Import Competition, Quality Upgrading, and Exporting: Evidence from the Peruvian Apparel Industry*

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Abstract

This paper studies quality upgrading to escape competition from low-wage countries and proposes a new channel that does not rely on access to new inputs or markets. Informed by Peruvian apparel firms' response to China's WTO accession, I introduce factor specificity in a multi-product-firm model. Profitability losses due to competition in low-quality segments induce firms to reallocate specific factors to produce high-quality varieties for high-income countries. Gains from this channel are large. Using an observed quality measure, I show that import competition substantially increases domestic firms' exports and high-quality export shares. Firms also reduce prices, resulting in additional welfare gains.

Keywords— F14, F15, F61

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How can firms escape competition from low-wage countries? In an age of unprecedented global market integration, this question has taken center stage in both the popular press and the academic literature. Part of the answer is quality upgrading, and the literature has identified two mechanisms through which the same integration that creates competition allows firms to escape it by quality upgrading. First, integration in input markets facilitates access to cheaper, more varied, and higher-quality inputs (Kugler and Verhoogen, 2012; Bas and Strauss-Kahn, 2015; Fieler, Eslava, and Xu, 2018). Second, integration in output markets enables firm-level investments that are complementary to market size (Verhoogen, 2008; Lileeva and Trefler, 2010; Bustos, 2011; Aw, Roberts, and Xu, 2011; Brambilla, Lederman, and Porto, 2012; Bastos, Silva, and Verhoogen, 2018).

In this paper, I present a heretofore unidentified channel through which trade-induced competition at the final good level drives firms to i) upgrade the quality of their product mix; and ii) increase exports. Under factor mobility frictions, an import competition shock leads firms to optimally reallocate the excess capacity of their firm-specific fixed factors to produce higher-quality goods for exporting rather than exit the market.

I investigate this adjustment mechanism using data on the Peruvian apparel industry during a period in which it faced intense import competition from China. This empirical setting is ideal for two reasons. First, China's accession to the WTO allows me to isolate the impact of an exogenous increase in import competition on Peruvian firms. Although this event meant that China gave Most Favored Nation status to shipments from Peru, it only led to a massive surge in Chinese garments to Peru, not to an export opportunity for Peruvian garment firms. Second, the apparel sector in Peru has an observable measure of product quality, which is recorded in all Peruvian export transactions. Specifically, for the basic garments produced by Peruvian apparel firms, product quality is determined by the quality of the material used. In Peru, the coexistence of high-quality native pima cotton and low-quality synthetic fabrics creates a clear hierarchy of material quality.

I document that, in response to import competition from China, apparel firms increased their high-quality exports, substituting away from low-quality goods. This happened without firms relying on imported inputs, or investing in new technologies or high-skilled labor, as there was no significant change in the size or composition of firm-level employment, capital, or investment. Instead, there is within-firm factor reallocation and broader use of high-quality materials.

I formalize and quantify this mechanism in an industry general equilibrium model of multi-product firms that captures the main features of the data. In the model, every period, firms can allocate capital and labor to the production of different quality varieties. However, while firms can freely adjust the total amount of labor they use, capital is firm-specific and fixed over the short and medium run. This fixed factor implies firm-level increasing marginal costs. As a result, firms' pricing and production decisions are no longer separable; they depend on the firm's total production and aggregate conditions in each market. Import competition reduces the return on the firm's fixed factor in the low-quality segment, making it optimal to reallocate it toward producing high-quality goods. Relative to standard trade models, consumer welfare increases because foreign competition reduces price indices, *and* domestic firms decrease prices on all final goods in response. The latter is not the result of the traditional pro-competitive effect of trade, but rather the consequence of a reduction in firms' marginal costs due to the decline in production for a given capital stock.

To empirically test the model predictions, I construct firm-level measures of Chinese import competition and examine their effect on firm performance. The results are striking. To illustrate, an increase in exposure to Chinese import competition from relatively low (25th percentile) to relatively high (75th percentile) leads to an average increase of 42% in annual exports (46% in high-quality exports), 5.8% in the number of exported products, and 6.5% in the probability of introducing at least one new high-quality product per year. Overall, higher exposure to foreign competition translates into higher value, quantity, and product shares of high-quality exports. It also drives down prices and domestic sales. Consistent with the mechanism I propose, these within-firm responses occur despite almost no change in firms' production factors, except for a shift to using higher quality materials. These findings are robust to several specifications, definitions of import competition shocks, and selection.

Finally, I structurally estimate the model and run two policy-relevant counterfactual exercises. First, I ask whether Peruvian firms would have escaped low-wage competition if they did not have access to a low-priced, high-quality input (e.g., pima cotton). Second, I ask how Peruvian firms would have fared if they did not have access to a foreign destination for their high-quality goods (e.g., the United States). I find that if Peruvian firms had to import pima cotton or lacked a destination market for high-quality goods—key conditions for switching—, annual industry sales would have decreased by 4%-13%, firm's profits by 4%-12% and industry employment by 8%-15%.

Related Literature This paper contributes to the vast body of literature on the effects of trade on quality by identifying a new channel in which quality upgrading is *not* the result of newly gained access to high-quality inputs or foreign markets.[1] Instead, the existence of specific fixed factors leads firms to upgrade their quality, akin to the literature on escaping competition and quality ladders (Aghion, Bloom, Blundell, Griffith, and Howitt, 2005; Khandelwal, 2010; Amiti and Khandelwal, 2013) and to the idea of a trapped factor (Bloom, Romer, Terry, and Van Reenen, 2014; Bloom, Draca, and Van Reenen, 2015).

This paper also extends the literature on margins of adjustments to trade shocks. With a

[1]Studies, where new access to imported inputs or larger markets results in quality upgrading, include Kugler and Verhoogen (2012); Bas and Strauss-Kahn (2015); Fieler, Eslava, and Xu (2018); Aw, Roberts, and Xu (2011); Bustos (2011); Lileeva and Trefler (2010); Fieler and Harrison (2018); Verhoogen (2008); Brambilla, Lederman, and Porto (2012); Bastos, Silva, and Verhoogen (2018). For a comprehensive summary of the literature, see Shu and Steinwender (2019).

fixed factor, firms face increasing marginal costs and optimize all their production bundle jointly. This allows me to explain empirical regularities, such as the correlation between domestic and export sales (Blum, Claro, and Horstmann, 2013); increasing marginal costs of production (Ahn and McQuoid, 2017; Almunia, Antràs, Lopez-Rodriguez, and Morales, 2018; Albornoz, Brambilla, and Ornelas, 2020); and the interdependence of the production of goods at the firm level (Bernard, Redding, and Schott, 2010; Hottman, Redding, and Weinstein, 2016). Relative to this work, which considers that all adjustments following a foreign competition shock happen through either a shift in the destination market or from non-core to core products, the mechanism proposed in this paper encompasses both product (quality) and market adjustments as an efficient firm-level response to import competition, and highlights the crucial role of the former.

Finally, the paper relates to the extensive literature on welfare gains from trade as import competition, through this channel, leads to an additional decrease in domestic firms' prices that is not the byproduct of pro-competitive effects (Lanteri, Medina, and Tan, 2019).

1 The Peruvian Apparel Industry

This section describes the data and introduces three critical facts about the Peruvian apparel industry that will inform the model; I particularly focus on the observed quality measure.

1.1 Data

This paper draws on two primary data sources from 2000 to 2012. First, I use Peruvian customs data, which provide information on every firm-level international trade transaction: the product at the 10-digit level of the Harmonized Tariff Schedule (HTS), shipment values, quantities, and destination or origin. Unlike many other customs datasets, these data also contain a detailed commercial description of the goods for every transaction, including materials, brand, and size.

I complement this information with the *Encuesta Económica Anual* (EEA), a nationwide annual firm-level survey administered by the Peruvian Statistical Agency (INEI). It includes balance-sheet information for each firm on total revenue, wage bill, intermediate inputs, investment, and capital stock. A subset of the firms also lists their main products and inputs, together with their unit values and quantities, which help understand the effects on the domestic market and factor reallocation.

From these sources, I select firms producing apparel, either classified under CIIU Rev.4. Codes 1410 and 1430, or exporting products under Chapters 61 and 62 of the HTS code. The final only-customs dataset has 9,015 firm-year-level observations; data based on the EEA contain 3,069.[2]

As is often the case with administrative datasets, the EEA is a census for large and medium firms but only a sample for small ones. While this does not affect the main within-firm results of the paper, it is crucial when thinking about the effects on survival bias and representativity. When I require information on these aspects, I supplement the EEA with the Peruvian Firm Registry (*Padrón RUC*), which covers 2000-2012; the 2007 Economic Census; and aggregate sales statistics provided by the Peruvian Tax Authority (SUNAT). Together, firms in the EEA estimation sample that list apparel production as the primary activity already account for approximately 50% of annual industry sales during the sample period.[3]

1.2 Key Facts of the Peruvian Apparel Industry

Sequential Production Process Garment manufacturing in Peru is a sequential assembly-oriented production process. Except for knitted products and leather garments, the apparel production process goes from design, cutting and pre-sewing, sewing and finishing, to create a final product. While it is relatively labor-intensive, materials represent the largest per-unit cost share.

[2]See Appendix A.1 for a detailed description of all datasets and the estimation sample.

[3]A second limitation is the lack of information on informal firms, as informality could pose an extra margin of adjustment to import competition in developing countries (Dix-Carneiro and Kovak, 2019; McCaig and Pavcnik, 2015). I use the Peruvian Household Survey to explore this channel. I discuss the implications for small firms and the informal sector in Appendix A.2.

Two additional features are a byproduct of this sequential production process. First, the production sequence is independent of the type of clothing manufactured. To produce any clothing, even using different materials, a firm can use the same assembly line. This independence is possible because labor and machinery are specialized to tasks instead of a specific garment. Second, the fabric requirement for a product does not vary with the type of fabric used. For example, a t-shirt of a particular size requires the same fabric amount, whether cotton, synthetic, or man-made.

Simple Garment Production Garment manufacturing in Peru is simple. Traditionally, Peruvian apparel firms have specialized in producing basic garments such as t-shirts, shirts, and pants. This pattern has not changed in the 2000s: In 2014, 71% of domestic apparel production was t-shirts, followed by undergarments, pants, shirts, and baby clothes. Moreover, it also shows on Peruvian apparel exports, where t-shirts alone account for a quarter of this market.

While critical for the sector, these products do not entail much investment in design or value-added at the local level. By 2010, most will be exported as plain garments to large foreign brands. Given the low complexity of the design and the little detail needed in the finishing stage, the sequential production process described above is more straightforward and similar across products in the Peruvian apparel industry than the process for sophisticated products.

Quality is in the Materials Since firms use the same methods, labor, and capital to produce various types of clothes, quality differentiation depends on materials, meticulousness (Atkin, Khandelwal, and Osman, 2017), and the stylishness of design. For Peru, given the lack of complexity of its apparel products, final output quality depends more heavily on materials and care.

I use this feature to construct an observed measure of product quality. Even though the degree of care is unobserved, it is possible to create a quality measure given correct information on material quality, insofar as there are no significant differences in care when using high-quality materials. In particular, it is fundamental to have a ranking of material quality and information on the materials used for each garment. My empirical set-up and data fit these requirements.

First, in Peru, there is a clear hierarchy of the quality of materials used in apparel. Peruvian-grown natural fibers are famous for their high quality. Peru's most important cotton varieties, pima and tangüis, are among the highest quality cotton in the world.[4] They have higher staple length and length uniformity than other cotton varieties.[5] In addition, pima and tangüis also feature superior strength and durability and are more likely to withstand breakage during the production process—that is, they are more resistant to fraying, tearing, pilling, wrinkling, and fading. Finally, for garments that can be produced using various fabrics, long cotton fibers are superior to synthetic and man-made materials due to their softness, breathability, and dyeing properties.[6]

Second, the data specify the material used in every exported garment. Besides the 10-digit HTS code, I use information collected from the commercial description of the product. This includes brand, size, and specific type of fabric used, as in "LACOSTE, Men Polo Shirt, 100% Pima Cotton."

With this information, I then define the observed quality measure as follows. A garment is high quality if its fabric contains 50% or more of pima or tangüis cotton fiber. Conversely, it is low quality if it is produced using other mixed-cotton varieties or synthetic or man-made cloth.[7]

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[4]Both are classified as *Gossypium Barbadense*, together with Egyptian Giza and Sea Island cotton.

[5]Pima has an extra-long 1 3/8" (34.925 mm) staple length, while US upland, the largest cotton crop in the world, has an average of 26-27 mm staple length.

[6]This advantage holds for simple daily wear, i.e., most of the Peruvian apparel production. This is not the case for apparel with a specific function, like swimsuits or sports gear, for which synthetic fibers will be superior due to their water-resistant or thermal properties.

[7]All other garments—which only represent around 5% of exports—are grouped in a non-comparable category. Results are robust to the use of different thresholds. See Appendix A.3 for more details.

2 Import Competition and Quality Upgrading

This section documents that, during the surge of Chinese import competition in the Peruvian market, Peruvian firms lost local market share but significantly increased exports. Foreign sales of high-quality products drive this export growth, primarily due to output mix changes within firms. Moreover, while more intensive use of high-quality inputs accompanied these changes, they did not require meaningful investments in productive factors.

2.1 Rising (Low-quality) Chinese Import Competition

Import competition intensified for the Peruvian apparel industry after China's accession to the WTO in 2001.[8] Panel (a) of Figure 1 shows the massive influx of Chinese clothing in the Peruvian market, measured by the value of Peruvian apparel imports, from 1994 to 2012. The solid line represents worldwide imports, and the dashed line shows imports originating in China. After 2001, total imports underwent exponential growth, mostly due to the increase in Chinese clothing imports. By 2012, 75% of Peruvian imports were of Chinese origin. In addition, imports from China entered the country at unusually low prices. Chinese clothes sold at approximately half the price of their main competitors in the Peruvian market.[9]

[FIGURE 1 HERE]

During this period, Chinese apparel products became the main competitors for Peruvian products in the domestic market, and the domestic market share of Peruvian firms declined from 88%

[8]Joining the WTO, China benefited from several changes in its apparel and overall exports, such as permanent MFN status, elimination of quotas for textiles and apparel, and access to the WTO's dispute mechanism. Together with China's domestic industrialization policy, these changes led to an explosion of apparel exports. For an extensive discussion, see Autor, Dorn, and Hanson (2016).

[9]See Appendix B.1 for the price comparison between Chinese and Peruvian garments.

to 70% between 2000 and 2011. In terms of the number of products and weight sold, by 2011, Chinese imports accounted for 57% and 50% of the Peruvian market, respectively. The situation was no different in Peru's most prominent export destinations: Chinese import competition also increased in the United States and other developed countries. With the end of the Multi-Fiber Arrangement, Chinese apparel exports to the United States rose by 4.5 times between 2004 and 2012, with Chinese shares of the American import market rising from 11% to 38% over the decade.

Critical to this fact, imported Chinese garments were not as high quality as pima cotton clothing. Even though Chinese apparel included products made of cotton, Chinese producers did not have access to high-quality imported cotton, as the Chinese government enforced and managed import quota restrictions for raw cotton and cotton cloth.[10]

2.2 Exporting and Quality-Upgrading

The Peruvian apparel industry experienced a massive transformation as it was hit by import competition. While Peruvian firms–which traditionally catered to the Peruvian market—lost substantial domestic market share, the industry kept afloat, much of it thanks to unprecedented export growth.

Panel (b) of Figure 1 documents this export growth. On the primary y-axis, the dashed line represents apparel imports from China, while the solid line on the secondary y-axis shows Peruvian apparel exports. As Chinese import competition intensified, Peruvian apparel exports increased

[10]Moreover, the worldwide supply of pima cotton is scarce. According to the Peruvian Ministry of Agriculture, Peru produced 268,000 tons in 1996/7, but only 82,000 tons in 2013/14. To source this material, in addition to its national production, Peru was able to purchase from the United States and transform the raw cotton into cloth, given its unique production model of vertical integration from the cotton crop to apparel manufacturing. Due to its historically high production, Peru has installed mill capacity designed explicitly for high-quality cotton fibers and established strong links with apparel production networks (Gereffi and Fernandez-Stark, 2016).

10-fold over 10 years. The rise was such that between 2000 and 2008, the export share in total industry sales rose from 56% to 71%. This export growth does not merely stem from a worldwide increase in apparel demand, nor is it a byproduct of new access to the Chinese market. Peruvian apparel exports grew faster than other countries', and Peruvian firms actually gained market shares abroad. In contrast, Peruvian garment exports to China remained stable and negligible.

Interestingly, most of this export growth happened in high-quality garments, especially after China's WTO accession. In 2000-2001, high- and low-quality exports accounted for 55% and 45% of the industry's exports growth, respectively. However, from 2001 to 2012—except for the 2008 financial crisis—high-quality exports accounted for around 90% of apparel exports growth.

A natural question to ask is how Peruvian firms became high-quality apparel exporters. To start answering this question, I first decompose the export growth in high- and low-quality apparel into an extensive and intensive margin. In particular, I break the observed increase in exports between 2000 and 2007—before the financial crisis—into components due to new exporters, exiting exporters, and exporters present for the entire period (incumbents). For high-quality exports, about half of the export growth during this period is on the intensive margin—due to incumbents—, while the other half is due to firms that entered into or exited from exporting. Second, among incumbents, I examine whether the export growth in high-quality products comes from a reallocation of exports across firms or changes in export mix within firms. Although both margins matter, close to 60% of the incumbents' observed export growth in high-quality goods happened within firm.[11]

Moreover, even some of the high-quality export growth carried out by new exporters is probably a consequence of within-firm output reallocation towards high-quality products. In all likelihood, some of these new exporters that sell high-quality products abroad were likely selling low-quality products to the domestic market, as 57% of the new exporters during this period existed and sold

[11]See Appendix B.2 for details on these decompositions.

domestically for, on average, 4.3 years before entering into exporting. To explore this possibility, I look at a subsample of these new entrants, for which I observe the product mix sold every year. Before entry into exporting, the share of high-quality sales was only 3%, jumping to 71% after selling abroad. Unfortunately, this subsample of firms is small (385) and possibly selected. That said, it seems that at least some of the observed growth in high-quality exports comes from new exporters who change their output mix towards high-quality products to serve foreign markets.

