are restated here. Also, when we refer to country H, we assume implicitly that it is a small country and that the rest of the world is a composite country F

A.1 Intermediate Results

We start by establishing some intermediate results that allow us to perform subsequent calculations more easily. In particular, we characterize how the optimal decisions by LFs (i.e., prices and investments) are impacted by variations in market shares and export trade costs. After this, we solve for the system of equations consisting of each firm's market shares, and characterize the relation between market shares with the domestic price index and export trade costs. Finally, we outline the impact on gross profits and, then, describe how the price index is impacted by export trade costs.

A.1.1 Optimal Prices

We begin by determining the partial effect of a change in trade costs on the prices set by a LF ω from $i \in \mathcal{C}$ in $j \in \mathcal{C}$. Conditional on ω's market share, (5) determines that this is simply given by

$$\frac{\partial \ln p_{ij}^{\omega}}{\partial \ln \tau_{ij}^{\omega}} = 1. \tag{25}$$

As for the effect of market share on prices, by (5), we can express domestic prices by $\ln p_{ij}^{\omega} = \ln m_{ij}^{\omega} + \ln c_{ij}^{\omega}$. Therefore,

$$\frac{\partial \ln p_{ij}^{\omega}}{\partial \ln s_{ij}^{\omega}} = \frac{\partial \ln m_{ij}^{\omega}}{\partial \ln s_{ij}^{\omega}} = \frac{\partial \ln m_{ij}^{\omega}}{\partial \ln \varepsilon_{ij}^{\omega}} \frac{\partial \ln \varepsilon_{ij}^{\omega}}{\partial \ln s_{ij}^{\omega}}.$$

In turn, $\ln m_{ij}^{\omega} = \ln \varepsilon_{ij}^{\omega} - \ln \left(\varepsilon_{ij}^{\omega} - 1 \right)$ and $\varepsilon_{ij}^{\omega} = \sigma + s_{ij}^{\omega} \left(1 - \sigma \right)$. Using these results,

$$\frac{\partial \ln m_{ij}^{\omega}}{\partial \ln \varepsilon_{ij}^{\omega}} = 1 - \frac{\varepsilon_{ij}^{\omega}}{\varepsilon_{ij}^{\omega} - 1} = 1 - m_{ij}^{\omega},$$

and, since $\frac{\partial \varepsilon_{ij}^{\omega}}{\partial s_{ij}^{\omega}} = 1 - \sigma$,

$$\frac{\partial \ln \varepsilon_{ij}^{\omega}}{\partial \ln s_{ij}^{\omega}} = \frac{s_{ij}^{\omega} \left(1 - \sigma \right)}{\varepsilon_{ij}^{\omega}}. \tag{26}$$

This establishes that $\frac{\partial \ln p_{ij}^{\omega}}{\partial \ln s_{ij}^{\omega}} = \left(1 - m_{ij}^{\omega} \right) \frac{s_{ij}^{\omega} (1-\sigma)}{\varepsilon_{ij}^{\omega}}$ which, by using that $1 - m_{ij}^{\omega} = \frac{-1}{\varepsilon_{ij}^{\omega} - 1}$ and $\varepsilon_{ij}^{\omega} - 1 = (\sigma - 1) \left(1 - s_{ij}^{\omega} \right)$, becomes

$$\frac{\partial \ln p_{ij}^{\omega}}{\partial \ln s_{ij}^{\omega}} = \frac{s_{ij}^{\omega}}{\left(1 - s_{ij}^{\omega} \right) \varepsilon_{ij}^{\omega}}. \tag{27}$$

For the case where H is a small economy, the expression for $\frac{\partial \ln p^{\omega}_{HF}}{\partial \ln \tau^{\omega}_{HF}}$ is still given by (25). Nonetheless, since any LF from H is negligible for any foreign country, its markups are constant in F, determining that $\frac{\partial \ln p^{\omega}_{HF}}{\partial \ln s^{\omega}_{HF}} = 0$.

For future references, we summarize the results for a LF from H that we use in subsequent derivations:

$$\frac{\partial \ln p^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}} = \frac{\partial \ln m^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}} = \frac{s^{\omega}_{HH}}{\left(1 - s^{\omega}_{HH}\right) \varepsilon^{\omega}_{HH}}, \tag{28a}$$

$$\frac{\partial \ln p^{\omega}_{HF}}{\partial \ln \tau^{\omega}_{HF}} = 1. \tag{28b}$$

A.1.2 Quality

We begin by showing how to obtain the solution for quality, i.e., (6). The first-order condition for quality determines that, for a LF ω from $i \in \mathcal{C}$,

$$\frac{\partial \pi^{\omega}_{i}}{\partial z^{\omega}_{i}} = \sum_{k \in \mathcal{C}} Q^{\omega}_{ik} \left(p^{\omega}_{ik} - c^{\omega}_{ik}\right) \left(\frac{\mathrm{d} \ln Q^{\omega}_{ik}}{\mathrm{d} \ln z^{\omega}_{i}}\right) \frac{1}{z^{\omega}_{i}} - f^{z}_{i} = 0. \tag{29}$$

By using optimal prices, it can be established that $Q^{\omega}_{ik} \left(p^{\omega}_{ik} - c^{\omega}_{ik}\right) = \frac{R^{\omega}_{ik}}{\varepsilon^{\omega}_{ik}}$. Moreover, if i is not a small country, so that it has market power in each $k \in \mathcal{C}$, then $\frac{\mathrm{d} \ln Q^{\omega}_{ik}}{\mathrm{d} \ln z^{\omega}_{i}} = \delta \left(1 - s^{\omega}_{ik}\right)$. Therefore, the solution to (29) determines (6) and, hence, (7).

In case $i = H$, so that i is a small country, then $\frac{\mathrm{d} \ln Q^{\omega}_{HH}}{\mathrm{d} \ln z^{\omega}_{H}} = \delta \left(1 - s^{\omega}_{HH}\right)$ and $\frac{\mathrm{d} \ln Q^{\omega}_{HF}}{\mathrm{d} \ln z^{\omega}_{H}} = \delta$ for any $j \neq H$. This establishes that (10) holds.

Consider now LF ω from H. Recall that, in the main part of the paper, we have defined $\rho^{\omega}_{HH} := \frac{R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH}}{R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH} + R^{\omega}_{HF}/\sigma}$ and $\rho^{\omega}_{HF} := \frac{R^{\omega}_{HF}/\sigma}{R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH} + R^{\omega}_{HF}/\sigma}$. Besides, by using that $R^{\omega}_{Hj} = E_j s^{\omega}_{Hj}$ for $j \in \{H, F\}$, optimal quality is a function $z^{\omega}_{H}\left(s^{\omega}_{HH}, s^{\omega}_{HF}\right)$. This also implies that z^{ω}_{H} does not depend directly on τ^{ω}_{HF}.

Next, we characterize how s^{ω}_{HH} and s^{ω}_{HF} impact investments. Concerning s^{ω}_{HH},

$$\begin{aligned}
\frac{\partial \ln z^{\omega}_{H}}{\partial \ln s^{\omega}_{HH}} &= \frac{\partial \ln \left[R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH} + R^{\omega}_{HF}/\sigma\right]}{\partial \ln s^{\omega}_{HH}}, \\
&= \rho^{\omega}_{HH} \frac{\partial \ln \left(\frac{R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)}{\varepsilon^{\omega}_{HH}}\right)}{\partial \ln s^{\omega}_{HH}}.
\end{aligned}$$

Besides, since $R_{HH} = E_H s^{\omega}_{HH}$, then

$$\frac{\partial \ln \left(\frac{R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)}{\varepsilon^{\omega}_{HH}}\right)}{\partial \ln s^{\omega}_{HH}} = \frac{\partial \ln \left(E_H s_{HH}\right)}{\partial \ln s^{\omega}_{HH}} - \frac{s^{\omega}_{HH}}{1 - s^{\omega}_{HH}} - \frac{\partial \ln \varepsilon^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}},$$

where we have used the fact that $\frac{\partial \ln\left(1 - s^{\omega}_{HH}\right)}{\partial \ln s^{\omega}_{HH}} = \frac{-s^{\omega}_{HH}}{1 - s^{\omega}_{HH}}$. Using that $\frac{\partial \ln \varepsilon^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}} = (1 - \sigma) \frac{s^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}}$ and the fact that $(1 - \sigma)\, s^{\omega}_{HH} = \varepsilon^{\omega}_{HH} - \sigma$ due to the definition of $\varepsilon^{\omega}_{HH}$,

$$\frac{\partial \ln \left(\frac{R^{\omega}_{HH}\left(1 - s^{\omega}_{HH}\right)}{\varepsilon^{\omega}_{HH}}\right)}{\partial \ln s^{\omega}_{HH}} = 1 - \frac{\varepsilon^{\omega}_{HH} - \sigma}{\varepsilon^{\omega}_{HH}} - \frac{s^{\omega}_{HH}}{1 - s^{\omega}_{HH}}.$$

Gathering terms and using that $\sigma\left(1-s_{HH}^{\omega}\right)=\varepsilon_{HH}^{\omega}-s_{HH}^{\omega}$, it is determined that

$$\frac{\partial \ln\left(\frac{R_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}{\varepsilon_{HH}^{\omega}}\right)}{\partial \ln s_{HH}^{\omega}}=\frac{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)},$$

which allows us to conclude that

$$\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HH}^{\omega}}=\rho_{HH}^{\omega}\frac{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}.$$

Regarding the impact of s_{HF}^{ω} on z_{H}^{ω}, we can proceed in the same fashion as above, determining that

$$\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HF}^{\omega}}=\rho_{HF}^{\omega}\frac{\partial \ln\left(R_{HF}^{\omega}/\sigma\right)}{\partial \ln s_{HF}^{\omega}}.$$

Therefore, since $R_{HF}^{\omega}=E_{F}s_{HF}^{\omega}$,

$$\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HF}^{\omega}}=\rho_{HF}^{\omega}.$$

Gathering all the results and using that $\frac{\partial \ln I_{H}^{\omega}}{\partial \ln s_{HH}^{\omega}}=\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HH}^{\omega}}$, we have that

$$\frac{\partial \ln I_{H}^{\omega}}{\partial \ln s_{HH}^{\omega}}=\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HH}^{\omega}}=\rho_{HH}^{\omega}\frac{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}, \tag{30a}$$

$$\frac{\partial \ln I_{H}^{\omega}}{\partial \ln s_{HF}^{\omega}}=\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HF}^{\omega}}=\rho_{HF}^{\omega}, \tag{30b}$$

A.1.3 Market Shares

Given the characterization of optimal prices and investments for H, summarized by (28) and (30), we proceed to study how the market shares of a LF ω from H are impacted by the price index of H and export trade costs. For the latter, we present results only for τ_{HF}^{ω} since $\frac{\partial \ln \tau_{HF}^{\omega}}{\partial \ln \tau^{\omega}}=\frac{\partial \ln \tau_{HF}^{\omega}}{\partial \ln \tau_{HF}}=1$, which implies that changes in its components τ^{ω} or τ_{HF} have the same logarithmic impact on market shares.