Overall, the evidence clearly shows that, together with import competition from China, Peruvian high-quality apparel exports rose exponentially. A large share of this growth happened as Peruvian firms changed their output mix towards high-quality products, a within-firm effect present in exporter incumbents and presumably in new exporters.

2.3 Factor Usage as Firms Shift towards High Quality Apparel

How did Peruvian firms shift towards high-quality products and increase exports? The existing literature suggests two mechanisms: access to cheaper imported high-quality inputs or investments complementary to market size. However, a 2004 report by the Peruvian Competition Agency (INDECOPI, 2004) offers a different view. It argues that China's direct competition decreased Peruvian firms' domestic sales and left them with sizeable idle capacity. Thus, Peruvian apparel producers had to reinvent themselves—by exporting high-quality goods—without further investments.

Examining factor usage at the industry and firm level confirms this assessment.[12] First, when faced with Chinese import competition, the Peruvian apparel industry did not substantially increase its physical capital investment, not even considering new apparel machinery. Even for incumbent exporters, the capital stock value of the median firm did not change between 2000 and 2007. Moreover, while the number of workers increased, the apparel employment share in manufacturing decreased from 27% to 25% between 2000 and 2007. Data on the industry wages do not show

[12] Appendix B.3 includes the details with respect to factor usage.

quality upgrading in the workforce either. Relative to minimum wage, the average worker in the apparel industry received less in 2007 than before 2001. The same is true when I look at incumbent exporters. For these firms, employment growth was accompanied by a decrease in real wages.[13]

Lastly, there was an increase of 14% on material expenditures when the industry shifted towards high-quality products and export markets. Moreover, the average price paid per kilo of fabric used as input also went up by close to 50%. This fact is also observed for incumbent exporters, which paid a 30% higher price, on average, per kilo of fabric used as an intermediate input between 2000 and 2007. This strongly suggests input quality upgrading in the industry.

In sum, the evidence suggests that, at the same time as the massive surge of Chinese apparel products, Peruvian apparel firms increased exports and changed their export composition towards high-quality products. In doing so, Peruvian firms did not invest significantly in capital—including new machinery—nor hired relatively more skilled workers. Instead, Peruvian firms increased their input quality. These patterns suggest a new adjustment mechanism not explained by the standard trade model of multi-product heterogeneous firms. In these models, a negative profitability shock in low-quality domestic products would not incentivize firms to undertake more expensive choices, such as upgrading quality or entering the export market (Bernard, Redding, and Schott, 2010). The following section builds a model to capture this new channel.

3 The Model

This section develops a multi-product, heterogeneous-firm trade model that captures how Peruvian firms responded to the China import competition shock. The key features of the model are the following. First, firms face frictions to adjust at least one production factor. This friction limits the firms' ability to downsize after the shock and leads firms to reallocate their idle production factor

[13]There were no marked changes in the occupational composition of the industry employment either.

across production lines *and* markets. Second, consumers have non-homothetic preferences; thus, after the shock, firms focus on high-quality varieties to be sold to high-income foreign markets.

3.1 Demand

The domestic market, d, is a small open economy with two vertically differentiated goods, high- (h) and low-quality (l). Consumers have preferences for both, as in Fieler (2011):

$$U_t^d = \omega_h \int_{\nu_h \in \Omega_h^d} Q_{ht}^c \left(\nu_h\right)^{\frac{\sigma_h - 1}{\sigma_h}} d\nu_h + \omega_l \int_{\nu_l \in \Omega_l^d} Q_{lt}^d \left(\nu_l\right)^{\frac{\sigma_l - 1}{\sigma_l}} d\nu_l \tag{1}$$

where ω_k are weights, ν_k are good k's varieties, Ω_k^d is the set of available k's varieties, and $\sigma_k > 1$ is the elasticity of substitution across k's varieties and the income elasticity of demand. Consumers in the export market, x, have the same preferences but are richer. This difference is important, as this utility representation allows for non-homothetic preferences across countries.[14] Every period, demand for a particular variety k in country $c = \{d, x\}$ is $Q_{kt}^c = \frac{X_{kt}^c {P_{kt}^c}^{-\sigma_k}}{{\mathbb{P}_{kt}^c}^{1-\sigma_k}}$, where P_{kt}^c are variety prices and $\mathbb{P}_{kt}^c$ represents the ideal CES price index.

3.2 Firms

Domestic producers are monopolistically competitive firms, denoted by j, which can potentially produce varieties of both goods. Firms can sell their goods domestically, in d, or export them to country x. To enter the domestic market, firms need to pay an entry cost f_e, measured in labor units. Next, firms get a productivity draw $\varphi_{jt} \sim G(\varphi)$, where $G(\varphi)$ is common knowledge. Firms then make productive decisions: (i) They determine their product mix, $\mathbf{a}_{jt}$, which includes quality type and destination, and (ii) conditional on $\mathbf{a}_{jt}$, they set prices.[15] Firms that do not produce exit.

[14] All else equal, if $\sigma_l < \sigma_h$, $\frac{X_{ht}^d}{X_{lt}^d} < \frac{X_{ht}^x}{X_{lt}^x}$, where X_{kt}^c is the total expenditure of country c on good k. As in Fieler (2011), σs combine income and substitution elasticities.

[15] $\mathbf{a}_{jt}$ is a 1x4 vector of indicator functions taking value one for the combinations of quality-destination market(s) in which the firm sells its product: $\mathbf{a}_{jt} = [\mathbb{1}_{ht}^d \, \mathbb{1}_{lt}^d \, \mathbb{1}_{ht}^x \, \mathbb{1}_{lt}^x]$. The set of all

Akin to the production process detailed in Section 1.2, the production of output, Q, is Cobb-Douglas in labor, L, and a productive factor, F, but Leontief in materials, M: $Q_{jt} = \min\{\varphi_{jt} L_{jt}^{\alpha} F^{1-\alpha}, M_{jt}\}$, $\alpha < 1$. While labor and materials are entirely mobile within and across firms, F is firm-specific and can only be reallocated within its boundaries. This assumption is the main departure of this paper from standard models and responds to the empirical evidence in Section 2.3. In principle, F could reflect any factor used in the production of all goods that is subject to short-run adjustment costs—e.g., specific capital, long-term contracted factors, or managerial ability. For the Peruvian apparel industry, it is physical capital. In the model, I assume that F is the same for all firms. This simplifying assumption allows me to focus only on the decision to reallocate F rather than also considering the dynamic investment choice on this factor.[16]

High- and low-quality products use the same technology, as described in Section 1.2. Firms do not change their factor requirements to quality differentiate goods, even for materials. Instead, they use the same amount of materials but of different qualities. Thus, in the model, I assume that higher (lower) quality garments are only different because they use higher (lower) quality materials.

Firms pay wages w_t to labor and rental rate r_t to the fixed factor. They also pay higher unit material prices, m_t, for higher-quality materials, such that $m_{ht} > m_{lt}$. I assume firms take these factor prices as given. Abstracting from these general equilibrium forces, though not trivial, is supported by the main features of the Peruvian apparel industry. First, wages in this industry follow the Peruvian minimum wage evolution closely. Second, Peru imports most low-quality material, and firms take those import prices as given. Third, Peruvian apparel firms are price-takers in

product mixes, $\mathbf{A}$, includes all potential values for $\mathbf{a}_{jt}$, including the no-production option.

[16] This assumption reflects a minimum factor requirement for production, such as investment in a production plant or manager hiring. Yet, the model could include the dynamic decision of F, as in heterogeneous firm models with partial irreversibility such as Lanteri, Medina, and Tan (2019).

the cotton market. From 2000 to 2010, the price of high-quality material (pima cotton) did not substantially change, in line with the cotton price worldwide.[17]

Firms solve the following optimization problem. To simplify exposition, I use row-vector notation henceforth.[18] Conditional on a product mix, firms choose their optimal pricing vector $\mathbf{P}_{jt}$ to maximize their profits,

$$\max_{\mathbf{P}_{jt}} \ \pi_{jt} = \mathbf{a}_{jt}[\mathbf{P}_{jt}.\mathbf{Q}_{jt}]' - w_t \left(\frac{\mathbf{a}_{jt}[\tau_{\mathbf{t}}.\mathbf{Q}_{jt}]'}{\varphi_{jt}.F^{1-\alpha}} \right)^{\frac{1}{\alpha}} - \mathbf{a}_{jt}[\mathbf{m}_t.\tau_t.\mathbf{Q}_{jt}]' - r_t F - \mathbf{a}_{jt}\Gamma', \tag{2}$$

subject to demands as in Section 3.1, where $\tau_{\mathbf{t}}$ is a standard "iceberg cost" exporters must pay ($\tau^x_{kt} > 1$, whereas $\tau^d_{kt} = 1$) and $\gamma^c_k \in \Gamma$ are fixed costs associated with adding a product-market to the product mix. Then, firms choose the product mix with the highest profit in every period.

If a product is included in $\mathbf{a}_{jt}$, its first-order condition is

$$P^c_{jkt} = \left(\frac{\sigma_k}{\sigma_k - 1} \right) \tau^c_{kt} \left[m_{kt} + \frac{w_t}{\alpha} \left(\frac{1}{\varphi_{jt} F^{1-\alpha}} \right)^{\frac{1}{\alpha}} \left(\mathbf{a}_{jt} \left[\tau_t.\mathbf{Q}_{jt} \right]' \right)^{\frac{1}{\alpha}-1} \right]. \tag{3}$$

Unlike models of monopolistic competition and constant returns to scale, markets are no longer segmented, and prices depend on total firm-level quantity across *all* of the firm's goods. The price of any good in a firm's product mix will react to conditions in its particular market and all other markets in which the firm sells.[19]

3.3 Equilibrium and Welfare

Given the parameters of the model, an industry equilibrium of the model is a sequence of price indices $\{\mathbf{P}\}_{t=1}^T$ that satisfy (i) consumers' utility maximization, as in equation (1); (ii) firms' profit

[17]For an extensive discussion of the main assumptions of production, see Appendix C.1.

[18]All vectors are 1x4 and follow the same order of good-market combination as $\mathbf{a}_{jt}$.

[19]While this interdependence limits closed-form solutions, some predictions of standard trade models still hold. More productive firms charge lower prices, sell more output, and earn more revenues and profits from their sales within a product-market category. See Appendix C.2 for proofs.

maximization, as in equation (2); and (iii) free entry for domestic producers.[20] Moreover, welfare is given by $W_t^c = \omega_h \left(\frac{X_{ht}^c}{\mathbb{P}_{ht}^c}\right)^{\frac{\sigma_h - 1}{\sigma_h}} + \omega_l \left(\frac{X_{lt}^c}{\mathbb{P}_{lt}^c}\right)^{\frac{\sigma_l - 1}{\sigma_l}}$.

3.4 Model Implications

What are the effects of an increase in import competition as predicted by the model? To answer this question, I introduce a third country, I (in this case, China), from which the domestic and foreign markets can import. I assume that I has a continuum of monopolistically competitive, single-product firms that specialize in the low-quality good and are heterogeneous in terms of productivity, $\hat{\varphi}_{jt}$. Moreover, I consider an import competition shock due to an exogenous increase in country I's firm productivity as in Section 2.1, which in the model has as first-order effects a decrease in imported prices $\mathbb{P}_{lt}^{cI}$ and a rise in imports from country I, M_{lt}^{cI}.[21]

Definition 1 *An import competition shock for countries c and x is defined as the increase in imports from country I and the decrease in the price of these imports ($\frac{\partial M_{lt}^{cI}}{\partial \hat{\varphi}_{jt}} > 0$, $\frac{\partial \mathbb{P}_{lt}^{cI}}{\partial \hat{\varphi}_{jt}} < 0$) due to an exogenous increase in the productivity of country I's firms.*

On impact, an import competition shock directly affects the price indices of low-quality products sold in the domestic and foreign markets, which, in turn, influences firm-level prices, quantities, revenues, and, through general equilibrium forces, all price indices. Considering all these margins, I examine the firm-level comparative statics in Proposition 2.

Proposition 2 *An increase in import competition, as stated in Definition 1, causes:*

1. *(Prices) Decreases in the prices of all goods in all firms.*
2. *(Quantities) Increases in the quantities sold of high-quality goods in all markets but has an ambiguous effect on the quantities sold of low-quality goods on both markets.*

[20] See Appendix C.3 for an extended definition.

[21] These first-order effects are the result of monopolistic competition and CES assumptions. See Appendix C.4 for more details. These results hold if the shock comes from a fall in trade costs.

3. *(Revenues) Increases in the sales of high-quality goods in all markets. The effect on the sales of low quality goods in the domestic and export markets is ambiguous.*
4. *(Shares) Increases in the revenue and quantity share of high-quality products ina given market if (i) the percentage increase in high quality sales or quality is higher than that of low quality or (ii) the import competition shock in the other market is negligible.*
5. *(Product Mix) Increases in the probability of including a high-quality good in the product mix.*
6. *(Profits) Decreases in profits for all domestic firms.*

Moreover, the magnitude of these effects is heterogeneous across firms: the effects are increasing in firms' productivity and the firms' share of the low-quality variety in revenues.

Proof. See Appendix C.5. ■

The intuition for the mechanism proposed by the model hinges on the within-firm reallocation of productive factor F. An unanticipated import competition shock in low-quality segments decreases firm profits. For firms, it is optimal to reduce the production of low-quality goods, which frees up resources. While labor and materials can be immediately reallocated to other firms, F is fixed in the short run. Since firms need to pay a per-period cost to use this factor, it is efficient to reallocate this idle resource within the firm to other production lines: high-quality goods. Moreover, because the foreign market places a higher value on higher-quality products, sales shift to exports. Thus, the model predicts an upgrade in quality and, given non-homothetic preferences, an export boom concentrated on the high-quality good.

Theoretically, the effect on sales of low-quality goods on the foreign and domestic markets is ambiguous. The reason is that firms adjust production and sales after a shock in two margins: quality and destination. Import competition in the domestic market alone shifts the use of productive factors to all other product lines, surely increasing the production of high-quality apparel for all markets but also expanding low-quality exports. Simultaneously, import competition in the foreign market decreases low-quality exports but increases sales in all other products, including low-quality goods sold domestically. The outcome for each firm depends on its productivity, the relative increase in import competition between the two countries, and aggregate expenditures.[22] In the Peruvian case, the import competition shock that hit its domestic market was substantially more salient. Because the shock affected the low-quality goods segment, firms adjusted production towards high-quality goods. Moreover, since the Peruvian market demands primarily low-quality goods, firms shifted sales towards foreign markets. This explains the massive increase in the exports of high-quality products and the smaller increase in exports of low-quality goods.

Despite this ambiguity, the model predicts changes to firms' quality composition. Firm-level high-quality shares will increase if high-quality goods' sales (or quantities) are significantly higher or import competition is only salient in one market. Furthermore, all these effects are more substantial for firms selling low-quality goods, as they endure both the direct and general equilibrium effects of import competition. In contrast, firms producing only high-quality only are affected by the latter. This heterogeneity will be key for measuring import competition exposure in the data.

Finally, the model stresses a new channel for short-run consumer welfare gains. In addition to the decrease in low-quality price indices due to the newly gained access to cheaper imported goods, domestic firms decrease prices for all their products in equilibrium due to excess capacity. This reaction further reduces both low- and high-quality price indices, raising welfare.[23]

4 Empirical Strategy

This section confirms the primary mechanism of the model by establishing a causal effect from an import competition shock to the reallocation of firms' output across production lines and markets in the Peruvian apparel data.

[22]See Appendix C.6 the effects when shocks are specific to only one market.

[23]See Appendix C.7 for the proof.

4.1 Measuring Firm-level Import Competition

I follow the stylized facts of Section 1 and the model of Section 3 to construct a firm-level measure of exposure to Chinese import competition. First, Chinese apparel production is assumed to be of low quality and, for each product, I consider an import competition shock like the one in Definition 1, whose direct effect is the increase of Peruvian imports from China, M^{cI}_{lt}. Because China is not the only origin of Peruvian garment imports, I use the Chinese import share relative to total country imports as the empirical counterpart to M^{cI}_{lt}. Second, Proposition 2 guides the aggregation of product-level shocks to the firm level. In particular, import competition affects firms differently depending on whether they produce low-quality, high-quality, or both goods. Thus, a firm-level measure of exposure to import competition should combine how directly a firm's products compete with Chinese clothing and their relative importance to the firm's product mix. The same heterogeneity is present in the data, as each firm produces a distinct bundle of goods.

I operationalize this concept as follows. Denote Chinese import penetration in country c on product k at time t as $ChPen^c_{kt}$. It refers to the share of imports originated in China on total imports of country c by product. Products are defined by 10-digit HTS codes. Then, a Peruvian firm j in period t faces the following exposure to Chinese import competition in its domestic market:

$$DComp_{jt} = \sum_k \frac{x_{jkt_0}}{x_{jt_0}} ChPen^{Peru}_{kt}, \tag{4}$$

where $\frac{x_{jkt_0}}{x_{jt_0}}$ is the share of product k of total firm-level exports. The subscript t_0 refers to the first period the firm is observed in the data and is used to alleviate concern that these shares (and the set of products) are responding to import competition.[24]

[24] Similar measures have been used by Lileeva and Trefler (2010); Iacovone, Rauch, and Winters (2013); Hummels, Jørgensen, Munch, and Xiang (2014); and Mayer, Melitz, and Ottaviano (2016).

Similarly, in its foreign destinations, the measure of exposure for Peruvian firm j in period t is

$$FComp_{jt} = \sum_{c} \frac{x^{c}_{jt_0}}{x_{jt_0}} \sum_{k} \frac{x^{c}_{jkt_0}}{x^{c}_{jt_0}} ChPen^{c}_{kt}, \tag{5}$$

where $\frac{x^{c}_{jt_0}}{x_{jt_0}}$ is the share of destination c of firm-level exports, and $\frac{x^{c}_{jkt_0}}{x^{c}_{jt_0}}$ is the share of product k of the firm's exports to country c. Because firms export different goods to various countries, this measure aggregates over products and destinations. Both $DComp_{jt}$ and $FComp_{jt}$ take values between zero and one, going from none to full exposure.[25]

These measures have two caveats worth discussing. First, an ideal measure of $DComp_{jt}$ will use product shares of domestic firms' sales as weights rather than exports. Unfortunately, I do not have these data for most firms. The underlying assumption when using export shares is that the firm's production structure is independent of the destination, which is not innocuous: It raises questions about multicollinearity and whether the domestic measure accurately captures Chinese import competition in the domestic market.

To alleviate these concerns, I first show that these measures are not similar. The Peruvian domestic market was rapidly inundated by Chinese imported clothing. The average exposure of firms to import competition was 0.21 in 2000; by 2006, it was 0.37, and went up to 0.50 in 2012. Quickly, Chinese goods became the main source of imports for Peruvians. This increase in import competition is much higher than the one seen in the export destinations. Average exposure to import competition in foreign markets only rose slightly before 2005 (from 0.11 in 2000 to 0.12 in 2004)—a potential result of the Multi-Fiber Arrangement. Moreover, the correlation between these measures is only 0.12 in levels and 0.19 in annual changes from 2000 to 2007, before the financial crisis.[26] In this sense, these measures are indeed capturing different firm-level exposures,

[25]See Appendix D.1 for summary statistics for these two variables.

[26]See Figure D1 for the histograms of $DComp_{jt}$ and $FComp_{jt}$.

and thus the problem of multicollinearity does not seem to be first order. Furthermore, I provide further additional against potential bias by replicating this measure on the subset of EEA firms with detailed product information. The problem with this sample is that it is small.[27] Yet, the correlation of these measures is positive (0.40 between 2000 and 2010), and there is considerable overlap on the histograms, as shown in Appendix D.2. Finally, as a robustness test, all main specifications are run using this sample, with no significant qualitative change.

A second issue relates to the measure of $ChPen^c_{kt}$ and whether it captures all the scope of the import competition shock. In particular, products facing different levels of increases in Chinese imports might see similar changes in $ChPen^c_{kt}$ depending on the size of total imports, how Chinese imports crowd out other countries' imports and local demand growth. To mitigate these concerns, while following the model closely, I construct two alternative firm-level competition measures that replace import penetration shares with (i) log(imports) and (ii) the ratio of imports relative to a proxy of domestic absorption. The former tackles the concern about differences in levels, while the latter addresses demand growth. Both measures have a high correlation with the baseline one, and robustness tests using these measures corroborate the main findings of the paper.[28]

4.2 Estimation and Results

I test for a causal relation by estimating the following specification:

$$y_{jt} = \beta + \beta_d DComp_{jt-1} + \beta_f FComp_{jt-1} + \delta_t + \mu_j + \delta_t \eta_{j_0} + \epsilon_{jt}, \tag{6}$$

where y_{jt} are the firm-level outcomes of interest; $DComp_{jt-1}$ and $FComp_{jt-1}$ are the firm-level competition measures at $t-1$ defined in Section 4.1; δ_t and μ_j are year and firm fixed effects, respectively; and $\delta_t \eta_{j_0}$ is a firm-specific linear trend, which controls for pre-trends and heterogeneity in growth paths by initial firm export size, η_{j_0}.

[27] Only 381 firms declare accurate information to categorize their products as HTS 6-digit codes.

[28] See Section 4.2.2 for these and other robustness tests.

The main predictions of the model stated in Proposition 2 inform the choice of the primary outcomes of interest. Specifically, I use the Peruvian customs data to examine the effects on firm-level total, high-quality, and low-quality exports; the number of products exported; and the shares of high-quality goods in firms' product mix. Moreover, I consider extensive margin effects, such as new product adoption and survival in the export market. In addition, I use the EEA sample to understand the impact on domestic sales and validate the model's primary mechanism regarding within-firm factor reallocation. For the latter, I examine within-firm responses to import competition on production factors such as labor, capital, and materials. The main parameters of interest are β_d and β_f, which measure the impact of import competition on the Peruvian market and Peru's main export destinations, respectively.

A natural concern is that demand conditions in Peru drive both $DComp_{jt-1}$ and y_{jt}. For example, suppose favorable economic conditions lead Peruvian firms to increase their production and, at the same time, induce Peruvian consumers to raise their import demand. In that case, β_d cannot be interpreted as the causal impact of import competition shock in the domestic market.

To address this issue, I adopt an instrumental variable (IV) strategy, as in Autor, Dorn, and Hanson (2013). I instrument Chinese import penetration in Peru using Chinese import penetration in other South American countries. The underlying idea is that the common component of these variables is the result of Chinese exogenous export growth rather than a response to local demand shocks. In particular, I use Colombia and Brazil—countries that share a border with Peru and have similar GDP per capita, but to which Peru does not significantly export apparel; hence, not driving $FComp_{jt-1}$. Moreover, I include year fixed effects to control for common unobserved trends.

The same concern applies to the measure of $FComp_{jt-1}$, but an instrument in the same spirit is hard to implement. The problem is that $FComp_{jt-1}$ is defined on all Peruvian export destinations rather than a specific country. Thus, there are nearly no countries left—not already in $FComp_{jt-1}$—

to instrument for import penetration of any Peruvian export destination. Given this challenge, the baseline measure of $FComp_{jt-1}$ will not be instrumented. Therefore, the coefficient β_f should be interpreted as reflecting the combination of an import competition shock in foreign markets and changes in export destinations' demand, which will likely bias the coefficient upward. However, to mitigate this issue, I consider a measure that uses only the United States as the Peruvian foreign market. This choice is fitting, as the United States is by far the leading export destination for Peruvian apparel during my entire sample period. Then, I can instrument this measure as in Autor, Dorn, and Hanson (2013). Results are unchanged and presented in Section 4.2.2.

4.2.1 Main Results

I now examine the effects of these Chinese import competition measures on the variables predicted by the model, focusing on the IV results.[29] Both instruments provide good predictive power and information and pass weak-instrument and overidentification tests for all samples.[30]

Exports I start by showing the results on within-firm-level responses using customs data, which confirm the stylized facts of Section 2.2 and tie directly to points (1) - (4) of Proposition 2.

Table 1 shows that Peruvian exporters significantly increase exports (mainly high-quality ones) as a response to domestic import competition from China. In particular, Column 1 implies that an increase in domestic Chinese import competition from the 25th to 75th percentile ($\sim$0.62)

[29]Relative to OLS, IV results are moderately larger, consistent with an upward bias as Chinese firms and Peruvian exporters respond to favorable Peruvian economic conditions.

[30]The first stage of the IV estimation is in Appendix D.3. Kleibergen-Paap RK Wald F-stats range from 165.91 to 473.40, and the null hypothesis in the Hansen J-stat test is never rejected, confirming that both instruments are valid. Moreover, using the decomposition by Goldsmith-Pinkham, Sorkin, and Swift (Forthcoming), results are concentrated on around 20 HTS codes (of 216), but 68% of all categories conform with the aggregate results of the paper.

leads firms to expand their annual exports by 41.8%. This effect, though, varies with apparel types, as shown by Columns 2 and 3. While this increase in domestic import competition implies a 45.9% increase in high-quality exports, significant at the 1% confidence level, the effect on low-quality apparel, although positive, is lower (22.9%) and not statistically significant. Moreover, after controlling for the shock to foreign markets, domestic import competition also increases low-quality exports, albeit not as substantially, as explained in Section 3.4 and Appendix C.6.

This differentiated effect by quality type increases high-quality firms' export value shares (Column 4) and decreases low-quality ones (Column 5), even when we consider all exported products (high- and low-quality and non-classified). The effects are sizable and statistically significant at the 10% threshold, as high-quality shares increase by 2.8 percentage points following an import competition shock to the domestic economy of the size of the interquartile range. These effects are stronger for the share of high-quality exports excluding non-classified products (Column 7).[31]

The same patterns emerge when considering exported quantities. I also document a nontrivial increase in firms' high-quality quantity share and the resulting decrease in low-quality ones. In particular, an increase in import competition in the domestic market of the size of the interquartile range leads to a rise in the export quantity share of high-quality goods of 3.2 percentage points: The average firm will increase its high-quality export quantity share from 57% to 60%. This outcome also holds in percentage terms, with a 3% increase in high-quality quantity share.[32]

In contrast, Chinese import competition in Peru's export destinations decreases total exports. Quantitatively, a change equivalent to the interquartile range ($\sim$0.24) leads to a 10% decrease in annual exports. However, this effect is much noisier and shows little difference across product types.

Finally, a distinctive feature of the model mechanism is that, in addition to firms switching their

[31]These non-classified products, on average, are twice as expensive as low-quality exports.

[32]See Tables D3 and D4 in Appendix D.4.1 for the complete set of results.

output mix towards high-quality products, firms will charge lower prices for all their products in response to import competition (point (1) of Proposition 2). I confirm this prediction in Columns 8 to 10. They show that import competition in the domestic market decreases prices: Firms reduce their average prices by 6.2% when exposed to import competition in the domestic market as large as the interquartile range. The effect holds when considering average prices by quality type, although it is less stark for low-quality garments. Competition abroad does not have an economically or statistically significant impact on prices.

[TABLE 1 HERE]

Margins of Adjustment The results in Table 1 combine multiple margins of within-firm adjustment to the competition shock. For instance, the observed changes in export revenue and quantity may come from firms switching their export product mix, firms exporting new products, or even firms who used to sell domestically only now starting to export.

Table 2 starts to identify these different adjustment margins by considering first product switching. Columns 1 to 5 show the impact of import competition on the number of varieties exported by the firm by product type. These varieties are measured by the number of 10-digit HTS codes exported by the firm in the data. Chinese import competition in the domestic market leads to a positive and significant—at the 1% level—increase in the number of varieties exported: 28.8% more varieties following a shock of the size of the interquartile range. Similar to export values and quantities, this impact is only significant for high-quality varieties (31.4% increase) and raises the firms' high-quality export product share by 2.9 percentage points. Again, the effects of competition in foreign markets are more muted, although they point to a decrease in low-quality export varieties and an increase in high-quality ones, as implied by points (2) and (4) of Proposition 2.

Columns 6 to 7 consider another possible margin of adjustment. These results show that import competition in the domestic market not only encourages Peruvian firms to increase the number of higher-quality products but also to start exporting products they had *not previously exported.* Empirically, these results strongly validate point (5) of Proposition 2 which claims that import competition leads to an increase in the probability of adding a high-quality good to the firms' product mix. In particular, a change equivalent to the interquartile range raises the likelihood of exporting a *new* product by 5.8%. However, the marginal effect is only economically and statistically significant for introducing new high-quality products (6.5%). The same is true due to Chinese competition in foreign markets, with increases of 2.9% and 3.4% on the probability of Peruvian firms starting to export a new product and a new high-quality product, respectively.

Additionally, Column 9 studies the effect of import competition on the firms' export decision, i.e., the firm-level extensive margin of export (point (5) of Proposition 2). In this case, the dependent variable takes the value of 1 if the firm quits exporting altogether and zero if the firm continues to export. The result is significant: Firms are 18.1% less likely to stop exporting following a Chinese import competition shock in the domestic market equal to the interquartile range.

[TABLE 2 HERE]

Lastly, I study the effect of import competition via within-firm output reallocation on incumbent exporters alone. To do so, I shut off the product- and firm-level extensive margins of trade and look at the effect of import competition on firms that continue to export both low- and high-quality products throughout the period. Table 3 shows the results for this subsample of the data. The results confirm that, even for firms already exporting low- and high-quality products, import competition in the domestic market caused changes in output mix towards high-quality products. In fact, the effects are much larger than the ones in Table 1, which include all adjustment margins.

[TABLE 3 HERE]

Overall, the evidence in Tables 1-3 show that Chinese import competition in the domestic market led Peruvian firms to focus on higher quality products and on export markets. Moreover, within-firm responses, through different margins, were largely responsible for these patterns.

Domestic Sales I now use the sample of firms that can be merged with the EEA to study the effect of import competition on firms' domestic and total sales. As discussed before, this sample is much smaller than the one of Peruvian exporters and, as a result, the analyses in this and the following sub-sections will not separate exporters by their adjustment margins.

Panel A of Table 4 shows the impact of Chinese import competition on total, domestic, and foreign sales. The effect of import competition on total sales is not statistically or economically significant. This muted impact on total sales results from a large effect of import competition on exports—an 87% increase in annual exports following an interquartile-sized shock—and no impact on domestic sales. The latter effect, in fact, turns negative when we consider firms that mostly sell domestically. In the case of import competition abroad, even though the direction of the effects is consistent with the model, the coefficients are not statistically significant from zero.

[TABLE 4 HERE]

The fact that import competition does not affect total sales as firms shift away from the domestic market and export more is not trivial. Given that export prices are higher than those of domestic sales, this result suggests that firms decrease their total quantity sold as a response to the shock.

As a final check, Columns 4-7 study the effect of import competition on exports on the sample of firms that can be merged with the EEA data. It is reassuring that the results show the same qualitative and quantitative effects as found on the full set of exporting firms, even though the sample of merged firms is significantly smaller.[33]

Factor Usage The primary mechanism in the model proposes that, in response to import competition, firms reallocate production factors across product lines with no (or minimal) new investments. This sub-section evaluates this prediction using the sample of firms merged with the

[33]See Appendix D.4.2 for OLS regressions and additional results on the number of exported products.

EEA. While I do not directly observe factor allocation to products within firms, I can study changes in firms' total factor use due to the import competition shock. Panel B of Table 4 shows these effects on firms' capital stock (total assets and machinery only), labor (labor expenditures, number of employees, and average wages), and materials (material expenditures and price per kilo).[34]

The results in Panel B of Table 4 support the notion that import competition did not lead Peruvian firms to make significant investments in capital or change their labor composition. In line with the patterns exposed in Section 2.3, these firms increased employment but did not raise the average quality of their labor force (as measured by wages).[35] Although firms' material expenditures did not change due to Chinese competition, the shock led firms to pay higher prices for materials, while using less quantity of them. The increase in the price per kilo paid for inputs (Column 7) suggests an increase in input quality, confirming again the stylized facts of Section 2.3.

Overall, when combined with the evidence that import competition led Peruvian firms to quality upgrade and increase exports, the evidence in Table 4 suggests that import competition led firms to reallocate production factors across product lines to do so.

These results are consistent with prior empirical findings on positive within-firm responses to adverse import competition shocks (Amiti and Khandelwal (2013); Iacovone, Rauch, and Winters (2013); Bloom, Draca, and Van Reenen (2015)); with the negative correlation between domestic and export sales found in Blum, Claro, and Horstmann (2013) and Almunia, Antràs, Lopez-Rodriguez, and Morales (2018); and with the production interdependence of goods at the firm level shown by

[34]Unfortunately, unlike Section 2.3, I cannot analyze the impact on firm-level imports of machinery, as most apparel manufacturers tend to purchase imported machinery from local intermediaries.

[35]The effect on employment could be due to exporting being more labor-intensive or the implementation of contemporary reforms to eliminate employment informality. However, the model's mechanism does not directly capture this response, which is a limitation of the analysis.

Bernard, Redding, and Schott (2010) and Hottman, Redding, and Weinstein (2016).

However, the evidence in this section reveals a different mechanism, with multiple margins at play behind these within-firm responses. This new mechanism indicates that Chinese import competition primarily reduced Peruvian firms' profits in the domestic market for low-quality goods. In response, firms shifted their production to high-quality garments, ultimately selling them in more profitable foreign markets. Operating in the background is the re-optimization of now idle existing production factors across product lines *and* markets. Note that even with these responses, lower unit prices and more expensive materials still caused profits to decrease. Yet, for survivors, they were still high enough relative to the option of exiting.

4.2.2 Robustness Tests

I perform a battery of robustness tests, which confirm the main findings of Section 4.2.1 and mechanism of the model. The details are in Appendix D.5.

First, I construct alternative firm-level measures of import competition that allow me to capture all the scope of the import competition shock. These measures replace import penetration shares with (i) log(imports) and (ii) the ratio of imports relative to a proxy of domestic absorption. The former tackles the concern about how differences in levels of imports matter, while the latter addresses what if there is demand growth for both imports and domestic firms. Both corroborate my main findings, and the estimates are quantitatively similar to the baseline.

Second, I use an alternative set of instruments for $DComp_{jt-1}$ to avoid common trends in South American countries. I choose two upper-middle-income countries that share similar GDP per capita with Peru and to which Peru does not significantly export apparel: Turkey and Malaysia. Results remain unchanged, and, as before, they are not statistically different from the baseline.

Third, to alleviate the potential endogeneity problem of $FComp_{jt-1}$, I do two things. I start by proposing an alternative measure that only considers import competition in the largest export market for Peruvian apparel, the United States. I can then instrument this measure as in Autor, Dorn, and Hanson (2013), considering import penetration from China to other OECD countries. Additionally, to further address multicollinearity issues, I run specifications in which I only include $DComp_{jt-1}$ over all the sample period and before 2005, the end of the Multi-Fiber Arrangement. All these results are consistent with the paper's main outcomes, suggesting that the endogeneity problems of $FComp_{jt-1}$ are not biasing the results for $DComp_{jt-1}$.