In logarithms, the system of market-shares equations for LF ω is

$$\begin{aligned}\ln s_{HH}^{\omega}&=(1-\sigma)\ln p_{HH}^{\omega}\left(s_{HH}^{\omega}\right)+\delta\ln z_{H}^{\omega}\left(s_{HH}^{\omega},s_{HF}^{\omega}\right)-(1-\sigma)\ln\mathbb{P}_{H},\\ \ln s_{HF}^{\omega}&=(1-\sigma)\ln p_{HF}^{\omega}\left(\tau_{HF}^{\omega}\right)+\delta\ln z_{H}^{\omega}\left(s_{HH}^{\omega},s_{HF}^{\omega}\right)-(1-\sigma)\ln\mathbb{P}_{F}.\end{aligned} \tag{31}$$

Next, we differentiate the system and express it in a matrix way. Before doing this, we obtain an intermediate result to express $1-\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln p_{HH}^{\omega}}\frac{\partial \ln p_{HH}^{\omega}}{\partial \ln s_{HH}^{\omega}}-\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln z_{H}^{\omega}}\frac{\mathrm{d}\ln z_{H}^{\omega}}{\mathrm{d}\ln s_{HH}^{\omega}}$. By using (13) and (15),

$$1-(\sigma-1)\frac{\partial \ln p_{HH}^{\omega}}{\partial \ln s_{HH}^{\omega}}-\delta\frac{\partial \ln z_{H}^{\omega}}{\mathrm{d}\ln s_{HH}^{\omega}}=1-(\sigma-1)\frac{s_{HH}^{\omega}}{\left(1-s_{HH}^{\omega}\right)\varepsilon_{HH}^{\omega}}-\delta\rho_{HH}^{\omega}\frac{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)}.$$

Working out the expression and, in particular, using that $(\sigma-1)\,s_{HH}^{\omega}=\sigma-\varepsilon_{HH}^{\omega}$, we establish that

$$1-\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln p_{HH}^{\omega}}\frac{\partial \ln p_{HH}^{\omega}}{\partial \ln s_{HH}^{\omega}}-\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln z_{H}^{\omega}}\frac{\partial \ln z_{H}^{\omega}}{\partial \ln s_{HH}^{\omega}}=\frac{\left(\sigma-\varepsilon_{HH}^{\omega}s_{HH}^{\omega}\right)-\delta\rho_{HH}^{\omega}\left[\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)-s_{HH}^{\omega}\right]}{\varepsilon_{HH}^{\omega}\left(1-s_{HH}^{\omega}\right)},$$

which can be shown that it is always positive, since $\delta\rho_{HH}^{\omega}\in(0,1)$.

Using this result, along with (28) and (30), we can differentiate the system (31) and express it in a matrix way:

$$\begin{pmatrix} \frac{(\sigma-\varepsilon^{\omega}_{HH}s^{\omega}_{HH})-\delta\rho^{\omega}_{HH}\left[\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})-s^{\omega}_{HH}\right]}{\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})} & -\delta\rho^{\omega}_{HF} \\ -\delta\rho^{\omega}_{HH}\left[\frac{\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})-s^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})}\right] & 1-\delta\rho^{\omega}_{HF} \end{pmatrix} \begin{pmatrix} \mathrm{d}\ln s^{\omega}_{HH} \\ \mathrm{d}\ln s^{\omega}_{HF} \end{pmatrix} = \begin{pmatrix} 0 & \sigma-1 \\ 1-\sigma & 0 \end{pmatrix} \begin{pmatrix} \mathrm{d}\ln \tau^{\omega}_{HF} \\ \mathrm{d}\ln \mathbb{P}_H \end{pmatrix}, \tag{32}$$

where, as in the main part of the paper, we define the matrix on the left-hand side (LHS) as J^{ω}_{H}. This determines that

$$\frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \tau^{\omega}_{HF}} = \frac{\delta\rho^{\omega}_{HF}(1-\sigma)}{\det J^{\omega}_{H}}, \tag{33a}$$

$$\frac{\partial \ln s^{\omega}_{HH}}{\partial \ln \mathbb{P}_{H}} = \frac{(\sigma-1)(1-\delta\rho^{\omega}_{HF})}{\det J^{\omega}_{H}}, \tag{33b}$$

$$\frac{\partial \ln s^{\omega}_{HF}}{\partial \ln \tau^{\omega}_{HF}} = \frac{(1-\sigma)}{\det J^{\omega}_{H}} \frac{(\sigma-\varepsilon^{\omega}_{HH}s^{\omega}_{HH})-\delta\rho^{\omega}_{HH}\left[\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})-s^{\omega}_{HH}\right]}{\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})}, \tag{33c}$$

$$\frac{\partial \ln s^{\omega}_{HF}}{\partial \ln \mathbb{P}_{H}} = \frac{(\sigma-1)\delta\rho^{\omega}_{HH}}{\det J^{\omega}_{H}} \left[\frac{\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})-s^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}(1-s^{\omega}_{HH})}\right]. \tag{33d}$$

A.1.4 LFs' Gross Profits Computation

Next, we show how we can obtain the expressions for gross profits of LF ω and total gross profits, given by (17) and (19). We also show that for the computation of (17) we need values of s^{ω}_{HH}, d^{ω}_{H}, and e^{ω}_{H} for each LF ω from H. For (19), in addition we need $\widetilde{s}^{\omega}_{HH}$ and $\widetilde{s}^{\omega}_{HF}$.

The optimal gross profits of a LF ω from H are given by (11). In order to perform calculations easier, this can be reexpressed as

$$\overline{\pi}^{\omega}_{H} := \exp\left\{\ln\left[\frac{R^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}}\left[1-\delta\left(1-s^{\omega}_{HH}\right)\right]\right]\right\} + \exp\left\{\ln\left[\frac{R^{\omega}_{HF}}{\sigma}\left(1-\delta\right)\right]\right\}.$$

Each of the partial effects is given by

$$\frac{\partial \overline{\pi}^{\omega}_{H}}{\partial \ln \mathbb{P}_{H}} = \sum_{k\in\{H,F\}} \frac{\partial \overline{\pi}^{\omega}_{H}}{\partial \ln s^{\omega}_{Hk}} \frac{\partial \ln s^{\omega}_{Hk}}{\partial \ln \mathbb{P}_{H}},$$

$$\frac{\partial \overline{\pi}^{\omega}_{H}}{\partial \ln \tau^{\omega}_{HF}} = \sum_{k\in\{H,F\}} \frac{\partial \overline{\pi}^{\omega}_{H}}{\partial \ln s^{\omega}_{Hk}} \frac{\partial \ln s^{\omega}_{Hk}}{\partial \ln \tau^{\omega}_{HF}}.$$

Next, we begin by obtaining an expression for $\frac{\partial \overline{\pi}^{\omega}_{H}}{\partial \ln s^{\omega}_{HH}}$. This is given by

$$\frac{\partial \overline{\pi}^{\omega}_{H}}{\partial \ln s^{\omega}_{HH}} = \frac{R^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}}\left[1-\delta\left(1-s^{\omega}_{HH}\right)\right]\left(\frac{\partial \ln\left(\frac{R^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}}\left[1-\delta\left(1-s^{\omega}_{HH}\right)\right]\right)}{\partial \ln s^{\omega}_{HH}}\right),$$

and, in turn, using that $R_{HH} = E_H s^{\omega}_{HH}$:

$$\frac{\partial \ln\left(\frac{R^{\omega}_{HH}}{\varepsilon^{\omega}_{HH}}\left[1-\delta\left(1-s^{\omega}_{HH}\right)\right]\right)}{\partial \ln s^{\omega}_{HH}} = 1 - \frac{\partial \ln \varepsilon^{\omega}_{HH}}{\partial \ln s^{\omega}_{HH}} + \frac{\delta s^{\omega}_{HH}}{1-\delta\left(1-s^{\omega}_{HH}\right)}.$$

Proceeding in the same fashion with $\frac{\partial \pi_H^\omega}{\partial \ln s_{HF}^\omega}$, it is determined that

$$\frac{\partial \pi_H^\omega}{\partial \ln \mathbb{P}_H} = \frac{R_{HH}^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right]}{\varepsilon_{HH}^\omega} \left(1 - \frac{\partial \ln \varepsilon_{HH}^\omega}{\partial \ln s_{HH}^\omega} + \frac{\delta s_{HH}^\omega}{1-\delta\left(1-s_{HH}^\omega\right)}\right) \frac{\partial \ln s_{HH}^\omega}{\partial \ln \mathbb{P}_H} + \frac{R_{HF}^\omega (1-\delta)}{\sigma} \frac{\partial \ln s_{HF}^\omega}{\partial \ln \mathbb{P}_H},$$

$$\frac{\partial \pi_H^\omega}{\partial \ln \tau_{HF}^\omega} = \frac{R_{HH}^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right]}{\varepsilon_{HH}^\omega} \left(1 - \frac{\partial \ln \varepsilon_{HH}^\omega}{\partial \ln s_{HH}^\omega} + \frac{\delta s_{HH}^\omega}{1-\delta\left(1-s_{HH}^\omega\right)}\right) \frac{\partial \ln s_{HH}^\omega}{\partial \ln \tau_{HF}^\omega} + \frac{R_{HF}^\omega (1-\delta)}{\sigma} \left(\frac{\partial \ln s_{HF}^\omega}{\partial \ln \tau_{HF}^\omega}\right).$$