Fourth, to verify that initial export shares do not drive the results, I perform the same baseline regressions by using (i) only firms that had begun to export by 2000, thus, avoiding the effect of import competition on shares; and (ii) the subsample for which there is complete information on product-level domestic production and replace export shares with production ones. While these regressions have a smaller sample size, they qualitatively confirm the paper's main results.

Finally, I tackle survival bias and differentiated exit by following the labor literature and assigning zero exports to firms when they are only operating in the local market. This simple method should correct for survival bias, assuming that one unobserved variable is monotonically related to exporting, i.e., productivity. To continue interpreting the results as semi-elasticities, I use the inverse hyperbolic sine transformation of exports as the dependent variable. Even with this extended sample, my reported coefficients are not statistically different from those in Table 1.

5 A Quantitative Assessment

This section evaluates the quantitative relevance of the mechanism uncovered in the paper. It examines the welfare effects of Chinese import competition if Peruvian firms i) did not have access to high-quality domestic inputs (pima cotton), or ii) faced higher fixed costs to exporting.

5.1 Structural Estimation

To match the richness of Peruvian firms' responses and account for the trend on Chinese imports, I rely on the panel structure of the data and estimate a dynamic version of the model in Section

3 using the data described in Section 1.1.[36] Appendix E.1 describes this version of the model in detail. Relative to the static one, firms face sunk costs to introduce a new variety to their product mix, as is standard in the trade literature. Moreover, productivity follows a Markov process, and firms correctly conjecture AR-1 processes for price indices and aggregate expenditures. Because I do not observe firms' domestic sales and prices, I assume that Peruvian firms sell low-quality apparel in the domestic market. In each quality type, every firm can sell one variety.

The main equations of the empirical model are the following. For the firm's problem, let s_{jt} be the set of state variables, which include firm's idiosyncratic productivity φ_{jt}, aggregate expenditures $\mathbb{X}^c_{kt}$, and price indices $\mathbb{P}^c_{kt}$. The Bellman equation for firm j is

$$V(s_{jt}) = \max_{a \in \mathbf{A}} \quad \pi_{jt}(a, s_{jt}) - \Gamma(a, h_{jt-1}) + \eta_{jt} + \beta \int V(s_{jt+1}) dF(s_{jt+1}|s_{jt}), \tag{7}$$

where π_{jt} is the static profit net of sunk costs $\gamma^c_k \in \Gamma(a, h_{jt-1})$ as in equation (2), β is a discount factor, $F(s_{jt+1}|s_{jt})$ is the transition probability of the state variables, governed by the Markov processes of productivity, price indices, and aggregate expenditures, and η_{jt} is assumed to be independently drawn from a Type 1 extreme value distribution.[37]

Finally, demand is as specified in equation (1) and firms' first-order conditions in equation (3) can be combined such that, in logs, $(\frac{1}{\tau_{ht}})p^x_{jht} = (\frac{\sigma_l - 1}{\sigma_l})(\frac{\sigma_h}{\sigma_h - 1})(\frac{1}{\tau_{lt}})p^x_{jlt} + (\frac{\sigma_h}{\sigma_h - 1})(m_{ht} - m_{lt}) + \epsilon_{jt}$, where σ_l and σ_h are the demand elasticities, and ϵ_{jt} is an *iid* shock, reflecting unobserved firm-level differences in the production of high- and low-quality garments.

All of the estimation details are in Appendix E.1.1. Broadly, I follow a two-step procedure. First, I estimate the necessary parameters to create the static profits, $\pi(a, s_{jt})$ and transition matrices of

[36] I do so to incorporate Peruvian firms' two margins of adjustment to import competition: increased sales of high-quality existing products and the addition of new products and markets.

[37] This error term reflects unobserved firm-specific reasons for choosing a particular product mix.

the state space. Second, I use the estimated parameters to compute dynamic parameters using a conditional choice probability method (CCP). Identification of the elasticities comes from the fact that final quality is only determined by material quality. Price differences respond only to differences in material costs and mark-ups, which depend on demand elasticities given the CES assumptions. Productivity-related parameters are identified with the demand structure and production data following De Loecker (2011). Finally, identifying the sunk cost parameters relies heavily on the observed movement of firms across the space of products and markets over time.

Panel A of Table 5 summarizes the estimated parameters.[38] Consistent with the non-homotheticity assumption that $\sigma_h > \sigma_l$, the implied elasticities are $\sigma_h = 2.53$ and $\sigma_l = 1.98$—which, in turn, represent mark-ups of 67% and 100% for high- and low-quality goods, respectively.[39] Output elasticities, shown in the second row, are 0.72 for labor and 0.13 for capital. I rely on these estimates to predict firm-level productivity and estimate its AR1 process. The parameters are presented in the third row and show moderate productivity persistence over time but considerable heterogeneity between firms. Finally, the estimates for sunk costs are recorded in the fourth row. They are expressed in millions of US dollars and are in line with the common empirical fact of substantial sunk costs related to exporting and starting a business.[40]

[TABLE 5 HERE]

5.2 The Role of Upgrading Costs

The key mechanism is the within-firm reallocation of fixed factors. However, this mechanism relies on firms earning profits while switching to other products and destinations. In this case, Peruvian

[38] The complete list of parameters is in Appendix E.2; Appendix E.3 examines the model fit.

[39] When considering the full sample of Peruvian apparel industry exporters, $\sigma_h = 2.77$ and $\sigma_l = 2.18$.

[40] Sunk costs for the domestic market are considerably high, as they likely capture the combined effect of firms selling both high- and low-quality apparel domestically.

firms were at an advantage as they had quick access to high-quality native inputs and were able to swiftly sell high-quality goods in foreign markets, but what would have happened if they did not?

To answer this question, I explore a counterfactual where Peruvian firms saw the same rising import competition as in the baseline estimated model but had to import high-quality fabric. In particular, I simulate an increase in the material unit cost for pima cotton cloth, m_{ht}, from 4 to 16 US$, which is the difference between the average price for pima cotton in Peru and the amount paid by Colombian firms importing it from Peru.

Panel B in Table 5 presents the results. Column 1 shows the percentage change in several industry performance measures relative to the estimated baseline. During the sample period, annual exports decrease by 7.9%, while domestic sales increase by an average of 2.3%, leading to a reduction in total industry sales of approximately 4%. In dollars, these results imply a cumulative increase in sales for the domestic market of US$ 146 million and a reduction of cumulative exports of US$ 682 million during the sample period. From the firms' point of view, average annual profits decrease by 4.2% and employment by 8%. Yet, consumer welfare in domestic and export markets remains unchanged as it is mostly affected by the decrease in prices due to Chinese import competition. I consider this scenario a potential explanation of why other Latin American apparel industries could not shift widely to high-quality and survive the Chinese expansion.

In Column 2, I also consider how important it was for Peruvian firms to have a large market to sell these high-quality products, e.g., the United States. To do that, I shut down the high-quality export channel when Peruvian firms face the same import competition as in baseline by simulating a sufficiently large increase in the sunk costs of exporting a new high-quality variety.[41]

In this case, the predictions are more striking, and the Peruvian apparel industry is severely affected. The average annual industry sales are down by 13.2%, with most of this effect coming

[41] Sunk costs of exporting high-quality goods go up 10-fold.

from a dramatic fall in exports (28%) that the increase in domestic sales cannot offset. In monetary terms, the effects are significant: The industry loses US$ 2.16 billion over 2001-2012. Moreover, the inability to quality upgrade and export costs firms approximately 11.8% of their annual profits. Relative to baseline, employment also decreases by approximately 15%. Finally, since firms are only selling low-quality goods, domestic consumer welfare increases by 0.06% due to slightly more competition, which drives down prices.

Both results point to significant losses if firms cannot change their product mix following an increase in import competition. They highlight the need to promote access to high-quality upstream supply chains and foreign downstream buyers.

6 Conclusion

This paper documents a new channel through which trade affects firms' incentives to quality upgrade: within-firm reallocation of specific factors. This channel does not rely on positive profitability shocks—such as access to cheaper inputs or larger markets—but rather is present despite profitability losses. To formalize and quantify the mechanism, I develop an industry equilibrium model and study the response of Peruvian apparel manufacturers to the increase in Chinese import competition during the 2000s. Together, the paper's main results suggest that firms escaped Chinese import competition with within-firm responses such as exporting and quality upgrading.

Moreover, this channel appears to have long-lasting effects. Even though the mechanism, due to a fixed factor, is short- to medium-run, almost all firms that upgraded quality or started exporting due to Chinese import competition continued to export, increased their sales, and had positive investment in capital by the beginning of the 2010s. That is, the "forced" quality upgrading and exporting activity engaged in by these firms to avoid competition led to additional long-run welfare gains not accounted for in this paper. Whether this represents evidence of learning-by-exporting or reputation gains in customer-supplier relationships warrants further research.

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TABLES

Table 1: Within-firm Responses: Exports

	Export Value							Unit Prices		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total	HQ	LQ	Share HQ	Share LQ	Share NC	$\frac{HQ}{HQ+LQ}$	All	HQ	LQ
A: OLS										
DComp_{jt-1}	0.353***	0.381***	0.216	0.032*	-0.047***	0.016	0.051***	-0.062*	-0.082**	-0.040
	(0.090)	(0.118)	(0.230)	(0.018)	(0.015)	(0.011)	(0.019)	(0.037)	(0.040)	(0.072)
FComp_{jt-1}	-0.259**	-0.122	-0.151	0.006	-0.014	0.007	0.035	-0.029	0.053	-0.081
	(0.129)	(0.192)	(0.364)	(0.022)	(0.019)	(0.017)	(0.026)	(0.050)	(0.074)	(0.123)
R-Squared	0.069	0.042	0.090	0.014	0.018	0.003	0.023	0.198	0.160	0.158
B: IV										
DComp_{jt-1}	0.674***	0.740***	0.370	0.045*	-0.068***	0.023	0.076***	-0.101*	-0.127*	-0.041
	(0.152)	(0.195)	(0.333)	(0.027)	(0.023)	(0.017)	(0.029)	(0.056)	(0.066)	(0.104)
FComp_{jt-1}	-0.415***	-0.313	-0.241	-0.000	-0.004	0.004	0.022	-0.009	0.077	-0.080
	(0.145)	(0.204)	(0.398)	(0.023)	(0.020)	(0.018)	(0.027)	(0.055)	(0.079)	(0.137)
F-stat	399.79	473.40	165.91	399.79	399.79	399.79	372.41	399.79	473.40	165.91
Hansen J P-val	0.84	0.29	0.38	0.18	0.09	0.76	0.02	0.34	0.56	0.59
Mean	1478.67	1296.81	106.46	0.67	0.14	0.19	0.81	28.31	12.55	10.69
Firms	1192	1106	740	1192	1192	1192	1143	1192	1106	740
Obs	5663	5178	2954	5663	5663	5663	5360	5663	5178	2954

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods, LQ low-quality ones and NC others non-classified. Unit prices refer to unit values of exported goods. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of exports is in thousands of US dollars, and the mean of unit values is in US dollars. The sample size changes because not all firms export both high- and low-quality goods.

Table 2: Within-firm Responses: Exports

	Number of Exported Products					New Exported Products			Export Decision
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Total	HQ	LQ	Share HQ	Share LQ	All	HQ	LQ	Prob Exit
A: OLS									
DComp_{jt-1}	0.263***	0.289***	0.209**	0.015	-0.037***	0.035	0.068*	0.012	-0.156***
	(0.062)	(0.066)	(0.089)	(0.016)	(0.012)	(0.033)	(0.039)	(0.039)	(0.026)
FComp_{jt-1}	0.242**	0.268**	-0.072	0.025	0.005	0.149***	0.159***	0.049	-0.025
	(0.097)	(0.111)	(0.137)	(0.023)	(0.018)	(0.055)	(0.059)	(0.066)	(0.040)
R-Squared	0.033	0.029	0.027	0.043	0.018	0.065	0.090	0.014	0.076
B: IV									
DComp_{jt-1}	0.465***	0.507***	0.225	0.047*	-0.065**	0.093*	0.105*	0.074	-0.292***
	(0.099)	(0.106)	(0.142)	(0.025)	(0.027)	(0.055)	(0.062)	(0.067)	(0.045)
FComp_{jt-1}	0.144	0.152	-0.081	0.010	0.018	0.121**	0.141**	0.018	0.033
	(0.099)	(0.116)	(0.155)	(0.024)	(0.018)	(0.060)	(0.064)	(0.070)	(0.042)
F-stat	399.79	473.40	165.91	399.79	399.79	399.79	399.79	399.79	333.21
Hansen J P-val	0.61	0.67	0.99	0.20	0.78	0.89	0.33	0.28	0.04
Mean	13.29	7.93	2.56	0.63	0.16	0.87	0.72	0.43	0.16
Firms	1192	1106	740	1192	1192	1192	1192	1192	1073
Obs	5663	5178	2954	5663	5663	5663	5663	5663	4967

Note: Number of exported products are in logs and shares take values between 0 and 1. All the other variables are dummies with values 0 or 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is in counts of 10-digit HTS codes, the others refer to the share of firms including new products or exiting exporting. The sample size changes because not all firms export both high- and low-quality goods and because the last year of the sample is not considered in the exit regression.

Table 3: Within-firm Responses: Exports

	Export Value					Export Quantity	
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ	(6) Share HQ	(7) Share LQ
A: Panel Exporters 2000-2012							
DComp_{jt-1}	1.467***	1.059*	1.034	0.047	-0.103	0.032	-0.149**
	(0.454)	(0.625)	(0.754)	(0.066)	(0.067)	(0.069)	(0.066)
FComp_{jt-1}	-0.829***	-0.525	0.296	0.041	-0.024	0.016	-0.008
	(0.266)	(0.349)	(0.723)	(0.035)	(0.032)	(0.043)	(0.016)
Mean	5213.06	4745.98	220.69	0.58	0.07	0.49	0.03
Firms	108	105	81	108	108	108	108
Obs	1380	1195	634	1380	1380	1380	1380
B: Panel Exporters of HQ and LQ during 2000-2012							
DComp_{jt-1}	8.602***	14.901***	3.788**	1.275***	-1.294***	1.024**	-1.049**
	(2.199)	(4.047)	(1.545)	(0.492)	(0.461)	(0.435)	(0.415)
FComp_{jt-1}	-7.207***	-5.571	-9.787***	0.850*	-0.669	0.560	-0.460
	(2.001)	(3.684)	(1.406)	(0.448)	(0.420)	(0.396)	(0.378)
Mean	9442.16	6731.90	685.74	0.43	0.24	0.31	0.12
Firms	5	5	5	5	5	5	5
Obs	65	65	65	65	65	65	65

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of exports is in thousands of US dollars. The sample size changes because not all firms export both high- and low-quality goods.

Table 4: Within-firm Responses: Total Sales

A: Total Sales

	Sales			Export Value			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	D+X	D	X	HQ	LQ	Share HQ	Share LQ
DComp_{jt-1}	-0.007	0.318	1.406***	0.836*	-0.467	0.074	0.009
	(0.166)	(0.439)	(0.481)	(0.466)	(0.708)	(0.109)	(0.096)
FComp_{jt-1}	-0.220	0.094	-0.733	-0.072	1.934	0.029	0.099
	(0.181)	(0.428)	(0.644)	(0.597)	(1.429)	(0.073)	(0.063)
F-stat	41.70	41.70	34.57	52.06	22.80	34.57	34.57
Hansen J P-value	0.01	0.58	0.17	0.44	0.92	0.80	0.88
Mean	17538.92	15119.30	2429.21	2225.51	96.27	0.75	0.09
Firms	173	173	147	138	85	147	147
Observations	865	865	748	689	351	748	748

B: Production Factors

	Capital		Labor			Materials	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Stock	Stock Machinery Only	Expenditure	N. Employees	Avg Wages	Expenditure	Value Input per kilo
DComp_{jt-1}	0.122	0.018	0.132	0.461**	-0.362**	0.031	0.262
	(0.166)	(0.160)	(0.158)	(0.222)	(0.157)	(0.216)	(0.506)
FComp_{jt-1}	-0.017	0.023	-0.154	-0.405*	0.272*	-0.208	0.807*
	(0.186)	(0.231)	(0.212)	(0.245)	(0.161)	(0.216)	(0.477)
F-stat	45.60	44.88	45.60	45.60	44.03	45.60	5.22
Hansen J P-value	0.74	0.73	0.12	0.36	0.30	0.99	0.43
Mean	12447.30	19690456.58	2327.97	3225.40	21533.40	8135.37	8.62
Firms	173	167	173	173	172	173	36
Observations	865	847	865	865	854	865	142

Note: All outcome variables are in logs, except for shares. D are domestic sales, X are exports; HQ indicates high-quality goods and LQ low-quality ones. The mean of all variables is in thousands of US dollars, except for shares, the number of employees (counts of workers) and material unit values (US dollars). The sample size changes, since not all firms export, and if they do, they do not necessarily export both high- and low-quality goods (Panel A) or due to missing values in some variables (Panel B). Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses.

Table 5: Structural Estimation

A: Structural Estimation Parameters

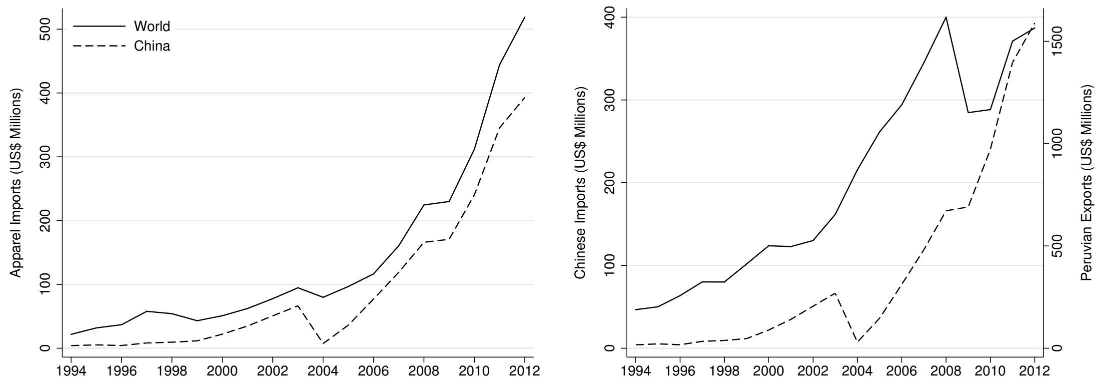
(1) Stage	(2) Estimation	(3) Parameter	(4) Coef.	(5) Std. Dev	(6) No. Obs.
1	Elasticities	σ_h	2.53	(1.53)	685
		σ_l	1.98	(0.82)	
1	Production Function	α_l	0.72	(0.02)	511
		α_k	0.13	(0.03)	
1	Production Process	ρ_0	0.25	(0.03)	404
		ρ_1	0.22	(0.08)	
		σ^2_ψ	0.42		
2	Sunk Costs	γ_d	6.08	(2.30)	222
		γ_h	7.10	(1.27)	
		γ_l	3.85	(3.87)	

B: The Role of Upgrading Costs

Criteria	(1) $\uparrow \mathbf{m_h}$	(2) $\uparrow \boldsymbol{\gamma_h}$
Annual % Change of Sales:		
Exports	-7.9%	-28.0%
Domestic	2.3%	5.9%
Industry	-3.7%	-13.2%
Cumulative 2001-2012		
(in millions of US$)	-536	-2,160
Annual Profits	-4.2%	-11.8%
Man Hours	-8%	-14.8%
Total Consumer welfare	0.02%	0.14%
Domestic Consumer welfare	0.02%	0.06%

Note: Panel A describes the estimates from the main parameters of the structural model. Panel B shows the results of two counterfactuals that assess the importance of upgradings costs. Column (1) considers the case of an increase in high-quality material price m_h (from 4 to 16 US dollars). Column (2) examines the case of a large increase in sunk costs of exporting high-quality γ_h (a ten-fold increase).

FIGURES



(a) Peruvian Apparel Imports (b) Peruvian Imports and Exports

Figure 1: Peruvian Apparel

Note: Panel (a) shows worldwide Peruvian apparel imports (solid line) and Peruvian apparel imports originated in China (dashed line) from 1994 to 2012. The drop in 2004 imports is due to the temporary tariffs imposed by the Peruvian government for 200 days. Panel (b) shows, in the primary y-axis, total imports originating in China (dashed line). The secondary y-axis (solid line) denotes Peruvian garment exports. The source for both panels is Peruvian customs.

ONLINE APPENDICES

A Data and Measurement

A.1 Datasets

The paper draws on two primary data sources from 2000 to 2012:

Peruvian Customs Data: The data come from the Peruvian Tax Authority (SUNAT) and contain information disclosed on the universe of individual customs declarations. Along with other variables, it has information on the exporter or importer name, its tax ID, date of transaction, the FOB or CIF values of the transaction, quantities and unit values, the origin or destination country, and a detailed description of the goods. The product classification is at the 10-digit HTS code.

***Encuesta Económica Anual* (EEA):** The EEA is an annual survey conducted by the Peruvian Statistical Agency (INEI), representative at the national and regional level. The EEA is effectively a census for medium and large firms, whereas small firms are sampled every year. The survey spans from 2000 onward and includes firm-level variables such as revenues, value-added, expenditures, investment, capital stock, and employment. These variables are reported in local currency. Annual exchange rates given by the Peruvian Central Bank are used to convert these variables to US dollars.

I can combine both datasets by using firms' tax IDs (RUC). For the analysis, I consider all firms listed in EEA as producing in industries with CIIU Rev 4. Codes 1410 or 1430 or exporting at least 20 thousand dollars annually on products in Chapters 61 and 62 of the HST code from 2000 to 2012 (to avoid firms that are shipping samples). In total, the sample derived from the customs data consists of 9,015 firm-year observations. Merged with the EEA sample, the sample reduces to 3,069 firm-year observations. The number of firms per year is shown in Columns 1 and 3 in Table A1. However, I only use firms that appear in the data for two consecutive years in the main empirical specifications. Columns 2 and 4 in Table A1 show the sample size that runs the OLS specification in each case. Samples are further reduced when considering other specifications.

The survey also includes questions about the primary goods and inputs produced and used by the firm, their prices, and sales. These items are self-reported, and thus not standardized. I categorize these articles into 6-digit HTS codes according to product names and descriptions. On the EEA sample, I can classify the final goods of 758 firms unequivocally (381 of which export). For this subsample, I construct an import competition shock based on production shares, as opposed to export ones. Then, I perform robustness checks for the main specifications of the model.

I complement these data with additional sources of information, such as:

The Peruvian Firm Registry (*Padrón RUC*): It is a complete list of all formal firms in Peru and includes information such as the date of the firm's start and end of operations, location of the firm, and tax ID. I use the version updated up to 2013.

The Peruvian Economic Census (CENEC): It contains all firms in Peru that were producing in 2007, including variables such as the number of establishments, number of workers, intermediate consumption, sales, production, value-added, and fixed assets, among others.

***Encuesta Nacional de Hogares* (ENAHO):** The ENAHO is an annual household survey representative at the national and regional levels. Its purpose is to measure the living conditions of households. People over 14 years old have to fill out an employment module. This module includes questions such as employment status (employed, searching for a job, not working), occupation,

Table A1: Number of Firms and Observations

	Customs Data		EEA Sample & Customs Data	
	All Firms	Estimation Sample	All Firms	Estimation Sample
2000	265	195	211	
2001	318	244	204	55
2002	336	275	150	52
2003	401	299	168	53
2004	463	359	221	60
2005	557	411	175	59
2006	671	485	165	53
2007	716	553	470	73
2008	890	643	204	111
2009	1,019	683	255	105
2010	924	707	252	119
2011	1,140	754	339	105
2012	1,315	886	254	110
N. Obs	9,015	6,494	3,069	955

Note: Tax-exempt institutions (government, education, nonprofit) or natural persons are not considered. Only legal entities are included. These are identified by the Peruvian Tax Authority with tax ID starting with 20.

the industry of the employer, and income, in addition to basic demographics and other individual characteristics. This information includes formal and informal work.

A.2 Additional Margins of Adjustment

This section considers other potential margins of adjustment for Peruvian firms, such as the response of small firms and informality. Small firms mostly exit after the trade shock; however, there is no evidence that the industry shifted to the informal sector.

A.2.1 Small Firms

As noted in Section 1.1, the EEA is not representative of small firms. Moreover, most small firms do not export and thus are not in the customs data. To understand whether these firms' responses differ from those analyzed in the main text, I examine two potential margins of adjustment. First, on the extensive margin, the model presented in Section 3 predicts that smaller (less productive) firms will exit the market in the event of import competition. For these firms, the selection effect is more substantial, given that they might not have the capacity to pay the fixed costs and higher marginal costs associated with selling and producing high-quality products. I observe this in the data. Using the Peruvian Firm Registry, I compare industry-wide entry-exit rates with the ones from the EEA sample. As shown in Columns 1 to 4 of Table A2, entry and exit rates are much higher in the aggregate relative to my estimation sample. This difference suggests that the churning in the apparel industry is coming from small firms.

Second, small firms have also shrunk their contribution to industry sales on the intensive margin. During the 2000s, the number and sales of firms not in the EEA have doubled, whereas sales in the EEA sample have increased by 3.2 times, and the number of firms went from 211 in 2000 to 254 in 2012. Thus, during this period, a subset of firms is becoming more prominent over time and coexist with an increasing fringe of smaller companies, as shown in Column 5 of Table A2.

Table A2: Small Firms' Adjustment

	Firm Registry		EEA Sample		
	Entry Rate	Exit Rate	Entry Rate	Exit Rate	Sales Contribution
2001	7.3	5.9	3.3	0.0	35%
2005	10.6	4.0	4.8	0.0	42%
2009	16.5	8.2	0.0	0.0	44%
2012	15.6	8.6	0.0	0.4	47%

Note: Tax-exempt institutions (government, education, nonprofit) or natural persons are not considered. Only legal entities are included. These are identified by the Peruvian Tax Authority with tax ID starting with 20.

Unfortunately, I cannot link these survival rates directly to Chinese import competition. However, these statistics suggest a difference between firms' adjustment depending on size, where small firms seem to have responded either by exiting or downsizing.

A.2.2 Informal Sector

My main datasets only consider formally registered firms. As Peru has a large informal sector, I explore to what extent this was a margin of adjustment to import competition. To do that, I use the ENAHO to construct industry-level informality rates for employment in the apparel industry. I complement this information with statistics from the INEI on the production of the informal sector. Table A3 shows the main statistics for the informal apparel sector from 2007 onward.[42]

Compared with any other manufacturing industry, the informal sector in apparel is substantial in terms of operating units and employment. While large in number, these informal firms provide a low contribution to industrial output. Furthermore, the trend is decreasing in size and participation. As seen in Table A3, the informal apparel sector is shrinking: Over this decade, apparel output did not consistently shift toward informal production. While I cannot rule out that the informal sector represented a margin of adjustment for a subset of firms—and it is likely to be for small ones in particular (Dix-Carneiro and Kovak, 2019)—it does not seem crucial for most.

Table A3: Informal Firms' Adjustment

	Informal Employment Rate	Productive Units (thousands)	% Industry Production
2007	81.9	210	23.7
2008	78.4	177	22.6
2009	79.3	171	24.2
2010	76.4	169	23.4
2011	80.4	138	23.0
2012	76.3	146	16.3

Note: Informal employment rate is calculated from the ENAHO with the definition of informality provided by the Peruvian Ministry of Employment. Statistics regarding productive units and industry production come from INEI reports.

[42]Previous statistics are not deemed reliable by the INEI due to a lack of updated economic censuses over two decades. However, many industry reports show similar patterns in prior years.

A.3 Quality Definition

I define high-quality goods as apparel made of fabrics containing at least 50% Peruvian cotton. By the same token, low-quality products refer to clothing made of other types of cotton, synthetic, or man-made fibers.

To operationalize this measure, I exclude two types of apparel from the categorization procedure.[43] First, while Peruvian cotton is of higher quality than other cotton varieties, it is not always the case that it is superior to synthetic or man-made fibers. For example, garments such as wetsuits, swimwear, winter clothing, sports gear, and water-resistant outerwear have specific functionality requirements. Synthetic fibers are often the best choice for these types of products, given they are lightweight, stretchy, and dry fast. In these cases, cotton is either not an option or even a bad one. To overcome this concern, I only consider HTS codes that accommodate both cotton and synthetic fabrics. This list includes t-shirts, shirts, pants, and blouses, among others, and excludes tracksuits, skisuits, swimwear, scarfs, bras, and pantyhose.[44]

Second, I exclude apparel that has a production process that differs from that of cotton or synthetic clothes. The main reason is that with varying methods of production, quality also becomes associated with other factors of production, such as machinery and labor. Thus, I only consider apparel for which firms use the production process outlined in Section 1.2 independent of material inputs. The excluded products are leather, silk, fine animal hair, and wool apparel.

These exclusions do not entail an essential loss of information. The surviving products account for 95% of the total HTS codes exported by Peru from 2000-2012. Moreover, they also represent 95% of annual exports during the sample period.

Of all transactions on these products, around 90% contain detailed information that allows me to identify them accurately. It is essential to note that in the data, almost all Peruvian export transactions of cotton apparel use native Peruvian high-quality cotton. That is, if Peruvians use cotton cloth, they use high-quality types. Therefore, I use the 50% threshold in the paper without loss of generality. All of the main results are robust to other thresholds of Peruvian cotton percentage, such as 80% or even 30%.

[43]Uncategorized products will be included in a third category that cannot be compared.

[44]Note that even though these measures attempt to better capture the margin of vertical differentiation across products, a degree of horizontal differentiation might still be present.

B Import Competition

B.1 Garment Unit Values

Chinese garments in Peru are very cheap. In particular, their unit values are considerably lower relative to other international origins and domestic production, as Figure B1 shows.

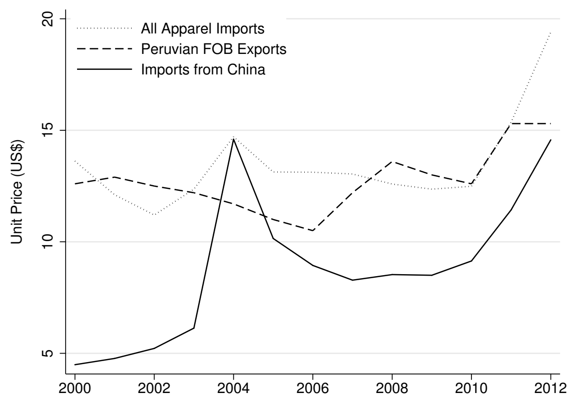


Figure B1: Unit Values

Note: Domestic unit prices are approximated with FOB unit values of Peruvian exports. Not considering duties and fees, FOB unit values approximately reflect production costs and markups. Source: Peruvian customs.

This is also true for all products that China and Peru jointly export. Figure B2 shows the average unit values of all Chinese and Peruvian garments sold to the United States. Moreover, Figure B3 compares these unit values for the case of cotton t-shirts and men's cotton shirts, the two most significant Peruvian apparel products in the American market. In both cases, Chinese garments sell much cheaper than their Peruvian counterparts.

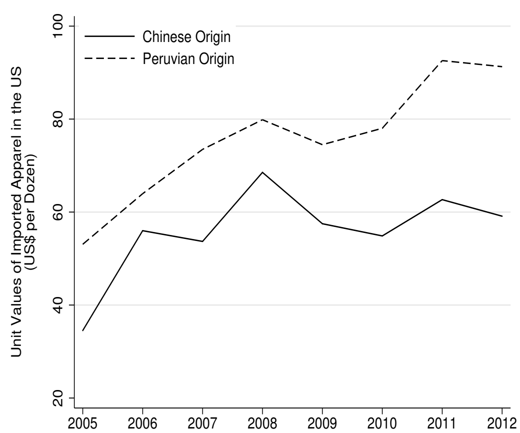
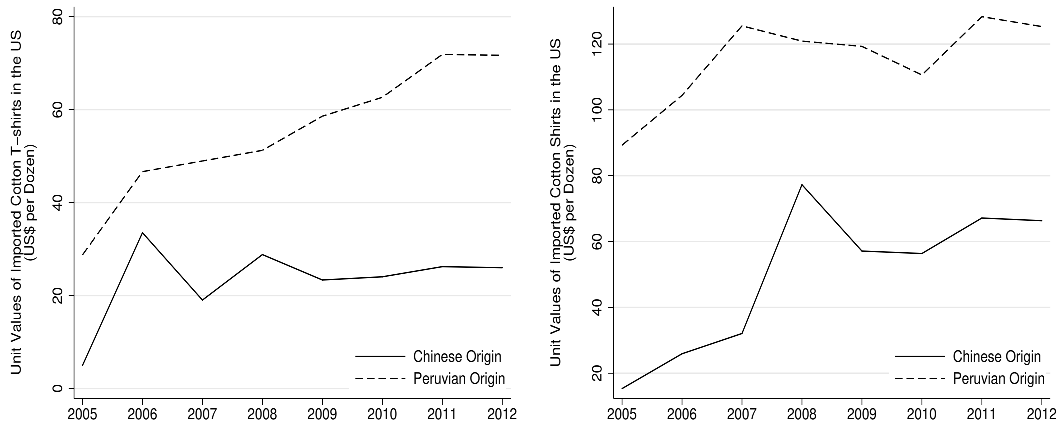


Figure B2: Unit Prices of American Apparel Imports, All Types

Note: The figure shows the average unit values of all apparel (defined at the 6-digit HTS code) sourced from China and Peru by the United States. Source: OTEXA.



(a) Cotton T-shirts (b) Cotton Shirts

Figure B3: Unit Prices of American Apparel Imports

Note: Panel (a) shows the average unit values of cotton t-shirts (HTS 610910) sourced from China and Peru by the United States. Panel (b) shows the average unit values of cotton shirts (HTS 610510) sourced from China and Peru by the United States.Source: OTEXA.

B.2 Export Growth Decompositions

Table B1 decomposes the export growth in high- and low-quality apparel into an extensive and intensive margin following $\Delta X_{07-00} = \Delta X_{Inc,07-00} + X_{Ent,07} - X_{Exit,00}$, where ΔX_{07-00} represents the aggregate change in exports in US$ millions between 2000 and 2007. Moreover, $\Delta X_{Inc,07-00}$ is the part accounted for firms surviving between 2000 and 2007 (Inc), $\Delta X_{Ent,07-00}$ the ones accounted for firms that entered between 2000 and 2007 (Ent), and $\Delta X_{Exit,07-00}$ the change coming from firms that exited between 2000 and 2007 ($Exit$).

Table B1: Change in Aggregate Exports by Product Type

	ΔX_{07-00}	$\Delta X_{Inc,07-00}$	$X_{Ent,07}$	$X_{Exit,00}$
High Quality	761.61	343.37	490.24	72.01
Low Quality	78.71	41.09	39.85	2.23

Note: ΔX_{07-00} represents the aggregate change in exports in US$ millions between 2000 and 2007, and $\Delta X_{j,07-00}$ represents this change for the group j, where j consists on firms that survived between 2000 and 2007 (Inc), firms that entered between 2000 and 2007 (Ent), and firms that exited between 2000 and 2007 ($Exit$).