Using (26) and the definition of elasticity, we get that $\frac{\partial \ln \varepsilon_{HH}^\omega}{\partial \ln s_{HH}^\omega} = \frac{s_{HH}^\omega (1-\sigma)}{\varepsilon_{HH}^\omega} = \frac{\varepsilon_{HH}^\omega - \sigma}{\varepsilon_{HH}^\omega}$. Working out the expression, this becomes $1 - \frac{\partial \ln \varepsilon_{HH}^\omega}{\partial \ln s_{HH}^\omega} + \frac{\delta s_{HH}^\omega}{1-\delta\left(1-s_{HH}^\omega\right)} = \frac{\sigma - \delta\left[\varepsilon_{HH}^\omega\left(1-s_{HH}^\omega\right) - s_{HH}^\omega\right]}{\varepsilon_{HH}^\omega\left[1-\delta\left(1-s_{HH}^\omega\right)\right]}$. Therefore,

$$\frac{\partial \pi_H^\omega}{\partial \ln \mathbb{P}_H} = \frac{R_{HH}^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right]}{\varepsilon_{HH}^\omega} \frac{\partial \ln s_{HH}^\omega}{\partial \ln \mathbb{P}_H} \left(\frac{\sigma - \delta\left[\varepsilon_{HH}^\omega\left(1-s_{HH}^\omega\right) - s_{HH}^\omega\right]}{\varepsilon_{HH}^\omega\left[1-\delta\left(1-s_{HH}^\omega\right)\right]}\right) + \frac{R_{HF}^\omega (1-\delta)}{\sigma} \left(\frac{\partial \ln s_{HF}^\omega}{\partial \ln \mathbb{P}_H}\right), \tag{34}$$

$$\frac{\partial \pi_H^\omega}{\partial \ln \tau_{HF}^\omega} = \frac{R_{HH}^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right]}{\varepsilon_{HH}^\omega} \frac{\partial \ln s_{HH}^\omega}{\partial \ln \tau_{HF}^\omega} \left(\frac{\sigma - \delta\left[\varepsilon_{HH}^\omega\left(1-s_{HH}^\omega\right) - s_{HH}^\omega\right]}{\varepsilon_{HH}^\omega\left[1-\delta\left(1-s_{HH}^\omega\right)\right]}\right) + \frac{R_{HF}^\omega (1-\delta)}{\sigma} \frac{\partial \ln s_{HF}^\omega}{\partial \ln \tau_{HF}^\omega}. \tag{35}$$

Notice that

$$\frac{R_{HH}^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right]}{\pi_H^\omega \varepsilon_{HH}^\omega} = \frac{d_H^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega}{d_H^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega + e_H^\omega (1-\delta)/\sigma} =: \phi_{HH}^\omega,$$
$$\frac{R_{HF}^\omega (1-\delta)}{\pi_H^\omega \sigma} = \frac{e_H^\omega (1-\delta)/\sigma}{d_H^\omega \left[1-\delta\left(1-s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega + e_H^\omega (1-\delta)/\sigma} =: \phi_{HF}^\omega,$$

where the second equality in each equation follows by using the definition of π_H^ω and by multiplying and dividing the LHS by $R_{HH}^\omega + R_{HF}^\omega$. By using this result, we can divide the right-hand side (RHS) of (34) and (35) by π_H^ω, and obtain

$$\frac{\partial \ln \pi_H^\omega}{\partial \ln \mathbb{P}_H} = \phi_{HH}^\omega \frac{\partial \ln s_{HH}^\omega}{\partial \ln \mathbb{P}_H} \left(\frac{\sigma - \delta\left[\varepsilon_{HH}^\omega\left(1-s_{HH}^\omega\right) - s_{HH}^\omega\right]}{\varepsilon_{HH}^\omega\left[1-\delta\left(1-s_{HH}^\omega\right)\right]}\right) + \phi_{HF}^\omega \frac{\partial \ln s_{HF}^\omega}{\partial \ln \mathbb{P}_H}, \tag{36a}$$

$$\frac{\partial \ln \pi_H^\omega}{\partial \ln \tau_{HF}^\omega} = \phi_{HH}^\omega \frac{\partial \ln s_{HH}^\omega}{\partial \ln \tau_{HF}^\omega} \left(\frac{\sigma - \delta\left[\varepsilon_{HH}^\omega\left(1-s_{HH}^\omega\right) - s_{HH}^\omega\right]}{\varepsilon_{HH}^\omega\left[1-\delta\left(1-s_{HH}^\omega\right)\right]}\right) + \phi_{HF}^\omega \frac{\partial \ln s_{HF}^\omega}{\partial \ln \tau_{HF}^\omega}. \tag{36b}$$

Next, we derive the partial effects of the gross profits of LFs as a group. First, notice that, by definition of $\overline{\Pi}_H^{\mathscr{L}}$,

$$\frac{\partial \overline{\Pi}_H^{\mathscr{L}}}{\partial \ln \mathbb{P}_H} = \sum_{\omega \in \mathscr{L}_H} \frac{\partial \pi_H^\omega}{\partial \ln \mathbb{P}_H},$$
$$\sum_{\omega \in \mathscr{L}_H} \frac{\partial \overline{\Pi}_H^{\mathscr{L}}}{\partial \ln \tau_{HF}^\omega} = \sum_{\omega \in \mathscr{L}_H} \frac{\partial \pi_H^\omega}{\partial \ln \tau_{HF}^\omega}.$$

Multiplying and dividing the LHS by $\overline{\Pi}_H^{\mathscr{L}}$ and each sum in the RHS by π_H^ω, these equations can be equivalently restated

$$\frac{\partial \ln \overline{\Pi}_H^{\mathscr{L}}}{\partial \ln \mathbb{P}_H} = \sum_{\omega \in \overline{\mathscr{L}}_H} \psi_H^\omega \frac{\partial \ln \overline{\pi}_H^\omega}{\partial \ln \mathbb{P}_H}, \tag{37a}$$

$$\sum_{\omega \in \overline{\mathscr{L}}_H} \frac{\partial \ln \overline{\Pi}_H^{\mathscr{L}}}{\partial \ln \tau_{HF}^\omega} = \sum_{\omega \in \overline{\mathscr{L}}_H} \psi_H^\omega \frac{\partial \ln \overline{\pi}_H^\omega}{\partial \ln \tau_{HF}}, \tag{37b}$$

where $\psi_H^\omega := \frac{\overline{\pi}_H^\omega}{\overline{\Pi}_H^{\mathscr{L}}}$ and, so,

$$\psi_H^\omega := \frac{R_{HH}^\omega \left[1 - \delta \left(1 - s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega + R_{HF}^\omega \left(1 - \delta\right) / \sigma}{\sum_{\omega \in \overline{\mathscr{L}}_H} \left[R_{HH}^\omega \left[1 - \delta \left(1 - s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega + R_{HF}^\omega \left(1 - \delta\right) / \sigma\right]}.$$

For its computation, we divide numerator and denominator by the total income of the industry, Y_H^{ind}, so that

$$\psi_H^\omega = \frac{\widetilde{s}_{HH}^\omega \left[1 - \delta \left(1 - s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega + \widetilde{s}_{HF}^\omega \left(1 - \delta\right) / \sigma}{\sum_{\omega \in \overline{\mathscr{L}}_H} \left[\widetilde{s}_{HH}^\omega \left[1 - \delta \left(1 - s_{HH}^\omega\right)\right] / \varepsilon_{HH}^\omega + \widetilde{s}_{HF}^\omega \left(1 - \delta\right) / \sigma\right]},$$

where $\widetilde{s}_{Hj}^\omega := \frac{R_{Hj}^\omega}{Y_H^{\text{ind}}}$ for $j \in \{H, F\}$.

A.1.5 Price Index

Since H is a small economy, the price index in H is completely determined by (FE) for H. Thus, it is only affected by export trade costs of SFs from H and given by (12). To obtain (12), consider a variation in $\tau_{HF}^{\mathcal{N}}$. By differentiating (FE), it is established that

$$\frac{\mathrm{d} \ln \mathbb{P}_H^*}{\mathrm{d} \ln \tau_{HF}^{\mathcal{N}}} = -\left(\frac{\partial \pi_H^{\mathbb{E},\mathcal{N}}}{\partial \ln \mathbb{P}_H}\right)^{-1} \frac{\partial \pi_H^{\mathbb{E},\mathcal{N}}}{\partial \ln \tau_{HF}^{\mathcal{N}}},$$

where $\frac{\partial \pi_H^{\mathbb{E},\mathcal{N}}}{\partial \ln \mathbb{P}_H} = \frac{\sigma - 1}{\sigma} r_{HH}^{\mathcal{N}}$ and $\frac{\partial \pi_H^{\mathbb{E},\mathcal{N}}}{\partial \ln \tau_{HF}^{\mathcal{N}}} = \frac{1 - \sigma}{\sigma} r_{HF}^{\mathcal{N}}$ with $r_{Hj}^{\mathcal{N}} := \frac{R_{Hj}^{\mathcal{N}}}{M_H^E}$ for $j \in \{H, F\}$. Then, (12) follows by multiplying numerator and denominator of $\frac{\mathrm{d} \ln \mathbb{P}_H^*}{\mathrm{d} \ln \tau_{HF}^{\mathcal{N}}}$ by M_H^E.

A.2 Export Shocks

Next, we concentrate on the propositions and results included in Section 3. Rcall that, throughout the paper, we have assumed that $\varepsilon_{ij}^\omega \left(1 - s_{ij}^\omega\right) - s_{ij}^\omega > 0$ for $i, j \in \mathcal{C}$, which holds when no firm ω has a disproportionately large market share, as in our Danish data for domestic firms. This is utilized in the results we present subsequently.

We begin by stating a lemma that is necessary for determining the signs of each effect.

Lemma 1. $\det J_H^\omega > 0$.