In addition, Table B2 decomposes this high-quality export growth among exporter incumbents. In particular, I examine whether the export growth in high-quality products comes from a reallocation of exports across firms or changes in export mix within firms. To do so, I write the changes in the average high-quality exports of incumbents from 2000 to 2007 as

$$\Delta \tilde{x}_{Inc,07-00} = \sum_i sh_{i,00}(\Delta x_{i,07-00}) + \sum_i x_{i,00}(\Delta sh_{i,07-00}) \tag{B1}$$

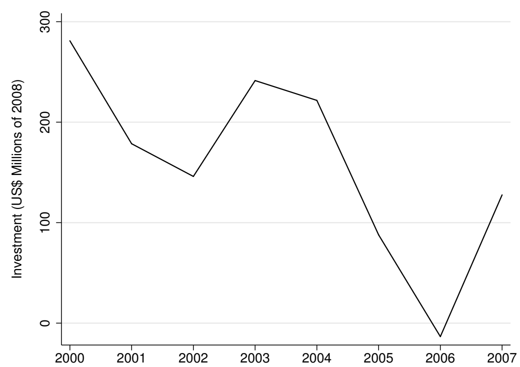
where $sh_{i,t}$ measures firm i's share of high-quality exports at time t. The first term on the right-hand side measures the within-firm contribution as changes in firm-level exports holding the firms' export shares constant, while the second term measures the importance of export reallocation across firms.

Table B2: Decomposition of Change in Weighted Average Exports of Incumbents

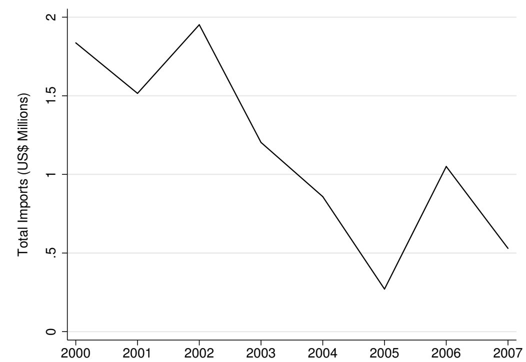
	$\Delta \tilde{x}_{Inc,07-00}$	$\sum_i sh_{i,00}(\Delta x_{i,07-00})$	$\sum_i x_{i,00}(\Delta sh_{i,07-00})$
High Quality	23.60	13.09	10.51
%		55.46	44.54

B.3 Factor Usage

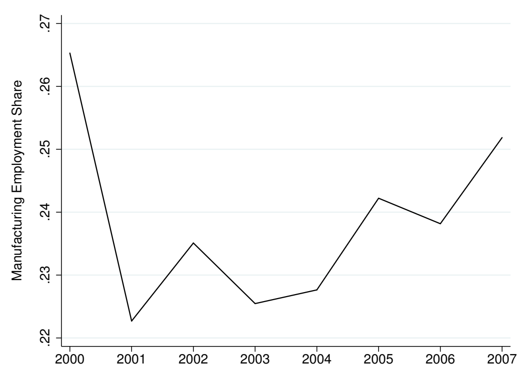
Figure B4 shows the factor usage dynamics of the Peruvian apparel industry explained in Section 2.3. It displays, from 2000 to 2007, the industry aggregate capital investment, including land, buildings, fixed installations, machinery and equipment, transportation units, and computers; imports of apparel machinery; total industry employment; relative average wages (to the national minimum wage); aggregate material expenditure; and the average material unit value paid per kilo by Peruvian apparel firms.



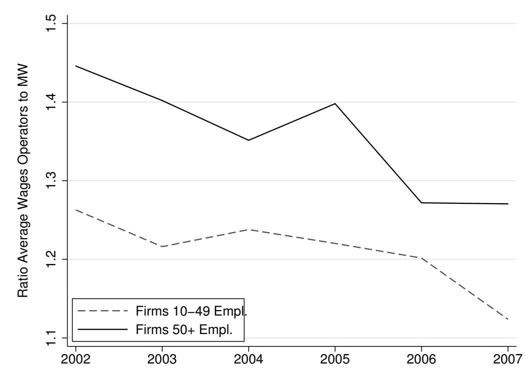
(a) Investment in Physical Capital



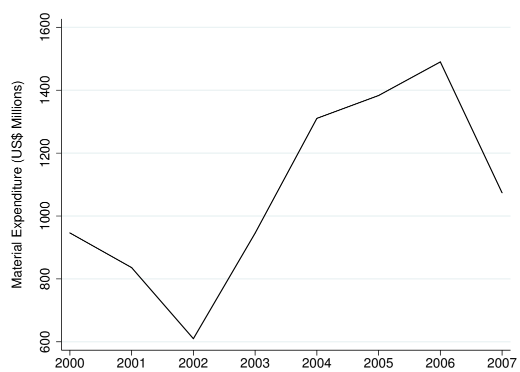
(b) Imports of Machinery



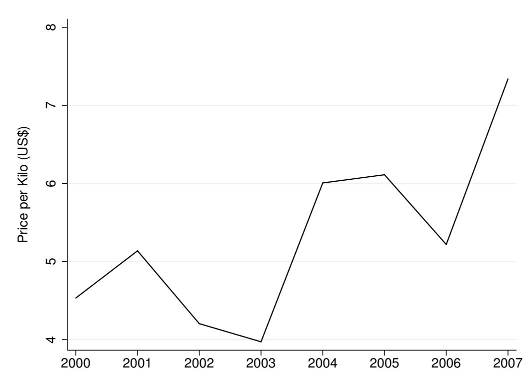
(c) Employment



(d) Relative Average Wages



(e) Material Expenditure



(f) Average Material Price

Figure B4: Factor and Input Usage

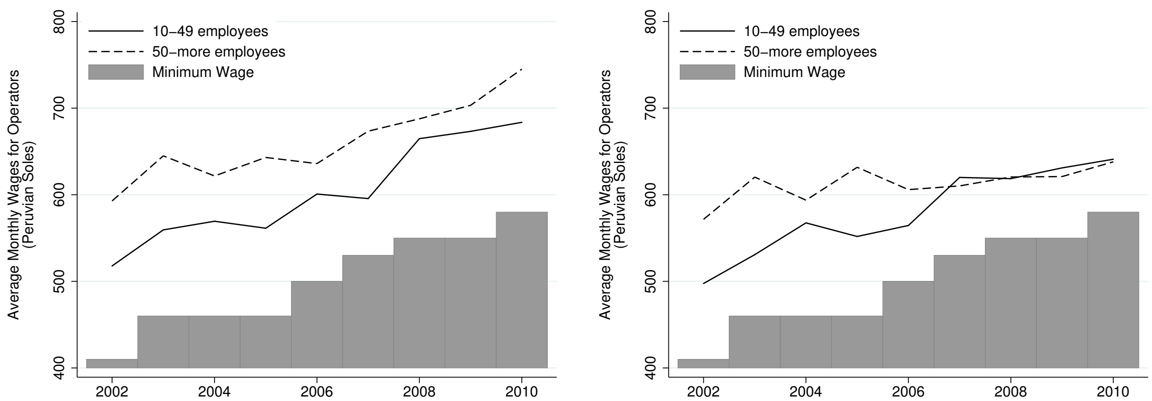
Note: Panel (a) presents the industry aggregate capital investment, including land, buildings, fixed installations, machinery and equipment, transportation units, and computers. Panel (b) shows imports of industrial sewing machines (HTS code 845221). Panel (c) displays the share of apparel in Peruvian manufacturing employment. Panel (d) exhibits operators' relative average wages (to the national minimum wage) for firms with 10 to 48 or more than 50 employees. Panel (e) shows the industry aggregate material expenditure. Panel (f) shows the average material unit value paid per kilo by Peruvian apparel firms.

C Model Details and Derivations

C.1 Assumptions on Factor Prices

In the model, I assume that firms take factor prices as given. This assumption is not innocuous, as it shuts down potential general equilibrium effects. However, I find little evidence that factor prices played a substantial role during the adjustment to the import competition shock.

First, average wages in the apparel industry closely follow the Peruvian minimum wage. Figure C1 shows both series for all productive workers (Panel (a)) and sewing operators only (Panel (b)). Solid lines show average wages for firms with 10 to 49 employees, and dashed lines refer to firms with 50 or more employees. Bars represent Peru's legal minimum wage during those years. Throughout the period, average wages for all apparel operators are approximately 20% to 32% higher than the Peruvian minimum wage, a stable percentage over time. Moreover, various reports from the Ministry of labor show that the industry had not changed its labor composition to include relatively more skilled workers. Thus, average wages do not seem to be hiding a compositional effect.



(a) All Operators (b) Sewing Operators

Figure C1: Average Monthly Wages

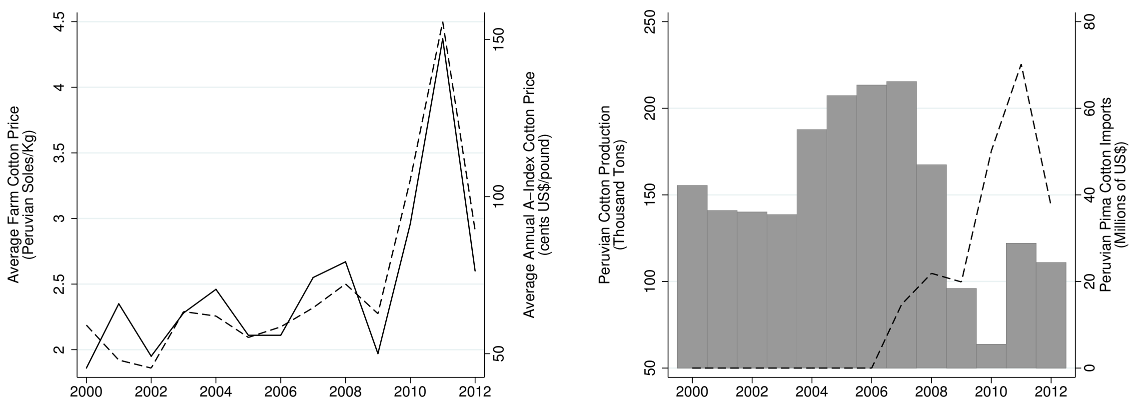
Notes: Panel (a) shows the average monthly wages of operators and technicians, and Panel (b) displays average monthly wages for sewing operators. In both graphs, the legal Peruvian minimum wage is included for comparison. All measures are in Peruvian soles. Source: Peruvian Ministry of Labor.

Second, Peru imports most of its synthetic or man-made materials and is unlikely to be an international price setter for these prices. However, Chinese export growth could have affected these material prices after. If this were the case, results should be even starker, as a decrease in the price of low-quality materials increases the profitability of this segment, rendering the shock less severe. If final good import competition and an increase in the availability of cheaper low-quality inputs are in play, my results will be a lower bound of the potential adverse effect.

Third, the price of high-quality Peruvian cotton has remained stable during the 2000s, as shown in Panel (a) of Figure C2.[45] In particular, the price of Peruvian cotton follows the same trend as the international price of cotton (Index A - Upland). Given that the latter is a commodity price resulting from global spot markets, in which Peru is not a big player, I consider the cost of high-quality cotton exogenous to domestic manufacturers' decisions. These patterns in the high-quality price input were possible because even though all Peruvian apparel firms used the domestic supply of pima and tangüis cotton after China's accession to the WTO, these firms were able to

[45]Prices spiked during 2010-2012, but they quickly returned to previous levels.

source materials from other countries. Panel (b) of Figure C2 presents domestic production and cotton imports of Peru. In particular, Peruvian textile and apparel firms took advantage of trade agreements with the United States, carrying zero tariffs on this type of cotton. When domestic production dropped (bars on the primary axis), Peru imported this high-quality cotton (dashed line on the secondary axis). In this way, domestic apparel producers, in reality, faced an elastic supply of pima cotton cloth over the decade. As mentioned in Section 2.1, this was particularly feasible given the long tradition of high-quality Peruvian fabric and its connection to apparel production.



(a) Cotton Prices

(b) Cotton Production

Figure C2: High-quality Cotton Statistics

Notes: Panel (a) shows the average farm prices of Peruvian cotton (primary axis) and average worldwide prices for Upland cotton (secondary axis). Panel (b) displays Peruvian cotton production (primary axis) and Peruvian pima cotton imports (secondary axis). Sources: Peruvian Ministry of Agriculture, Peruvian customs, and the United States Department of Agriculture.

Overall, the evidence points to a lack of general equilibrium effects manifested through factor prices. Therefore, I simplify the model by making this assumption.

C.2 Productivity Relations

This section shows that more productive firms sell at lower prices, trade more, and have higher profits within a given product type. I detail the proof for the case in which a firm sells all products to all markets. The derivations are straightforward for the other cases.

More productive firms sell at lower prices Differentiating equation (3) for P^d_{jht},

$$\begin{aligned}(\frac{\sigma_h-1}{\sigma_h})dP^d_{jht} = \left(-\frac{w}{\alpha^2}(\frac{1}{F^{1-\alpha}})^{\frac{1}{\alpha}}\varphi_{jt}^{-\frac{1}{\alpha}-1}Q_{jt}^{\frac{1-\alpha}{\alpha}}\right)d\varphi_{jt} + \frac{w}{\alpha}(\frac{1}{F^{1-\alpha}})^{\frac{1}{\alpha}}(\frac{1-\alpha}{\alpha})Q_{jt}^{\frac{1-\alpha}{\alpha}-1} *\\ * \Big[-\sigma_h X^d_{ht}(\mathbb{P}^d_{ht})^{\sigma_h-1}(P^d_{jht})^{-\sigma_h-1}dP^d_{jht} - \sigma_h\tau^x_{ht}X^x_{ht}(\mathbb{P}^x_{ht})^{\sigma_h-1}(P^x_{jht})^{-\sigma_h-1}dP^x_{jht}\\ - \sigma_l X^d_{lt}(\mathbb{P}^d_{lt})^{\sigma_l-1}(P^d_{jlt})^{-\sigma_l-1}dP^d_{jlt} - \sigma_l\tau^x_{lt}X^x_{lt}(\mathbb{P}^x_{lt})^{\sigma_l-1}(P^x_{jlt})^{-\sigma_l-1}dP^x_{jlt}\Big].\end{aligned} \tag{C1}$$

Given $(\frac{\sigma_h-1}{\sigma_h})dP^d_{jht} = (\frac{\sigma_l-1}{\sigma_l})dP^d_{jlt}$, and $(\frac{\sigma_h-1}{\sigma_h})\frac{1}{\tau^x_{ht}}dP^x_{jht} = (\frac{\sigma_l-1}{\sigma_l})\frac{1}{\tau^x_{lt}}dP^x_{jlt}$, equation (C1) implies $\frac{dP^d_{jht}}{d\varphi_{jt}} < 0$. Similarly, $\frac{dP^d_{jlt}}{d\varphi_{jt}} < 0$, $\frac{dP^x_{jht}}{d\varphi_{jt}} < 0$, and $\frac{dP^x_{jlt}}{d\varphi_{jt}} < 0$.

More productive firms produce more Differentiating the demand function implies $\frac{dQ^d_{jht}}{dP^d_{jht}} <$

0. Then, given the previous result, $\frac{dQ^d_{jht}}{d\varphi_{jt}} = \frac{dQ^d_{jht}}{dP^d_{jht}} \frac{dP^d_{jht}}{d\varphi_{jt}} > 0$. Similarly, $\frac{dQ^d_{jlt}}{d\varphi_{jt}} > 0$, $\frac{dQ^x_{jht}}{d\varphi_{jt}} > 0$, and $\frac{dQ^x_{jlt}}{d\varphi_{jt}} > 0$.

More productive firms sell more

Let R^d_{jht} be the revenue from high-quality sales to the domestic market; then

$$dR^d_{jht} = (-\sigma_h + 1) X^d_{ht} (\mathbb{P}^d_{ht})^{\sigma_h - 1} (P^d_{jht})^{\sigma_h} dP^d_{jht}. \tag{C2}$$

Thus, $\frac{dR^d_{jht}}{dP^d_{jht}} < 0$. Then, given the previous result, $\frac{dR^d_{jht}}{d\varphi_{jt}} = \frac{dR^d_{jht}}{dP^d_{jht}} \frac{dP^d_{jht}}{d\varphi_{jt}} > 0$. Similarly, $\frac{dR^d_{jlt}}{d\varphi_{jt}} > 0$, $\frac{dR^x_{jht}}{d\varphi_{jt}} > 0$, and $\frac{dR^x_{jlt}}{d\varphi_{jt}} > 0$.