Proof of Lemma 1. Differentiating the system (31) determines (32) and, hence, J_H^ω. This is defined by

$$J_H^\omega := \begin{pmatrix} \frac{(\sigma-\varepsilon_{HH}^\omega s_{HH}^\omega)-\delta\rho_{HH}^\omega[\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega]}{\varepsilon_{HH}^\omega(1-s_{HH}^\omega)} & -\delta\rho_{HF}^\omega \\ -\delta\rho_{HH}^\omega\left[\frac{\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega}{\varepsilon_{HH}^\omega(1-s_{HH}^\omega)}\right] & 1-\delta\rho_{HF}^\omega \end{pmatrix}.$$

Using that $\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega>0$, it can be shown that $\arg\inf_\delta(\det J_H^\omega)=1$. Thus, the proof requires that $\det J_H^\omega>0$ when $\delta\to1$, which ensures that the lemma holds for any $\delta\in(0,1)$. Incorporating that $\delta\to1$, $\det J_H^\omega>0$ when

$$\frac{(\sigma-\varepsilon_{HH}^\omega s_{HH}^\omega)-\rho_{HH}^\omega[\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega]}{\varepsilon_{HH}^\omega(1-s_{HH}^\omega)}(1-\rho_{HF}^\omega)>\rho_{HF}^\omega\rho_{HH}^\omega\left[\frac{\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega}{\varepsilon_{HH}^\omega(1-s_{HH}^\omega)}\right].$$

Taking into account that $1-\rho_{HF}^\omega=\rho_{HH}^\omega$, this inequality holds if

$$(\sigma-\varepsilon_{HH}^\omega s_{HH}^\omega)-\rho_{HH}^\omega[\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega]>\rho_{HF}^\omega[\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega]$$

or, by using that $1=\rho_{HH}^\omega+\rho_{HF}^\omega$, if

$$\sigma-\varepsilon_{HH}^\omega s_{HH}^\omega>\varepsilon_{HH}^\omega(1-s_{HH}^\omega)-s_{HH}^\omega.$$

This inequality can be reexpressed as $\sigma+s_{HH}^\omega>\varepsilon_{HH}^\omega$ and, since $\sigma>\varepsilon_{HH}^\omega$ for any $s_{HH}^\omega>0$, the result follows. ■

Using that $\varepsilon_{ij}^\omega\left(1-s_{ij}^\omega\right)-s_{ij}^\omega>0$ for $i,j\in\mathcal{C}$, it can be easily shown that $\left(\sigma-\varepsilon_{ij}^\omega s_{ij}^\omega\right)-\delta\rho_{ij}^\omega\left[\varepsilon_{ij}^\omega\left(1-s_{ij}^\omega\right)-s_{ij}^\omega\right]>0$ by using that $\delta\rho_{ij}^\omega<1$ and $\sigma\geq\varepsilon_{ij}^\omega$ with strict inequality if the firm ω is non-negligible. Thus, by using these results and Lemma 1, we can determine the sign of all the partial effects. To reference them subsequently, we incorporate them as a lemma.

Lemma 2. *The following signs hold:*

- *for* (28): $\frac{\partial\ln p_{HH}^\omega}{\partial\ln s_{HH}^\omega}=\frac{\partial\ln m_{HH}^\omega}{\partial\ln s_{HH}^\omega}>0$,
- *for* (30): $\frac{\partial\ln I_H^\omega}{\partial\ln s_{HH}^\omega}=\frac{\partial\ln z_H^\omega}{\partial\ln s_{HH}^\omega}>0$, $\frac{\partial\ln I_H^\omega}{\partial\ln s_{HF}^\omega}=\frac{\partial\ln z_H^\omega}{\partial\ln s_{HF}^\omega}>0$,
- *for* (33): $\frac{\partial\ln s_{HH}^\omega}{\partial\ln\mathbb{P}_H}>0$, $\frac{\partial\ln s_{HF}^\omega}{\partial\ln\mathbb{P}_H}>0$, $\frac{\partial\ln s_{HH}^\omega}{\partial\ln\tau_{HF}^\omega}<0$, *and* $\frac{\partial\ln s_{HF}^\omega}{\partial\ln\tau_{HF}^\omega}<0$.

  Moreover, with those results, it can be shown as a corollary that:
- *for* (36): $\frac{\partial\ln\overline{\pi}_H^\omega}{\partial\ln\mathbb{P}_H}>0$ *and* $\frac{\partial\ln\overline{\pi}_H^\omega}{\partial\ln\tau_{HF}^\omega}<0$,
- *for* (37): $\frac{\partial\ln\overline{\Pi}_H^{\mathscr{L}}}{\partial\ln\mathbb{P}_H}>0$ *and* $\frac{\partial\ln\overline{\Pi}_H^{\mathscr{L}}}{\partial\ln\tau_{HF}^\omega}<0$.

A.2.1 Export Shock to SFs

Next, we consider the results included in Section 3.2. We begin by presenting a lemma.

Lemma 3. $\frac{\partial\ln s_{FH}^\omega}{\partial\ln\mathbb{P}_H}>0$

Proof of Lemma 3. Optimal market shares can be obtained by using equation (31) and that optimal prices and quality are given, respectively, by (5) and (6). Proceeding in a similar fashion as in the derivation for (33), we can differentiate the system (31) for LFs from F and obtain that:

$$\begin{pmatrix} \frac{(\sigma-\varepsilon^{\omega}_{FF}s^{\omega}_{FF})-\delta\rho^{\omega}_{FF}[\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}]}{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})} & -\delta\rho^{\omega}_{FH}\frac{\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}}{\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})} \\ -\delta\rho^{\omega}_{FF}\left[\frac{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}}{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})}\right] & \frac{(\sigma-\varepsilon^{\omega}_{FH}s^{\omega}_{FH})-\delta\rho^{\omega}_{FH}[\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}]}{\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})} \end{pmatrix} \begin{pmatrix} \frac{\partial \ln s^{\omega}_{FF}}{\partial \ln \mathbb{P}_H} \\ \frac{\partial \ln s^{\omega}_{FH}}{\partial \ln \mathbb{P}_H} \end{pmatrix} = \begin{pmatrix} 0 \\ \sigma - 1 \end{pmatrix}.$$

We have assumed in the main part of the paper that $\varepsilon^{\omega}_{Fk}(1-s^{\omega}_{Fk}) - s^{\omega}_{Fk} > 0$ for $k \in \mathcal{C}$. Given this, $\arg\inf_{\delta}(\det J^{\omega}_F) = 1$. Thus, if we show that $\det J^{\omega}_F > 0$ when $\delta \to 1$, the result follows for any $\delta \in (0,1)$. This holds when

$$\frac{(\sigma-\varepsilon^{\omega}_{FF}s^{\omega}_{FF})-\rho^{\omega}_{FF}[\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}]}{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})}\frac{(\sigma-\varepsilon^{\omega}_{FH}s^{\omega}_{FH})-\rho^{\omega}_{FH}[\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}]}{\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})} > \rho^{\omega}_{FH}\frac{\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}}{\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})}\rho^{\omega}_{FF}\left[\frac{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}}{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})}\right],$$

and a sufficient condition for this to hold is that the following inequalities hold simultaneously:

$$\begin{aligned} (\sigma-\varepsilon^{\omega}_{FF}s^{\omega}_{FF})-\rho^{\omega}_{FF}[\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}] &\geq \rho^{\omega}_{FH}[\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}], \\ (\sigma-\varepsilon^{\omega}_{FH}s^{\omega}_{FH})-\rho^{\omega}_{FH}[\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}] &\geq \rho^{\omega}_{FF}[\varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}], \end{aligned}$$

with one of them holding with strict inequality. By using that $\rho^{\omega}_{FF}+\rho^{\omega}_{FH}=1$, this becomes

$$\begin{aligned} \sigma-\varepsilon^{\omega}_{FF}s^{\omega}_{FF} &\geq \varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}, \\ \sigma-\varepsilon^{\omega}_{FH}s^{\omega}_{FH} &\geq \varepsilon^{\omega}_{FH}(1-s^{\omega}_{FH})-s^{\omega}_{FH}, \end{aligned}$$

where both are satisfied since $\sigma \geq \varepsilon^{\omega}_{Fk}$ for any $k \in \mathcal{C}$ and one of them has to be holding with strict inequality with non-negligible firms. Therefore, $\det J^{\omega}_F > 0$.

Finally, solving the system, it is determined that

$$\frac{\partial \ln s^{\omega}_{FH}}{\partial \ln \mathbb{P}_H} = \frac{(\sigma-1)}{\det J^{\omega}_F}\frac{(\sigma-\varepsilon^{\omega}_{FF}s^{\omega}_{FF})-\delta\rho^{\omega}_{FF}[\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}]}{\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})},$$

which, by using that $(\sigma-\varepsilon^{\omega}_{FF}s^{\omega}_{FF})-\delta\rho^{\omega}_{FF}[\varepsilon^{\omega}_{FF}(1-s^{\omega}_{FF})-s^{\omega}_{FF}] > 0$, is positive. ■

By using this lemma, we are in position to provide a proof for the first proposition of the main part of the paper.

Proof of Proposition 1. Since only SFs from H have a better export access, then $\mathrm{d}\ln\tau^{\mathcal{N}_H} < 0$. By (12) we know that $\frac{\mathrm{d}\ln \mathbb{P}^*_H}{\mathrm{d}\ln\tau^{\mathcal{N}_H}} > 0$, which determines that $\mathbb{P}^*_H$ decreases.

As for LFs from H, any firm ω is impacted by $\mathbb{P}^*_H$ exclusively. Thus, the total impact on each variable is given by (21). By using Lemma 2 and (12), all the signs in (21) follow. This determines that each LF from H invests less in quality, decreases its domestic prices and markups, garners lower gross profits, and loses domestic market share. Moreover, since all LFs have lower gross profits and market fixed costs did not vary, the total profits are lower too. Consequently, the total profits of LFs from H as a group is lower too.

As for SFs from H, we begin by showing that the domestic survival productivity cutoff, φ^*_{HH}, increases. This is given by (9), and for the domestic market is given by the function

$$\varphi^{\mathcal{N}}(\mathbb{P}^*_H) := \frac{(z^{\mathcal{N}}_H)^{\frac{\delta}{1-\sigma}}\sigma w_H}{(\sigma-1)\mathbb{P}^*_H}\left(\frac{\sigma f_{HH}}{E_H}\right)^{\frac{1}{\sigma-1}}.$$

Noticing that $\frac{\mathrm{d}\ln\varphi^*_{HH}}{\mathrm{d}\ln\mathbb{P}_H}=-1$ and that $\mathbb{P}^*_H$ decreases, the result follows.

Moreover, to show that SFs from H gain domestic market share, we make use of (MS) for H. Notice that this equation is not affected by variations in $\tau^{\mathcal{N}_H}$. Moreover, given that H is a small economy, $\left(\mathbb{P}^*_F, M^{E*}_F\right)$ does not vary. Reexpressing it and stating it as a function of only the variables that change, (MS) for H becomes

$$s^{\mathcal{N}}_{HH}\left(\mathbb{P}^*_H, M^{E*}_H\right)+s^{\mathcal{N}}_{FH}\left(\mathbb{P}^*_H\right)+\sum_{k\in\{H,F\}}\sum_{\omega\in\Omega^{\mathscr{L}}_{kH}} s^{\omega}_{kH}\left(\mathbb{P}^*_H\right)=1.$$

Besides, differentiating it,

$$\mathrm{d}s^{\mathcal{N}}_{HH}+\mathrm{d}s^{\mathcal{N}}_{FH}+\sum_{k\in\{H,F\}}\sum_{\omega\in\Omega^{\mathscr{L}}_{kH}}\mathrm{d}s^{\omega}_{kH}=0.$$

Next, we show that $\mathrm{d}s^{\mathcal{N}}_{FH}<0$, and $\mathrm{d}s^{\omega}_{kH}<0$ for each $\omega\in\Omega^{\mathscr{L}}_{kH}$ and $k\in\{H,F\}$. First, notice that they are only impacted by changes in $\mathbb{P}^*_H$. By Lemma 2, we know that $\frac{\partial\ln s^{\omega}_{HH}}{\partial\ln\mathbb{P}_H}>0$ for any $\omega\in\Omega^{\mathscr{L}}_{HH}$. Moreover, by Lemma 3, $\frac{\partial\ln s^{\omega}_{FH}}{\partial\ln\mathbb{P}_H}>0$ for $\omega\in\Omega^{\mathscr{L}}_{FH}$. Given that $\mathbb{P}^*_H$ decreases, this determines that $\sum_{k\in\{H,F\}}\sum_{\omega\in\Omega^{\mathscr{L}}_{kH}}\mathrm{d}s^{\omega}_{kH}<0$. As for $\mathrm{d}s^{\mathcal{N}}_{FH}$, we have that

$$s^{\mathcal{N}}_{FH}=M^{E*}_F\int_{\varphi^*_{FH}}^{\overline{\varphi}_F}\frac{\left[p^{\mathcal{N}}_{FH}\left(\varphi\right)\right]^{1-\sigma}\left(z^{\mathcal{N}}_F\right)^{\delta}}{\left(\mathbb{P}^*_H\right)^{1-\sigma}}\mathrm{d}G_F\left(\varphi\right)$$

and

$$\frac{\mathrm{d}s^{\mathcal{N}}_{FH}}{\mathrm{d}\mathbb{P}_H}=\underbrace{\frac{\partial s^{\mathcal{N}}_{FH}}{\partial\mathbb{P}_H}}_{+}+\underbrace{\frac{\partial s^{\mathcal{N}}_{FH}}{\partial\varphi^*_{FH}}\frac{\partial\varphi^*_{FH}}{\partial\mathbb{P}_H}}_{+},$$

where we have used that φ^*_{FH} corresponds to the function (9). Since $\mathbb{P}^*_H$ decreases, this determines that $\mathrm{d}s^{\mathcal{N}}_{FH}<0$. Therefore,

$$\mathrm{d}s^{\mathcal{N}}_{HH}=-\mathrm{d}s^{\mathcal{N}}_{FH}-\sum_{k\in\{H,F\}}\sum_{\omega\in\Omega^{\mathscr{L}}_{kH}}\mathrm{d}s^{\omega}_{kH}>0$$

and the result follows. ■

A.2.2 Export Shock to LFs

Proof of Proposition 2. Suppose that each LF ω from H has better export access, so that $\mathrm{d}\ln\tau^{\omega}<0$. We exploit the fact that $\frac{\partial\ln\tau^{\omega}_{HF}}{\partial\ln\tau^{\omega}}=1$, which allows us to characterize the total impact through a variation in τ^{ω}_{HF}. Regarding the equilibrium price index of H, it is pinned down by (FE) for H. Since τ^{ω}_{HF} does not affect that condition directly, then $\mathbb{P}^*_H$ does not vary. Moreover, by (9), this determines that φ^*_{HH} does not vary either.

Regarding LF ω from H, since $\mathbb{P}^*_H$ does not vary, it is only impacted by the variation in τ^{ω}. This determines that the total impact on each variable of ω is given by (22). The signs of each of these terms are determined by Lemma 2. Thus, each LF from H invests more in quality, increases its domestic prices and markups, and ends up with greater gross profits and domestic market share. Moreover, since all LFs have greater gross profits and market fixed costs do not vary, total profits increase. As a corollary, the total profits of LFs from H as a group increase too.

As for SFs from H, we need to show that M_H^{E*} decreases and that they lose domestic market share. Both can be shown by using (MS) for H. Given that H is a small economy, $\left(\mathbb{P}_F^*, M_F^{E*}\right)$ does not vary. Therefore, (MS) for H can be expressed as

$$s_{HH}^{\mathcal{N}}\left(\mathbb{P}_H^*, M_H^{E*}\right) + s_{FH}^{\mathcal{N}}\left(\mathbb{P}_H^*\right) + \sum_{\omega\in\Omega_{HH}^{\mathscr{L}}} s_{HH}^{\omega}\left(\mathbb{P}_H^*, \tau_{HF}^{\omega}\right) + \sum_{\omega\in\Omega_{FH}^{\mathscr{L}}} s_{FH}^{\omega}\left(\mathbb{P}_H^*\right) = 1.$$

Differentiating the expression,

$$\mathrm{d}s_{HH}^{\mathcal{N}} + \mathrm{d}s_{FH}^{\mathcal{N}} + \sum_{\omega\in\Omega_{HH}^{\mathscr{L}}} \mathrm{d}s_{HH}^{\omega} + \sum_{\omega\in\Omega_{FH}^{\mathscr{L}}} \mathrm{d}s_{FH}^{\omega} = 0.$$

We have already determined that $\mathbb{P}_H^*$ does not vary. Consequently, $\mathrm{d}s_{FH}^{\mathcal{N}} = \mathrm{d}s_{FH}^{\omega} = 0$ for each $\omega \in \Omega_{FH}^{\mathscr{L}}$. Moreover, By Lemma 2, we know that $\frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \tau_{HF}^{\omega}} < 0$ for each $\omega \in \Omega_{HH}^{\mathscr{L}}$. In addition, $\frac{\partial \ln s_{HH}^{\mathcal{N}}}{\partial \ln M_H^{E*}} > 0$. Thus,

$$\frac{\partial \ln s_{HH}^{\mathcal{N}}}{\partial \ln M_H^{E}} \,\mathrm{d}\ln M_H^{E*} + \sum_{\omega\in\Omega_{HH}^{\mathscr{L}}} \frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \tau_{HF}^{\omega}} \,\mathrm{d}\ln \tau^{\omega} = 0,$$

and, since $\mathrm{d}\ln \tau^{\omega} < 0$ for each LF ω from H, it is determined that $\mathrm{d}\ln M_H^{E*} < 0$. Thus, M_H^{E*} decreases and SFs from H lose domestic market share. ■

A.2.3 Export Shock to All Firms

With $\frac{\mathrm{d}\ln \mathbb{P}_H^*}{\mathrm{d}\ln \tau_{HF}}$ determined by (12), all the results regarding LFs from H can be obtained by utilizing the results in Appendix A.1. Specifically, the impact on the domestic market share of a LF ω is given by

$$\frac{\mathrm{d}\ln s_{HH}^{\omega}}{\mathrm{d}\ln \tau_{HF}} = \frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}_H^*}{\mathrm{d}\ln \tau_{HF}} + \frac{\partial \ln s_{HH}^{\omega}}{\partial \ln \tau_{HF}},$$

which can be computed by making use of (12) and (16)

As for the impact on domestic prices and quality investments, they are given by

$$\begin{aligned}
\frac{\mathrm{d}\ln I_H^{\omega}}{\mathrm{d}\ln \tau_{HF}} &= \frac{\partial \ln z_H^{\omega}}{\partial \ln s_{HH}^{\omega}} \frac{\mathrm{d}\ln s_{HH}^{\omega}}{\mathrm{d}\ln \tau_{HF}} + \frac{\partial \ln z_H^{\omega}}{\partial \ln s_{HF}^{\omega}} \left(\frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \mathbb{P}_H} \frac{\mathrm{d}\ln \mathbb{P}_H^*}{\mathrm{d}\ln \tau_{HF}} + \frac{\partial \ln s_{HF}^{\omega}}{\partial \ln \tau_{HF}} \right), \\
\frac{\mathrm{d}\ln p_{HH}^{\omega}}{\mathrm{d}\ln \tau_{HF}} &= \frac{\partial \ln p_{HH}^{\omega}}{\partial \ln s_{HH}^{\omega}} \frac{\mathrm{d}\ln s_{HH}^{\omega}}{\mathrm{d}\ln \tau_{HF}},
\end{aligned}$$

which, additionally, require computing (28) and (30).

A.3 Computations

In the main part of the paper, we have estimated the model considering large changes in export trade costs. As we have indicated there, the definition of variables and the necessary information for computing the total effects are similar to the case in which the variations are infinitesimal. Due to this, taking advantage that we have already established the equations for their computation, here we show how we can calculate the total effects for this case.

To take the model to the data when there is an infinitesimal variation in export trade costs it is necessary to compute (28), (30), (33), (36), and (37). In terms of parameters, they require estimations of σ and δ, whose procedures are described in Appendix B.