More productive firms have higher profits

$$\begin{aligned}
d\pi_{jt} =& \frac{X^d_{ht}(\mathbb{P}^d_{ht})^{\sigma_h - 1}}{(P^d_{jht})^{\sigma_h}} \left[(1-\sigma_h) + \frac{w}{\alpha} (\frac{1}{\varphi_{jt} F^{1-\alpha}})^{\frac{1}{\alpha}} Q_{jt}^{\frac{1-\alpha}{\alpha}} \frac{\sigma_1}{P^d_{jht}} + m_{ht} \frac{\sigma_h}{P^d_{jht}} \right] dP^d_{jht} \\
&+ \frac{X^d_{lt}(\mathbb{P}^d_{lt})^{\sigma_l - 1}}{(P^d_{jlt})^{\sigma_l}} \left[(1-\sigma_l) + \frac{w}{\alpha} (\frac{1}{\varphi_{jt} F^{1-\alpha}})^{\frac{1}{\alpha}} Q_{jt}^{\frac{1-\alpha}{\alpha}} \frac{\sigma_l}{P^d_{jlt}} + m_{lt} \frac{\sigma_l}{P^d_{jlt}} \right] dP^d_{jlt} \\
&+ \frac{\tau^x_{ht} X^x_{ht}(\mathbb{P}^x_{ht})^{\sigma_h - 1}}{(P^x_{jht})^{\sigma_h}} \left[\frac{(1-\sigma_h)}{\tau^x_{ht}} + \frac{w}{\alpha} (\frac{1}{\varphi_{jt} F^{1-\alpha}})^{\frac{1}{\alpha}} Q_{jt}^{\frac{1-\alpha}{\alpha}} \frac{\sigma_h}{P^x_{jht}} + m_{ht} \frac{\sigma_h}{P^x_{jht}} \right] dP^x_{jht} \\
&+ \frac{\tau^x_{lt} X^x_{lt}(\mathbb{P}^d_{lt} x^{\sigma_l - 1}}{(P^x_{jlt})^{\sigma_l}} \left[\frac{(1-\sigma_l)}{\tau^x_{lt}} + \frac{w}{\alpha} (\frac{1}{\varphi_{jt} F^{1-\alpha}})^{\frac{1}{\alpha}} Q_{jt}^{\frac{1-\alpha}{\alpha}} \frac{\sigma_l}{P^x_{jlt}} + m_{lt} \frac{\sigma_l}{P^x_{jlt}} \right] dP^x_{jlt} \\
&+ \frac{w}{\alpha^2} (\frac{1}{F^{1-\alpha}})^{\frac{1}{\alpha}} \varphi_{jt}^{-\frac{1}{\alpha} - 1} d\varphi_{jt}.
\end{aligned} \tag{C3}$$

All terms in brackets are 0 by the first-order conditions. Thus, $d\pi_{jt} = \frac{w}{\alpha^2} (\frac{1}{F^{1-\alpha}})^{\frac{1}{\alpha}} \varphi_{jt}^{-\frac{1}{\alpha} - 1} d\varphi_{jt}$. It follows that $\frac{d\pi_{jt}}{d\varphi_{jt}} > 0$.

C.3 Equilibrium Definition

The parameters of the model are the demand elasticities σ_k, production parameters, iceberg costs τ_{kt}, aggregate expenditures $\mathbf{X}$, fixed factor F, and fixed costs $\mathbf{\Gamma}$.

Given the parameters, an industry equilibrium of the model is a sequence of price indices $\{\mathbf{P}\}_{t=1}^{T}$ that satisfy:

1. Domestic and foreign consumers' utility maximization specified in expression (1);

2. The firms' optimization specified in expression (2);

3. Free entry for domestic producers: $w_t f_e = \int_{\varphi} \Pi_{jt}(\varphi) dG(\varphi)$, where ex ante, discounted expected profits Π must be equal to entry costs.

C.4 Definition of Import Competition

To define import competition, I introduce a third country, I, from which the domestic and foreign markets can import. I assume that I has a continuum of monopolistically competitive firms specializing in low-quality production. These firms are heterogeneous in productivity, $\hat{\varphi}_{jt}$, but they are single-product. To export Q_{jlt}^{cI}, where the superscript denotes the flow from country I to country $c = \{d, x\}$, the firm has to ship $\tau_{lt}^{cI} Q_{jlt}^{cI}$.

These assumptions, together with the CES demand in Section 3.1, generate the well-known price formulation, $P_{jlt}^{cI} = \left(\frac{\sigma_l}{\sigma_l - 1}\right) \frac{\tau_{lt}^{cI} mc_l}{\hat{\varphi}_{jt}}$, where mc_l is the constant marginal cost of producing low-quality goods in I. Moreover, imports from country I to country c can be defined as $R_{jlt}^{cI} = P_{jlt}^{cI} Q_{jlt}^{cI}$. This, in turn, can be expressed as $R_{jlt}^{cI} = \frac{X_{jt}^c}{\mathbb{P}_{lt}^c} (P_{jlt}^{cI})^{1-\sigma_l} = \frac{X_{jt}^c}{\mathbb{P}_{lt}^c} (\left(\frac{\sigma_l}{\sigma_l - 1}\right) \frac{\tau_{lt}^{cI} mc_l}{\hat{\varphi}_{jt}})^{1-\sigma_l}$.

Moreover, the price indices of imported goods from I to c, $\mathbb{P}_{lt}^{cI}$, can be expressed as

$$\mathbb{P}_{lt}^{cI} = \tau_{lt}^{cI} \left(\frac{\sigma_l}{\sigma_l - 1}\right) mc_l \left[\int_{\nu_l \in \Omega_{lt}^{cI}} \left(\frac{1}{\hat{\varphi}_{jt}}\right)^{1-\sigma_l} d\nu_l\right]^{\frac{1}{1-\sigma_l}}, \tag{C4}$$

and total imports from I to country c, M_{lt}^{cI}, are

$$M_{lt}^{cI} = X_{jt}^c \left(\frac{\mathbb{P}_{lt}^{cI}}{\mathbb{P}_{lt}^c}\right)^{1-\sigma_l}. \tag{C5}$$

Therefore, an exogenous change in $\hat{\varphi}_{jt}$ leads to the following first-order effects, described in Definition 1,

$$\frac{\partial \mathbb{P}_{lt}^{cI}}{\partial \hat{\varphi}_{jt}} < 0, \ \frac{\partial M_{lt}^{cI}}{\partial \hat{\varphi}_{jt}} > 0. \tag{C6}$$

C.5 Proof of Proposition 2

This proof proceeds in several steps. First, I show how the import competition shock specified in Definition 1 leads to a reduction in the import price index of low-quality goods in countries d and x. Second, I establish how this affects overall price indices in countries d and x. Third, I consider how goods' price indices in the domestic and foreign markets can be expressed in terms of changes in firm-level prices and exogenous variables. Then, I solve for the responses of firm-level prices to exogenous increases in import competition using the first-order conditions of firms. With the responses of firm-level prices, I finally build the impacts on quantity, revenues, and profits.

C.5.1 Price Indices of Imported Goods

One of the direct effects of an import competition shock is to decrease the price indices of low-quality goods imported from country I to countries c and d.

Total differentiation of the imported price indices in country c in Appendix C.4 yields $d\mathbb{P}_{lt}^{cI} = (\frac{\mathbb{P}_{lt}^{cI}}{P_{jlt}^{cI}})^{\sigma_l} dP_{jlt}^{cI}$. Moreover, the effect of an import competition shock characterized as in Definition 1 in P_{jlt}^{cI} is $dP_{jlt}^{cI} = -\left(\frac{\sigma_l}{\sigma_l - 1}\right) \frac{\tau_{lt}^{cI} mc_l}{\hat{\varphi}_{jt}^2} d\hat{\varphi}_{jt}$. Thus, $\frac{d\mathbb{P}_{lt}^{cI}}{d\hat{\varphi}_{jt}} < 0$, $\forall c$. These changes in the price indices of imported goods from I are the direct result of an exogenous increase in country's I productivity. For that reason, in the following sections of this proof I will derive all results as a funcion of $d\mathbb{P}_{lt}^{dI}$ and $d\mathbb{P}_{lt}^{xI}$, which I show represent an exogenous decrease in these price indices coming from the import competition shock.

C.5.2 Price Indices

I start by considering the effect of changes in import price indices from goods of country I on domestic and foreign price indices. From the definition of a CES ideal price index, we can rearrange the terms to define

$$\left(\mathbb{P}^c_{lt}\right)^{1-\sigma_l} = \int_{v_l \in \Omega^c_{lt}} \left(P^c_{jlt}\left(v_l\right)\right)^{1-\sigma_l} dv_l + \left(\mathbb{P}^{cI}_{lt}\right)^{1-\sigma_l}, \tag{C7}$$

where the first term on the right-hand side refers to the prices of domestic firms and the second to the price index of imports from I.

Differentiating equation (C7),

$$d\mathbb{P}^c_{lt} = \left(\frac{\mathbb{P}^c_{lt}}{P^c_{jlt}}\right)^{\sigma_l} dP^c_{jlt} + \left(\frac{\mathbb{P}^c_{lt}}{\mathbb{P}^{cI}_{lt}}\right)^{\sigma_l} d\mathbb{P}^{cI}_{lt}. \tag{C8}$$

As previously shown, $d\mathbb{P}^{cI}_{lt}$, $\forall c$ in equation (C8) is a function of the changes in firm-level prices as well as the exogenous change in the import price index of low-quality goods.

With the same procedure, $d\mathbb{P}^{cI}_{lt}$, $\forall c$ takes the form

$$d\mathbb{P}^c_{ht} = \left(\frac{\mathbb{P}^c_{ht}}{P^c_{jht}}\right)^{\sigma_h} dP^c_{jht.} \tag{C9}$$

Since there was no import competition in the high-quality segment, the price index only responds to firm-level prices. These will, in turn, depend on the import competition shock due to general equilibrium effects, as the next section shows.

C.5.3 Firm-level Prices

I will derive the effects of import competition for a firm that is multi-product and multi-market. That is, $\mathbf{a}_{jt} = \begin{bmatrix} 1 & 1 & 1 & 1 \end{bmatrix}$. The impact for firms that have product mixes with fewer goods or markets follows the same procedure.

First, consider the first-order condition for P^d_{jht},

$$P^d_{jht} = \left(\frac{\sigma_l}{\sigma_l - 1}\right)\left[m_{ht} + \frac{w_c}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-1}\right]. \tag{C10}$$

Total differentiation of equation (C10),

$$\left(\frac{\sigma_l - 1}{\sigma_l}\right) dP^d_{jht} = \frac{w_c}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}\left(\frac{1-\alpha}{\alpha}\right)\left\{\mathbf{a}_{jt}\mathbf{O}\right\}, \tag{C11}$$

where

$$\mathbf{O} = \begin{bmatrix} \frac{X^d_{ht}(-\sigma_h)\left(P^d_{jht}\right)^{-\sigma_h-1}}{\left(\mathbb{P}^d_{ht}\right)^{1-\sigma_h}} dP^d_{jht} + (\sigma_h - 1)\frac{X^d_{ht}(-\sigma_h)\left(P^d_{jht}\right)^{-\sigma_h}}{\left(\mathbb{P}^d_{ht}\right)^{2-\sigma_h}} d\mathbb{P}^d_{ht} \\ \frac{X^d_{lt}(-\sigma_l)\left(P^d_{jlt}\right)^{-\sigma_l-1}}{\left(\mathbb{P}^d_{lt}\right)^{1-\sigma_l}} dP^d_{jlt} + (\sigma_l - 1)\frac{X^d_{lt}(-\sigma_l)\left(P^d_{jlt}\right)^{-\sigma_l}}{\left(\mathbb{P}^d_{lt}\right)^{2-\sigma_l}} d\mathbb{P}^d_{lt} \\ \tau_{ht}\left[\frac{X^x_{ht}(-\sigma_h)\left(P^x_{jht}\right)^{-\sigma_h-1}}{\left(\mathbb{P}^x_{ht}\right)^{1-\sigma_h}} dP^d_{jht} + (\sigma_h - 1)\frac{X^x_{ht}(-\sigma_h)\left(P^x_{jht}\right)^{-\sigma_h}}{\left(\mathbb{P}^x_{ht}\right)^{2-\sigma_h}} d\mathbb{P}^x_{ht}\right] \\ \tau_{lt}\left[\frac{X^x_{lt}(-\sigma_l)\left(P^x_{jlt}\right)^{-\sigma_l-1}}{\left(\mathbb{P}^x_{lt}\right)^{1-\sigma_l}} dP^x_{jlt} + (\sigma_l - 1)\frac{X^x_{lt}(-\sigma_l)\left(P^x_{jlt}\right)^{-\sigma_l}}{\left(\mathbb{P}^x_{lt}\right)^{2-\sigma_l}} d\mathbb{P}^x_{lt}\right] \end{bmatrix}.$$

Using the results in C8 and C9, the vector $\mathbf{O}$ becomes

$$\mathbf{O}=\begin{bmatrix} -\sigma_h \frac{Q^d_{jht}}{P^d_{jht}} dP^d_{jht} + (\sigma_h-1)\frac{Q^d_{jht}}{\mathbb{P}^d_{ht}}\left[\left(\frac{\mathbb{P}^d_{ht}}{P^d_{jht}}\right)^{\sigma_h} dP^d_{jht}\right] \\ -\sigma_l \frac{Q^d_{jlt}}{P^d_{jlt}} dP^d_{jlt} + (\sigma_l-1)\frac{Q^d_{jlt}}{\mathbb{P}^d_{lt}}\left[\left(\frac{\mathbb{P}^d_{lt}}{P^d_{jlt}}\right)^{\sigma_l} dP^d_{jlt} + \left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l} d\mathbb{P}^{dI}_{lt}\right] \\ \tau_{ht}\left[-\sigma_h \frac{Q^x_{jht}}{P^x_{jht}} dP^x_{jht} + (\sigma_h-1)\frac{Q^x_{jht}}{\mathbb{P}^x_{ht}}\left\{\left(\frac{\mathbb{P}^x_{ht}}{P^x_{jht}}\right)^{\sigma_h} dP^x_{jht}\right\}\right] \\ \tau_{lt}\left[-\sigma_l \frac{Q^x_{jlt}}{P^x_{jlt}} dP^x_{jlt} + (\sigma_l-1)\frac{Q^x_{jlt}}{\mathbb{P}^x_{lt}}\left\{\left(\frac{\mathbb{P}^x_{lt}}{P^x_{jlt}}\right)^{\sigma_l} dP^x_{jlt} + \left(\frac{\mathbb{P}^x_{lt}}{\mathbb{P}^{xI}_{lt}}\right)^{\sigma_l} d\mathbb{P}^{xI}_{lt}\right\}\right] \end{bmatrix}.$$

Notice that all of the terms in $\mathbf{O}$ now only depend on changes in firm-level prices and exogenous changes in the price indices of imported goods from I.

Next, let us simplify every row of $\mathbf{O}$ one by one. In particular, define $S^c_{jkt}=\left(\frac{\mathbb{P}^c_{kt}}{P^c_{jkt}}\right)^{\sigma_k-1}$ such that

$$\mathbf{O}=\begin{bmatrix} -\left(\sigma_h \frac{Q^d_{jht}}{P^d_{jht}}\left(1-S^d_{jht}\right) + \frac{Q^d_{jht}}{\mathbb{P}^d_{ht}}\left(\frac{\mathbb{P}^d_{ht}}{P^d_{jht}}\right)^{\sigma_h}\right) dP^d_{jht} \\ -\left(\sigma_l \frac{Q^d_{jlt}}{P^d_{jlt}}\left(1-S^d_{jlt}\right) + \frac{Q^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{P^d_{jlt}}\right)^{1-\sigma_l}\right) dP^d_{jlt} + (\sigma_l-1)\frac{Q^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l} d\mathbb{P}^{dI}_{lt} \\ -\tau_{lt}\left(\sigma_h \frac{Q^x_{jht}}{P^x_{jht}}\left(1-S^x_{jht}\right) + \frac{Q^x_{jht}}{\mathbb{P}^x_{ht}}\left(\frac{\mathbb{P}^x_{ht}}{P^x_{jht}}\right)^{\sigma_h}\right) dP^x_{jht} \\ -\tau_{lt}\left(\sigma_l \frac{Q^x_{jlt}}{P^x_{jlt}}\left(1-S^x_{jlt}\right) + \frac{Q^x_{jlt}}{\mathbb{P}^x_{lt}}\left(\frac{\mathbb{P}^x_{lt}}{P^x_{jlt}}\right)^{1-\sigma_l}\right) dP^x_{jlt} + (\sigma_l-1)\tau_{lt}\frac{Q^x_{jlt}}{\mathbb{P}^x_{lt}}\left(\frac{\mathbb{P}^x_{lt}}{\mathbb{P}^{xI}_{lt}}\right)^{\sigma_l} d\mathbb{P}^{xI}_{lt} \end{bmatrix}.$$

Using the relationship between prices given by the first-order conditions ($dP^d_{jlt}=\frac{\sigma_l}{\sigma_l-1}\frac{\sigma_h-1}{\sigma_h}dP^d_{jht}$, $dP^x_{jht}=\tau^x_{ht}dP^d_{jht}$, $dP^x_{jlt}=\tau^x_{lt}\frac{\sigma_l}{\sigma_l-1}\frac{\sigma_h-1}{\sigma_h}dP^d_{jht}$), we can solve for dP^d_{jht} in terms of exogenous increases in imported price indices, as in

$$dP^d_{jht}=\frac{\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}}{\left(\frac{\sigma_h-1}{\sigma_h}\right)+\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}\left[\mathbf{a}_{jt}\mathbf{\Lambda}^1_{hd}\right]}\left\{\left[a_{jt}\mathbf{\Lambda}^2_{hd}\right]d\mathbb{P}^{dI}_{lt}+\left[a_{jt}\mathbf{\Lambda}^3_{hd}\right]d\mathbb{P}^{xI}_{lt}\right\} \tag{C12}$$

where

$$\mathbf{\Lambda}^1_{hd}=\begin{bmatrix} \left(\sigma_h \frac{Q^d_{jht}}{P^d_{jht}}\left(1-S^d_{jht}\right) + \frac{Q^d_{jht}}{P^d_{jht}}\left(\frac{P^d_{jht}}{\mathbb{P}^d_{ht}}\right)^{1-\sigma_h}\right) \\ \left(\sigma_l \frac{Q^d_{jlt}}{P^d_{jlt}}\left(1-S^d_{jlt}\right) + \frac{Q^d_{jlt}}{P^d_{jlt}}\left(\frac{P^d_{jlt}}{\mathbb{P}^d_{lt}}\right)^{1-\sigma_l}\right)\left(\frac{\sigma_h-1}{\sigma_h}\right)\left(\frac{\sigma_l}{\sigma_l-1}\right) \\ \left(\sigma_h \frac{Q^x_{jht}}{P^x_{jht}}\left(1-S^x_{jht}\right) + \frac{Q^x_{jht}}{P^x_{jht}}\left(\frac{P^x_{jht}}{\mathbb{P}^x_{ht}}\right)^{1-\sigma_h}\right)\tau^2_{ht} \\ \left(\sigma_l \frac{Q^x_{jlt}}{P^x_{jlt}}\left(1-S^x_{jlt}\right) + \frac{Q^x_{jlt}}{P^x_{jlt}}\left(\frac{P^x_{jlt}}{\mathbb{P}^x_{lt}}\right)^{1-\sigma_l}\right)\tau^2_{ht}\left(\frac{\sigma_h-1}{\sigma_h}\right)\left(\frac{\sigma_l}{\sigma_l-1}\right) \end{bmatrix},$$

$$\mathbf{\Lambda}^2_{hd}=\begin{bmatrix} 0 \\ (\sigma_l-1)\frac{Q^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l} \\ 0 \\ 0 \end{bmatrix},$$

$$\boldsymbol{\Lambda}^3_{hd} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ (\sigma_l - 1)\,\frac{Q^x_{jlt}}{\mathbb{P}^x_{lt}}\left(\frac{\mathbb{P}^x_{lt}}{\mathbb{P}^{xI}_{lt}}\right)^{\sigma_l}\tau_{lt} \end{bmatrix}.$$

Furthermore, by the results in Appendix C.5.1, we can express equation (C12) in terms of changes in country's I productivity, as in

$$\begin{aligned} dP^d_{jht} = &-\frac{\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}}{\left(\frac{\sigma_h-1}{\sigma_h}\right)+\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}\left[\mathbf{a}_{jt}\boldsymbol{\Lambda}^1_{hd}\right]} * \\ &\left\{\left[a_{jt}\boldsymbol{\Lambda}^2_{hd}\right](\frac{\mathbb{P}^{dI}_{lt}}{P^{dI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{dI}_{lt}mc_l}{\hat{\varphi}^2_{jt}} + \left[a_{jt}\boldsymbol{\Lambda}^3_{hd}\right](\frac{\mathbb{P}^{xI}_{lt}}{P^{xI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{xI}_{lt}mc_l}{\hat{\varphi}^2_{jt}}\right\} d\hat{\varphi}_{jt}. \end{aligned} \tag{C13}$$

Thus, $\frac{dP^d_{jht}}{d\hat{\varphi}_{jt}} < 0$, which implies that if there is an increase in import competition as defined in Definition 1, there will be a decrease in the firm-level prices of high-quality goods produced and sold in country d.