As for (28), (30), (33), and (36), by inspection of the terms, it is determined that for its computation is necessary to have values for s^{ω}_{HH}, $\varepsilon^{\omega}_{HH}$, ρ^{ω}_{HH}, ρ^{ω}_{HF}, ϕ^{ω}_{HH}, and ϕ^{ω}_{HF} for each LF ω. All these expressions can be calculated by knowledge of the expenditure-based domestic market share and the domestic intensities of each LF ω. In terms of our notation, they correspond to s^{ω}_{HH} and d^{ω}_{H}. To see this, regarding $\varepsilon^{\omega}_{HH}$, its value is completely determined by s^{ω}_{HH}. As for ρ^{ω}_{HH} and ρ^{ω}_{HF}, by dividing numerator and denominator by $R^{\omega}_{HH} + R^{\omega}_{HF}$, we obtain $\rho^{\omega}_{HH} := \frac{d^{\omega}_{H}\left(1-s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH}}{d^{\omega}_{H}\left(1-s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH}+e^{\omega}_{H}/\sigma}$ and $\rho^{\omega}_{HF} := \frac{e^{\omega}_{H}/\sigma}{d^{\omega}_{H}\left(1-s^{\omega}_{HH}\right)/\varepsilon^{\omega}_{HH}+e^{\omega}_{H}/\sigma}$, where e^{ω}_{H} can be computed since $e^{\omega}_{H} := 1 - d^{\omega}_{H}$. Similar procedure for ϕ^{ω}_{HH} and ϕ^{ω}_{HF}. Finally, for (37), we need additionally information of $\widetilde{s}^{\omega}_{HH}$ and $\widetilde{s}^{\omega}_{HF}$ to compute ψ^{ω}_{H}.

A.4 Large Changes in Export Trade Costs

Next, we derive the system of equations (24), which is used to compute the total effects when there is an arbitrary change in export trade costs. Specifically, suppose export trade costs in H at the initial situation given by $\left(\tau^{\mathcal{N}}_{HF}\right)'$ for SFs and $\left(\tau^{\omega}_{HF}\right)'$ for each LF ω, with common component of export trade costs τ'_{HF}. Besides, consider that there is an export shock, so that export trade costs become $\left(\tau^{\mathcal{N}}_{HF}\right)''$ for SFs and $\left(\tau^{\omega}_{HF}\right)''$ for each LF ω, with common component of export trade costs τ''_{HF}. Depending on the experiment under analysis, we keep some of the export trade costs unaltered between both scenarios.

As in the main part of the paper, for any variable x, we denote its equilibrium under each set of export trade costs by x' and x'', and express the results by $\widehat{x} := \frac{x''}{x'}$.

We begin by establishing (24a). To do this, we reexpress (FE) for H with the productivity distribution we assumed for large changes in export trade costs. Specifically,

$$\left[\frac{r\left(\mathbb{P}_H,\varphi^D\right)}{\sigma} - f_{HH}\right]\left[\Pr\left(\varphi^D\right) + \Pr\left(\varphi^X\right)\right] + \left[\frac{r\left(\mathbb{P}_F,\varphi^X;\tau^{\mathcal{N}}_{HF}\right)}{\sigma} - f_{HF}\right]\Pr\!\left(\varphi^X\right) = F_H. \tag{38}$$

Given (38) for $\left(\tau^{\mathcal{N}}_{HF}\right)'$ and $\left(\tau^{\mathcal{N}}_{HF}\right)''$, and substituting revenues for their definitions,

$$\begin{aligned}&\left[E_H\frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{\varphi^D}\right)^{1-\sigma}\left(z^{\mathcal{N}}_H\right)^{\delta}}{\sigma\left(\mathbb{P}'_H\right)^{1-\sigma}} - f_{HH}\right]\Pr\left(\varphi^D\right) + \left[E_H\frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{\varphi^X}\right)^{1-\sigma}\left(z^{\mathcal{N}}_H\right)^{\delta}}{\sigma\left(\mathbb{P}'_H\right)^{1-\sigma}} - f_{HH}\right]\Pr(\varphi^X) + \left[E_F\frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{\varphi^X}\right)^{1-\sigma}\left(z^{\mathcal{N}}_H\right)^{\delta}}{\sigma\left(\mathbb{P}_F\right)^{1-\sigma}}\left[\left(\tau^{\mathcal{N}}_{HF}\right)'\right]^{1-\sigma} - f_{HF}\right]\Pr(\varphi^X) =\\&\left[E_H\frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{\varphi^D}\right)^{1-\sigma}\left(z^{\mathcal{N}}_H\right)^{\delta}}{\sigma\left(\mathbb{P}''_H\right)^{1-\sigma}} - f_{HH}\right]\Pr\left(\varphi^D\right) + \left[E_H\frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{\varphi^X}\right)^{1-\sigma}\left(z^{\mathcal{N}}_H\right)^{\delta}}{\sigma\left(\mathbb{P}''_H\right)^{1-\sigma}} - f_{HH}\right]\Pr(\varphi^X) + \left[E_F\frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{\varphi^X}\right)^{1-\sigma}\left(z^{\mathcal{N}}_H\right)^{\delta}}{\sigma\left(\mathbb{P}_F\right)^{1-\sigma}}\left[\left(\tau^{\mathcal{N}}_{HF}\right)''\right]^{1-\sigma} - f_{HF}\right]\Pr(\varphi^X).\end{aligned}$$

After some algebra, this can be reexpressed as

$$\gamma\left[\left(\widehat{\mathbb{P}}_H\right)^{\sigma-1} - 1\right] + \chi\left[\left(\widehat{\tau}^{\mathcal{N}}_{HF}\right)^{1-\sigma} - 1\right] = 0,$$

where $\gamma := \frac{r\left(\mathbb{P}'_H,\varphi^D\right)}{\sigma}\Pr\left(\varphi^D\right) + \frac{r\left(\mathbb{P}'_H,\varphi^X\right)}{\sigma}\Pr\!\left(\varphi^X\right)$ and $\chi := \frac{r\left[\mathbb{P}_F,\varphi^X;\left(\tau^{\mathcal{N}}_{HF}\right)'\right]}{\sigma}\Pr\!\left(\varphi^X\right)$. Using that $\left(M_{HH}\right)' = \left(M^E_H\right)'\left[\Pr\left(\varphi^D\right) + \Pr\left(\varphi^X\right)\right]$ and $\left(M_{HF}\right)' = \left(M^E_H\right)'\Pr\left(\varphi^X\right)$, we can multiply these terms by $\left(M_H^E\right)'$ to obtain $\gamma\left(M_H^E\right)' = \frac{\left(R_{HH}^{\mathcal{N}}\right)'}{\sigma}$ and $\chi\left(M_H^E\right)' = \frac{\left(R_{HF}^{\mathcal{N}}\right)'}{\sigma}$. Thus,

$$\widehat{\mathbb{P}}_H = \left\{1 - \frac{\left(e_H^{\mathcal{N}}\right)'}{\left(d_H^{\mathcal{N}}\right)'}\left[\left(\widehat{\tau}_{HF}^{\mathcal{N}}\right)^{1-\sigma} - 1\right]\right\}^{\frac{1}{\sigma-1}}, \tag{39}$$

where, under the productivity distribution assumed, $\frac{e_H^{\mathcal{N}}}{d_H^{\mathcal{N}}} = \frac{\gamma\left(M_H^E\right)'/\left[\left(R_{HH}^{\mathcal{N}}\right)'+\left(R_{HF}^{\mathcal{N}}\right)'\right]}{\chi\left(M_H^E\right)'/\left[\left(R_{HH}^{\mathcal{N}}\right)'+\left(R_{HF}^{\mathcal{N}}\right)'\right]}$.

As for domestic prices and markups of LF ω, which are given by (24b), we begin by reexpressing the price elasticity of demand. Expressing $\varepsilon\left(s_{HH}^{\omega}\right) = \sigma + s_{HH}^{\omega}\left(1-\sigma\right)$ in terms of differences,

$$\left(\varepsilon_{HH}^{\omega}\right)'' - \left(\varepsilon_{HH}^{\omega}\right)' = \left[\left(s_{HH}^{\omega}\right)'' - \left(s_{HH}^{\omega}\right)'\right]\left(1-\sigma\right),$$

and, by using that $\left(x_{HH}^{\omega}\right)'' - \left(x_{HH}^{\omega}\right)' = \widehat{x}_{HH}^{\omega}\left(x_{HH}^{\omega}\right)'$ for any variable x, this can be reexpresed by

$$\widehat{\varepsilon}_{HH}^{\omega} = 1 + \left(1 - \widehat{s}_{HH}^{\omega}\right)\frac{\left(s_{HH}^{\omega}\right)'\left(\sigma-1\right)}{\sigma - \left(s_{HH}^{\omega}\right)'\left(\sigma-1\right)}.$$

Thus, given that $\widehat{m}_{HH}^{\omega} = \frac{\left(\varepsilon_{HH}^{\omega}\right)''}{\left(\varepsilon_{HH}^{\omega}\right)''-1}\frac{\left(\varepsilon_{HH}^{\omega}\right)'-1}{\left(\varepsilon_{HH}^{\omega}\right)'}$ for markups, then

$$\widehat{p}_{HH}^{\omega} = \widehat{m}_{HH}^{\omega} = \widehat{\varepsilon}_{HH}^{\omega}\frac{\left(\varepsilon_{HH}^{\omega}\right)'-1}{\widehat{\varepsilon}_{HH}^{\omega}\left(\varepsilon_{HH}^{\omega}\right)'-1}. \tag{40}$$

Regarding investments from a LF ω, their variation is given by (24c). Making use of that $R\left(s_{Hk}^{\omega}\right) = E_k s_{Hk}^{\omega}$ for $k \in \mathcal{C}$, then

$$\left(I_H^{\omega}\right)'' - \left(I_H^{\omega}\right)' = \delta E_H\left[\frac{\left(s_{HH}^{\omega}\right)''}{\varepsilon\left[\left(s_{HH}^{\omega}\right)''\right]}\left[1-\left(s_{HH}^{\omega}\right)''\right] - \frac{\left(s_{HH}^{\omega}\right)'}{\varepsilon\left[\left(s_{HH}^{\omega}\right)'\right]}\left[1-\left(s_{HH}^{\omega}\right)'\right]\right] + \delta\frac{E_F}{\sigma}\left[\left(s_{HF}^{\omega}\right)'' - \left(s_{HF}^{\omega}\right)'\right]. \tag{41}$$

The first term on the LHS can be reexpressed as $\left(I_H^{\omega}\right)'' - \left(I_H^{\omega}\right)' = \left(\widehat{I}_H^{\omega} - 1\right)\left(I_H^{\omega}\right)'$, while the second term on the RHS as $\delta\frac{E_F}{\sigma}\left[\left(s_{HF}^{\omega}\right)'' - \left(s_{HF}^{\omega}\right)'\right] = \delta\frac{R_{HF}^{\omega}}{\sigma}\left(\widehat{s}_{HF}^{\omega} - 1\right)$. Moreover, after working out the expression, the first term of the RHS becomes

$$E_H\delta\frac{\left(s_{HH}^{\omega}\right)'}{\left(\varepsilon_{HH}^{\omega}\right)'}\left[1-\left(s_{HH}^{\omega}\right)'\right]\left[\frac{\widehat{s_{HH}^{\omega}}}{\widehat{\varepsilon_{HH}^{\omega}}}\frac{1-\left(s_{HH}^{\omega}\right)'\widehat{s_{HH}^{\omega}}}{1-\left(s_{HH}^{\omega}\right)'} - 1\right],$$

which determines that (41) is

$$\left(\widehat{I}_H^{\omega} - 1\right)\left(I_H^{\omega}\right)' = \delta\frac{\left(R_{HH}^{\omega}\right)'}{\left(\varepsilon_{HH}^{\omega}\right)'}\left[1-\left(s_{HH}^{\omega}\right)'\right]\left[\frac{\widehat{s}_{HH}^{\omega}}{\widehat{\varepsilon}_{HH}^{\omega}}\frac{1-\widehat{s}_{HH}^{\omega}\left(s_{HH}^{\omega}\right)'}{1-\left(s_{HH}^{\omega}\right)'} - 1\right] + \delta\frac{\left(R_{HF}^{\omega}\right)'}{\sigma}\left(\widehat{s}_{HF}^{\omega} - 1\right).$$

Finally, dividing by $\left(I_H^{\omega}\right)'$, we can utilize ρ_{HH}^{ω}, as defined by for the case of infinitesimal variations in export trade costs, determining that

$$\widehat{I}_H^\omega = \widehat{z}_H^\omega = 1 + \left(\rho_{HH}^\omega\right)' \left[\frac{\widehat{s}_{HH}^\omega}{\widehat{\varepsilon}_{HH}^\omega} \frac{1-\widehat{s}_{HH}^\omega \left(s_{HH}^\omega\right)'}{1-\left(s_{HH}^\omega\right)'} - 1 \right] + \left(\rho_{HF}^\omega\right)' \left[\widehat{s}_{HF}^\omega - 1\right]. \tag{42}$$

Regarding market shares of LF ω, it is immediate to obtain (24d) and (24e):

$$\widehat{s}_{HH}^\omega = \frac{\left(\widehat{m}_{HH}^\omega\right)^{1-\sigma} \left(\widehat{z}_H^\omega\right)^\delta}{\left(\widehat{\mathbb{P}}_H\right)^{1-\sigma}},$$

$$\widehat{s}_{HF}^\omega = \left(\widehat{\tau}_{HF}^\omega\right)^{1-\sigma} \left(\widehat{z}_H^\omega\right)^\delta.$$

Regarding gross profits of LF ω, $\overline{\pi}_H^\omega$, their variations are given by (24f). To obtain this expression, we proceed in a similar fashion as for investments. Their difference is given by

$$\left(\overline{\pi}_H^\omega\right)'' - \left(\overline{\pi}_H^\omega\right)' = E_H \left\{ \frac{\left(s_{HH}^\omega\right)''}{\left(\varepsilon_{HH}^\omega\right)''} \left[1-\delta\left(1-\left(s_{HH}^\omega\right)''\right)\right] - \frac{\left(s_{HH}^\omega\right)'}{\left(\varepsilon_{HH}^\omega\right)'} \left[1-\delta\left(1-\left(s_{HH}^\omega\right)'\right)\right] \right\} + \frac{E_F}{\sigma}\left(1-\delta\right)\left[\left(s_{HF}^\omega\right)'' - \left(s_{HF}^\omega\right)'\right].$$

The first term of the RHS can be reexpressed as

$$\delta E \frac{\left(s_{HH}^\omega\right)'}{\left(\varepsilon_{HH}^\omega\right)'} \left[1-\delta\left(1-\left(s_{HH}^\omega\right)'\right)\right] \left\{ \frac{\widehat{s}_{HH}^\omega}{\widehat{\varepsilon}_{HH}^\omega} \frac{1-\delta\left(1-\widehat{s}_{HH}^\omega\left(s_{HH}^\omega\right)'\right)}{1-\delta\left(1-\left(s_{HH}^\omega\right)'\right)} - 1 \right\},$$

and the second term of the RHS by $\frac{E_F}{\sigma}\left(1-\delta\right)\left[\left(s_{HF}^\omega\right)'' - \left(s_{HF}^\omega\right)'\right] = \frac{E_F}{\sigma}\left(1-\delta\right)\left(s_{HF}^\omega\right)'\left(\widehat{s}_{HF}^\omega - 1\right)$. This determines that

$$\left(\widehat{\overline{\pi}}_H^\omega - 1\right)\left(\overline{\pi}_H^\omega\right)' = \frac{E_H\left(s_{HH}^\omega\right)'}{\left(\varepsilon_{HH}^\omega\right)'} \left[1-\delta\left(1-\left(s_{HH}^\omega\right)'\right)\right] \left\{ \frac{\widehat{s}_{HH}^\omega}{\widehat{\varepsilon}_{HH}^\omega} \frac{1-\delta\left(1-\widehat{s}_{HH}^\omega\left(s_{HH}^\omega\right)'\right)}{1-\delta\left(1-\left(s_{HH}^\omega\right)'\right)} - 1 \right\} + \frac{E_F\left(s_{HF}^\omega\right)'}{\sigma}\left(1-\delta\right)\left(\widehat{s}_{HF}^\omega - 1\right).$$

Using the same definitions for ϕ_{HH}^ω and ϕ_{HF}^ω as in the case of infinitesimal changes, then

$$\widehat{\overline{\pi}}_H^\omega = 1 + \left(\phi_{HH}^\omega\right)' \left\{ \frac{\widehat{s}_{HH}^\omega}{\widehat{\varepsilon}_{HH}^\omega} \frac{1-\delta\left(1-\widehat{s}_{HH}^\omega\left(s_{HH}^\omega\right)'\right)}{1-\delta\left(1-\left(s_{HH}^\omega\right)'\right)} - 1 \right\} + \left(\phi_{HF}^\omega\right)'\left(\widehat{s}_{HF}^\omega - 1\right). \tag{43}$$

Finally, we can calculate the increases in total gross profits, which are given by (24g). Multiplying and dividing $\left(\overline{\pi}_H^\omega\right)''$ by $\left(\overline{\pi}_H^\omega\right)'$, we obtain that $\left(\overline{\Pi}_H^{\mathscr{L}}\right)'' = \sum_{\omega\in\overline{\mathscr{L}}_H} \widehat{\overline{\pi}}_H^\omega \left(\overline{\pi}_H^\omega\right)'$. Therefore, dividing both sides by $\left(\overline{\Pi}_H^{\mathscr{L}}\right)'$, it is established that

$$\widehat{\overline{\Pi}}_H^{\mathscr{L}} = \sum_{\omega\in\overline{\mathscr{L}}_H} \psi_H^\omega \widehat{\overline{\pi}}_H^\omega,$$

where $\psi_H^\omega := \frac{\overline{\pi}_H^\omega}{\overline{\Pi}_H^{\mathscr{L}}}$.

B Parameters Calibration

For the computations of results, we need values for σ and δ. The latter comes from the parameter estimates by Soderbery (2015), which we compute by using industry-revenue weights. Thus, next, we concentrate on the procedure for δ.

Intuitively, we calibrate δ by fitting, as close as possible to the model, each LF's domestic market share variation not explained by its prices. The approach is based on the logic of how quality is usually estimated and, in particular, resembles the approach of Berry et al. (2016), which is employed to quantify changes in quality in counterfactual scenarios when this is not observable.

We begin by explaining how we obtain prices, which are necessary for the estimation of δ. By exploiting that our datasets include information on quantities at the 8-digit Combined Nomenclature (henceforth CN8) level, we define prices as unit values. As is well known, unit values constitute an extremely noisy measure of prices. Moreover, as is common in Prodcom datasets, firms are not obliged to report quantities in Denmark. Thus, the data include both missing values and reports of quantities in different units of measure. In addition, since we only utilize the LFs' prices, the sample becomes smaller than usual, making measurement error more severe.

To reduce the noise, we clean the data by following standard procedures that use similar datasets (e.g., Amiti and Khandelwal 2013, Amiti et al. 2018, and Piveteau and Smagghue 2019). Using the logarithm of unit values as prices, this is accomplished by performing the following steps:

- by CN8 product, we drop prices that fall below the 5 percentile or above the 95 percentile, and
- by firm-CN8 product, we remove prices that are 150% greater or 66% lower than the previous or subsequent year.

Also, to increase the sample, when units are expressed in different but comparable units, we express them in a same unit.[15]

This procedure defines prices at the firm-product level, whereas we perform an analysis at the firm-industry level. Due to this, it is necessary to aggregate prices at this level. To do this, for each firm-industry, we calculate its prices as a weighted average of prices at the CN8 level, with weights given by the contribution of each CN8 product to the firm's revenue. For the procedure, we remove industries where at least one Danish LF does not report quantities or at least one CN8 is not expressed in comparable units.

With these prices, next we describe how we estimate δ. We begin by expressing (4) in logarithms, which determines that the market share of a Danish LF producing variety ω in the industry n is,

$$\ln s_{\omega n} = (1 - \sigma_n) \ln p_{\omega n} + \delta \ln z_{\omega n} - \ln \mathbb{A}_n. \tag{44}$$

Regarding each term, $s_{\omega n}$ and $p_{\omega n}$ correspond to the domestic market share and domestic prices, respectively, which are obtained from the Danish data. Moreover, σ_n comes from the estimations by Soderbery (2015) aggregated at the industry level by expenditure weights, while $\mathbb{A}_n$ is treated as fixed effect. As for $z_{\omega n}$, we make use of (10) and reexpress it in the following way:

$$z_{\omega n} := Y_n \frac{\delta}{f^z} \left[\frac{\widetilde{s}^D_{\omega n}}{\varepsilon \left(s_{\omega n} \right)} \left(1 - s_{\omega n} \right) + \frac{\widetilde{s}^X_{\omega n}}{\sigma} \right],$$

where Y_n is the revenue of industry n, $\varepsilon \left(s_{\omega n} \right)$ is the domestic price elasticity of firm-industry (ω, n),

[15] For example, if some CN8 is expressed in kilograms and other CN8 in tons, we express both in kilograms.

and $\widetilde{s}^D_{\omega n}$ and $\widetilde{s}^X_{\omega n}$ are the domestic and export revenue share of firm-industry (ω, n). Adding an error term $\varepsilon_{\omega n}$, this implies that

$$\ln \nu_{\omega n} = \delta \ln z_{\omega n} - \ln \mathbb{A}_n + \varepsilon_{\omega n}, \tag{45}$$

where $\ln \nu_{\omega n} := \ln s_{\omega n} - (1 - \sigma_n) \ln p_{\omega n}$. Finally, since some of the terms in $z_{\omega n}$ are industry specific, (44) can be equivalently expressed as

$$\ln \nu_{\omega n} = \Lambda_n + \delta \ln \xi_{\omega n} + \varepsilon_{\omega n}, \tag{46}$$

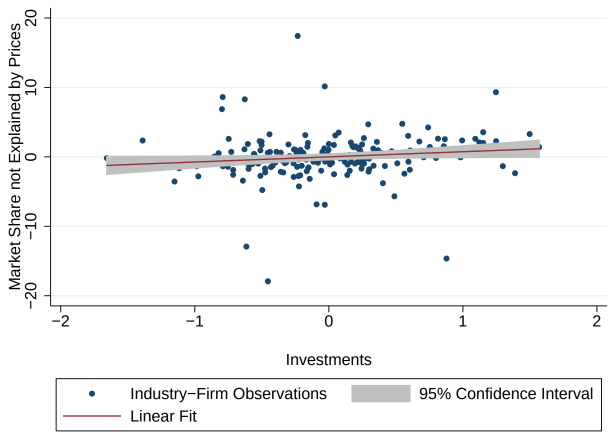
where $\xi_{\omega n} := \frac{\widetilde{s}^D_{\omega n}}{\varepsilon(s_{\omega n})}(1 - s_{\omega n}) + \frac{\widetilde{s}^X_{\omega n}}{\sigma}$ and $\Lambda_n := \delta \ln \left(\frac{Y_n \delta}{f^z} \right) - \ln \mathbb{A}_n$. Thus, δ is obtained by regressing (46). The results of the fit are presented in Figure 6a, which indicates two results. The first one shows the estimation of δ when we utilize the values of σ by Soderbery (2015) for each industry. In addition, for comparison, we include results for a fixed sigma $\sigma := 3.53$, which is the value for a representative manufacturing industry obtained by using industry-revenue weights and used for the empirical analysis. As it can be appreciated, when σ is fixed, δ is calibrated more precisely and, at the same time, provides a similar result.

Figure 6. *Estimation of δ*

(a) Results

	$\ln \nu_{\omega n}$	
	(1)	(2)
$\ln \xi_{\omega n}$	0.677	0.742**
	(0.437)	(0.447)
Industry FE	Yes	Yes
σ	Variable	Fixed
N	211	211
R^2	0.991	0.882

(b) Scatter Plot with Industry-Demeaned Variables



C Machinery

In the main part of the paper, we have based our choice of specific sectors on their contribution to total manufacturing income, expenditures, and exports. By Table 1, this led us to conclude that the top three sectors are Food & Beverages, Chemicals, and Machinery. We presented results for the first two and, next, we do it for Machinery.

Compared to the representative manufacturing industry, concentration in Machinery is substantially lower. This responds to the existence of a large number of SFs operating in the sector, determining an average number of 76 firms in each industry. In addition, the export intensity of firms is high: SFs have a greater export intensity than even SFs in Chemicals, and each LF has an export intensity that is at least 50%.

Regarding results, export shocks to SFs and to all firms determine reductions in the price index that double the magnitude relative to manufacturing. In addition, the results for LFs are the following.

Table 6. *Impact of a 1% Reduction in Export Trade Costs - Machinery*

(a) Impact on each LF

Better Export Access	**Firm**	**Domestic Market Share** Change (p.p.)	**Domestic Prices/Markups** Change (%)	**Quality Investments** Change (%)	**Export Revenues** Change (%)	**Total Gross Profits** Change (%)
For All Firms	Top 1	0.03	0.01	38.55	62.95	35.13
	Top 2	-0.71	-0.22	5.83	35.67	3.07
	Top 3	-0.37	-0.11	13.46	42.25	11.65
	Top 4	-0.13	-0.04	25.26	52.15	24.08
Only For LFs	Top 1	2.81	0.94	65.00	83.51	67.49
	Top 2	1.17	0.26	42.91	66.42	44.31
	Top 3	0.94	0.28	49.87	71.89	50.98
	Top 4	0.81	0.24	59.33	79.19	60.21
Only For SFs	Top 1	-2.23	-0.71	-19.88	-13.99	-22.71
	Top 2	-1.59	-0.48	-29.47	-21.13	-31.78
	Top 3	-1.07	-0.32	-27.84	-19.90	-29.35
	Top 4	-0.74	-0.22	-24.90	-17.69	-25.88

(b) Impact on LFs as Group

Better Export Access	**Domestic Market Share** Change (p.p.)	**Total Gross Profits** Change (%)
For All Firms	-1.19	23.68
Only For LFs	5.72	59.36
Only For SFs	-5.63	-25.95

Even when, as we indicated, the characterization of this industry is somewhat different from manufacturing, the qualitative results for LFs are quite similar. In particular, concerning an export shock to all firms, all LFs increase their quality investments and garner greater profits. Moreover, the top firm increases its domestic presence and prices, while the opposite happens with the rest of the firms. The only difference relative to manufacturing is that, overall, this shock determines that LFs lose domestic market share as a group.

Department of Economics, University of Alberta
Working Paper Series

2020-09: Trade Liberalizations with Granular Firms – **Alfaro, M.**, Warzynski, F.
2020-08: Routine Tasks were Demanded from Workers during an Energy Boom – **Marchand, J.**
2020-07: Financial Frictions, Borrowing Costs, and Firm Size Across Sectors – Bento, P., **Ranasinghe, A.**
2020-06: Bank Lending, Monetary Policy Transmission, and Interest on Excess Reserves: A FAVAR Analysis – **Dave, C.,** Dressler, S., Zhang, L.
2020-05: Vertical Integration and Capacity Investment in the Electricity Sector – **Brown, D.,** Sappington, D.
2020-04: Residential Electricity Pricing in Texas's Competitive Retail Market – **Brown, D.,** Tsai, C., Woo, C., Zarnikau, J., Zhu, S.
2020-03: Competition in Higher Education – Kaganovich, M., Sarpca, S., **Su, X.**
2020-02: Misallocation across Establishment Gender – **Ranasinghe, A.**
2020-01: Does Locational Marginal Pricing Impact Generation Investment Location Decisions? An Analysis of Texas's Wholesale Electricity Market – **Brown, D.,** Zarnikau, J., Woo, C.
2019-16: A Unified Explanation of Trade Liberalization Effects Across Models of Imperfect Competition – **Alfaro, M.**, Lander, D.
2019-15: Analyzing Firm Behaviour in Restructured Electricity Markets: Empirical Challenges with a Residual Demand Analysis – **Brown, D., Eckert, A.**
2019-14: LinkedIn(to) Job Opportunities: Experimental Evidence from Job Readiness Training – **Wheeler, L.**, Garlick, R., Johnson, E., Shaw, P., Gargano, M.
2019-13: Entry Preemption by Domestic Leaders and Home-Bias Patterns: Theory and Empirics – **Alfaro, M.**
2019-12: How Much are Good Schools Worth? Evidence from School Acquisitions in Beijing – **Su, X.,** Yu, H.
2019-11: Enumerating Rights: More is Not Always Better – Ball, S., **Dave, C.,** Dodds, S.
2019-10: Motivating the Optimal Procurement and Deployment of Electric Storage as a Transmission Asset – **Brown, D.,** Sappington, D.
2019-09: Pricing Patterns in Wholesale Electricity Markets: Unilateral Market Power or Coordinated Behavior? – **Brown, D., Eckert, A.**
2019-08: Son Preference and Child Under Nutrition in the Arab Countries: Is There a Gender Bias Against Girls? – **Sharaf, M.,** Rashad, A., Mansour, E.
2019-07: How Local Economic Conditions Affect School Finances, Teacher Quality, and Student Achievement: Evidence from the Texas Shale Boom – **Marchand, J.,** Weber, J.
2019-06: Subjects in the Lab, Activists in the Field: Public Goods and Punishment – **Dave, C.,** Hamre, S., Kephart, C., Reuben, A.
2019-05: Fiscal Austerity in Emerging Market Economies – **Dave, C.,** Ghate, C., Gopalakrishnan, P., Tarafdar, S.
2019-04: Inequality and Trade Policy: Pro-Poor Bias of Contemporary Trade Restrictions – **Ural Marchand, B.**
2019-03: Determinants of Locational Patenting Behavior of Canadian Firms – **Eckert, A., Langinier, C., Zhao, L.**
2019-02: The Microeconomics of New Trade Models – **Alfaro, M.**
2019-01: Universal Childcare for the Youngest and the Maternal Labour Supply – Kunze, A., **Liu, X.**