The same procedure is applied to examine the responses of the other firm-level prices such that $\frac{dP^c_{jkt}}{d\hat{\varphi}_{jt}} < 0$ for all k and c.

C.5.4 Firm-level Quantities

First, consider Q^d_{jht}. Totally differentiating the demand expressions in Section 3.1,

$$dQ^d_{jht} = -\left[\sigma_h \frac{Q^d_{jht}}{P^d_{jht}}\left(1 - S^d_{jht}\right) + \frac{Q^d_{jht}}{P^{dd}_{jht}}\left(\frac{P^d_{jht}}{\mathbb{P}^d_{ht}}\right)^{1-\sigma_h}\right] dP^d_{jht}.$$

Since by equation (C13) $\frac{dP^d_{jht}}{d\hat{\varphi}_{jt}} < 0$,

$$\frac{dQ^d_{jht}}{d\hat{\varphi}_{jt}} = \underbrace{\frac{dQ^d_{jht}}{dP^d_{jht}}}_{<0}\underbrace{\frac{dP^d_{jht}}{d\hat{\varphi}_{jt}}}_{<0} > 0.$$

Therefore, an import competition shock increases firm-level production quantities of high-quality goods on the domestic market. For Q^x_{jht}, we follow the same procedure and find $\frac{dQ^x_{jht}}{d\hat{\varphi}_{jt}} > 0$.

A more complicated picture arises when we think about the low-quality quantities produced. Consider now the case for Q^d_{jlt} and follow the same steps, replacing $d\mathbb{P}^d_{lt}$ from equation (C8),

$$dQ^d_{jlt} = -\frac{Q^d_{jlt}}{P^d_{jlt}}\left[\sigma_l\left(1 - S^d_{jlt}\right) + S^d_{jlt}\right] dP^d_{jlt} + (\sigma_l - 1)\,\frac{Q^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l} d\mathbb{P}^{dI}_{lt}. \tag{C14}$$

Furthermore, replacing dP^d_{jlt},

$$dQ^d_{jlt} = \Bigg[\frac{Q^d_{jlt}}{P^d_{jlt}}\left[\sigma_l\left(1-S^d_{jlt}\right)+S^d_{jlt}\right]\frac{\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}}{\left(\frac{\sigma_l-1}{\sigma_l}\right)+\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}\left[\mathbf{a}_{jt}\mathbf{\Lambda}^1_{ld}\right]} *$$
$$\left\{\left[\mathbf{a}_{jt}\mathbf{\Lambda}^2_{ld}\right](\frac{\mathbb{P}^{dI}_{lt}}{P^{dI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{dI}_{lt}mc_l}{\hat{\varphi}^2_{jt}}+\left[\mathbf{a}_{jt}\mathbf{\Lambda}^3_{ld}\right](\frac{\mathbb{P}^{xI}_{lt}}{P^{xI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{xI}_{lt}mc_l}{\hat{\varphi}^2_{jt}}\right\}-$$
$$(\sigma_l-1)\frac{Q^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l}(\frac{\mathbb{P}^{dI}_{lt}}{P^{dI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{dI}_{lt}mc_l}{\hat{\varphi}^2_{jt}}\Bigg]d\hat{\varphi}_{jt}.$$

In this case, the expression in big brackets is not unequivocally determined. Therefore, the effect of an import competition shock on the quantity sold of low-quality goods in the domestic market is ambiguous. This same ambiguity holds for Q^x_{jlt}, following the same procedure.

C.5.5 Firm-level Revenues

Consider first the efect in $R^d_{jht} = \frac{X^d_{ht}\left(P^d_{jht}\right)^{1-\sigma_h}}{\left(\mathbb{P}^d_{ht}\right)^{1-\sigma_h}}$. Total differentiation and substitution of $d\mathbb{P}^d_{ht}$ from equation (C9) yields

$$dR^d_{jht} \quad = \quad (1-\sigma_h)\frac{R^d_{jht}}{P^d_{jht}}\left[1-S^d_{jht}\right]dP^d_{jht}. \tag{C15}$$

Thus, combined with the result in equation (C12) that $\frac{dP^d_{jht}}{\hat{\varphi}_{jt}} < 0$,

$$\frac{dR^d_{jht}}{d\hat{\varphi}_{jt}} = \underbrace{\frac{dR^d_{jht}}{dP^d_{jht}}}_{<0}\underbrace{\frac{dP^d_{jht}}{d\hat{\varphi}_{jt}}}_{<0} > 0.$$

A similar case holds for R^x_{jht}.

Now, consider the revenues for the low-quality goods. First, let us examine the impact on $R^d_{jlt} = \frac{X^d_{lt}\left(P^d_{jlt}\right)^{1-\sigma_l}}{\left(\mathbb{P}^d_{lt}\right)^{1-\sigma_l}}$. As before, total differentiation of this expression and substitution of dP^d_{jlt} yields

$$dR^d_{jlt} = (1-\sigma_l)\frac{R^d_{jlt}}{P^d_{jlt}}\left[1-S^d_{jlt}\right]dP^d_{jlt} - (1-\sigma_l)\frac{R^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l}d\mathbb{P}^{dI}_{lt}. \tag{C16}$$

Moreover, replacing dP^d_{jlt} from our previous result and $d\mathbb{P}^{dI}_{lt}$ from the equations in Appendix

C.5.1, it follows that

$$dR^d_{jlt} = \Bigg[(\sigma_l - 1)\, \frac{R^d_{jlt}}{P^d_{jlt}} \left[1 - S^d_{jlt}\right] \frac{\frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}} \left(\frac{1-\alpha}{\alpha}\right) \left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}}{\left(\frac{\sigma_l-1}{\sigma_l}\right) + \frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}} \left(\frac{1-\alpha}{\alpha}\right) \left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2} \left[\mathbf{a}_{jt}\mathbf{\Lambda}^1_{ld}\right]} *$$
$$\left\{ \left[\mathbf{a}_{jt}\mathbf{\Lambda}^2_{ld}\right] (\frac{\mathbb{P}^{dI}_{lt}}{P^{dI}_{jlt}})^{\sigma_l} \left(\frac{\sigma_l}{\sigma_l - 1}\right) \frac{\tau^{dI}_{lt} mc_l}{\hat{\varphi}^2_{jt}} + \left[\mathbf{a}_{jt}\mathbf{\Lambda}^3_{ld}\right] (\frac{\mathbb{P}^{xI}_{lt}}{P^{xI}_{jlt}})^{\sigma_l} \left(\frac{\sigma_l}{\sigma_l - 1}\right) \frac{\tau^{xI}_{lt} mc_l}{\hat{\varphi}^2_{jt}} \right\} -$$
$$(\sigma_l - 1)\, \frac{R^d_{jlt}}{\mathbb{P}^d_{lt}} \left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l} (\frac{\mathbb{P}^{dI}_{lt}}{P^{dI}_{jlt}})^{\sigma_l} \left(\frac{\sigma_l}{\sigma_l - 1}\right) \frac{\tau^{dI}_{lt} mc_l}{\hat{\varphi}^2_{jt}} \Bigg] d\hat{\varphi}_{jt}.$$

Unlike previous cases, the sign of the term in large brackets is not determined. Therefore, the impact of an import competition shock on the revenues of the low-quality good in the domestic market is ambiguous. The same is true for R^x_{jlt} following the same procedure.

C.5.6 Firm-level High-quality Shares

Consider first the case of high-quality quantity shares in each market, $ShQ^c_{jht} = \frac{Q^c_{jht}}{Q^c_{jht}+Q^c_{jlt}}$. Total differentiation implies

$$dShQ^c_{jht} = \frac{1}{Q^c_{jt}}(1 - ShQ^c_{jht})dQ^c_{jht} - \frac{1}{Q^c_{jt}} ShQ^c_{jht} dQ^c_{jlt}, \tag{C17}$$

where $Q^c_{jt} = Q^c_{jht} + Q^c_{jlt}$.

Thus, $ShQ^c_{jht} > 0$ following an import competition shock if $(1 - ShQ^c_{jht})dQ^c_{jht} > ShQ^c_{jht} dQ^c_{jlt}$. In turn, substituting changes in quantities for this inequality with the changes found in Section C.5.4,

$$(1 - ShQ^c_{jht})\{-\frac{Q^c_{jht}}{P^c_{jht}}[\sigma_h(1 - S^c_{jht}) + S^c_{jht}]\}dP^c_{jht} > ShQ^c_{jht}\Big(\{-\frac{Q^c_{jlt}}{P^c_{jht}}[\sigma_l(1 - S^c_{jlt}) + S^c_{jlt}]\}dP^c_{jht} + (\sigma_l)\frac{Q^c_{jlt}}{\mathbb{P}^c_{lt}} \frac{\mathbb{P}^c_{lt}}{\mathbb{P}^{cI}_{lt}} d\mathbb{P}^{cI}_{lt}\Big). \tag{C18}$$

This will happen if

$$\frac{dQ^c_{jht}}{dQ^c_{jlt}} = \frac{\{-\frac{Q^c_{jht}}{P^c_{jht}}[\sigma_h(1 - S^c_{jht}) + S^c_{jht}]\}dP^c_{jht}}{\left(\{-\frac{Q^c_{jlt}}{P^c_{jht}}[\sigma_l(1 - S^c_{jlt}) + S^c_{jlt}]\}dP^c_{jht} + (\sigma_l)\frac{Q^c_{jlt}}{\mathbb{P}^c_{lt}} \frac{\mathbb{P}^c_{lt}}{\mathbb{P}^{cI}_{lt}} d\mathbb{P}^{cI}_{lt}\right)} > \frac{Q^c_{jht}}{Q^c_{jlt}}. \tag{C19}$$

This inequality will more likely hold when $\frac{d\mathbb{P}^{cI}_{lt}}{d\hat{\varphi}}$ tends to zero (import competition in the foreign market is not very large) or, in general, when the percentage increase in high-quality goods is higher than the percentage increase in low-quality ones.

Now consider revenue shares $SR^c_{jht} = \frac{R^c_{jht}}{R^c_{jht}+R^c_{jlt}}$. Again, total differentiation leads to

$$dShR^c_{jht} = \frac{1}{R^c_{jt}}(1 - ShR^c_{jht})dR^c_{jht} - \frac{1}{R^c_{jt}} ShR^c_{jht} dR^c_{jlt}, \tag{C20}$$

where $R^c_{jt} = R^c_{jht} + R^c_{jlt}$.

As in the case for quantities, $dShR^c_{jht} > 0$ following an import competition shock if

$$\frac{dR^c_{jht}}{dR^c_{jlt}} = \frac{\{\frac{R^c_{jht}}{P^c_{jht}}(1-\sigma_h)(1-S^c_{jht})\}dP^c_{jht}}{\left(\{\frac{R^c_{jlt}}{P^c_{jht}}(1-\sigma_l)(1-S^c_{jlt})\}dP^c_{jht} + (1-\sigma_l)\frac{R^c_{jlt}}{\mathbb{P}^c_{lt}}\frac{\mathbb{P}^c_{lt}}{\mathbb{P}^{cI}_{lt}}d\mathbb{P}^{cI}_{lt}\right)} > \frac{R^c_{jht}}{R^c_{jlt}}. \tag{C21}$$

Similar to quantities, this inequality holds when $d\mathbb{P}^{cI}_{lt}$ goes to zero following an import competition shock or when the percentage increase in revenues is much higher for higher quality goods than for low-quality ones.

C.5.7 Product Mix

The proof comes straight from the fact that relative to high-quality products, low-quality ones are less profitable when their price indices decrease, everything else constant.

C.5.8 Firm-level Profits

Total differentiation of the profit expression implies

$$d\pi_{jt} \;=\; \mathbf{a}_{jt}\begin{bmatrix} dR^d_{jht} \\ dR^d_{jlt} \\ dR^x_{jht} \\ dR^d_{jlt}\end{bmatrix} - \frac{w_t}{\alpha}\left(\frac{1}{\varphi_{jt}F^{1-\alpha}}\right)^{\frac{1}{\alpha}}[\mathbf{a}_{jt}Q_{jt}]'^{\frac{1}{\alpha}-1}\,\mathbf{a}_{jt}\left[\tau_t.\begin{bmatrix} dQ^d_{jht} \\ dQ^d_{jlt} \\ dQ^x_{jht} \\ dQ^d_{jlt}\end{bmatrix} - \mathbf{a}_{jt}\left[\mathbf{m}_t.\tau_t.\begin{bmatrix} dQ^d_{jht} \\ dQ^d_{jlt} \\ dQ^x_{jht} \\ dQ^d_{jlt}\end{bmatrix}\right]\right].$$

Replacing dR and dQ as derived previously, and using the first-order conditions of the profit maximization problem, $d\pi_{jt}$ is simplified to

$$d\pi_{jt} = \mathbf{a}_{jt}\begin{bmatrix} \left(\frac{\sigma_h-1}{\sigma_h}\right)\frac{R^d_{jht}}{P^d_{jht}}S^d_{jht}dP^d_{jht} \\ \left(\frac{\sigma_l-1}{\sigma_l}\right)\frac{R^d_{jlt}}{P^d_{jlt}}S^d_{jlt}dP^d_{jlt} + \left(\frac{\sigma_l-1}{\sigma_l}\right)\frac{R^d_{jlt}}{\mathbb{P}^d_{lt}}\left(\frac{\mathbb{P}^d_{lt}}{\mathbb{P}^{dI}_{lt}}\right)^{\sigma_l}d\mathbb{P}^{dI}_{lt} \\ \left(\frac{\sigma_h-1}{\sigma_h}\right)\frac{R^x_{jht}}{P^x_{jht}}S^x_{jht}dP^x_{jht} \\ \left(\frac{\sigma_l-1}{\sigma_l}\right)\frac{R^x_{jlt}}{P^x_{jlt}}S^x_{jlt}dP^x_{jlt} + \left(\frac{\sigma_l-1}{\sigma_l}\right)\frac{R^x_{jlt}}{\mathbb{P}^x_{lt}}\left(\frac{R^x_{jlt}}{\mathbb{P}^x_{lt}}\right)\left(\frac{\mathbb{P}^x_{lt}}{\mathbb{P}^{xI}_{lt}}\right)d\mathbb{P}^{xI}_{lt}\end{bmatrix}. \tag{C22}$$

Since $\frac{dP^c_{jkt}}{d\hat{\varphi}} < 0, \forall c, k$, and $\frac{d\mathbb{P}^{cI}_{lt}}{d\hat{\varphi}} < 0, \forall c$, $\frac{d\pi_{jt}}{d\hat{\varphi}} < 0$. Therefore, domestic firms lose profits after an import competition shock.

C.5.9 Heterogeneous Effects

For prices, first consider equation (C13), which provides an expression for $\frac{dP^d_{jht}}{d\hat{\varphi}}$. Now, further derive it with respect to φ_{jt}, such that $\frac{\partial|\frac{dP^d_{jht}}{d\hat{\varphi}}|}{\partial\varphi}$ takes the form of

$$\frac{\partial|\frac{dP^d_{jht}}{d\hat{\varphi}}|}{\partial\varphi} = \frac{\frac{w_t}{\alpha}\left(\frac{1}{F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}\left(\frac{\sigma_h-1}{\sigma_h}\frac{1}{\alpha}\varphi_{jt}^{\frac{1}{\alpha}-1}\right)}{\left[\left(\frac{\sigma_h-1}{\sigma_h}\varphi_{jt}^{\frac{1}{\alpha}}\right) + \frac{w_t}{\alpha}\left(\frac{1}{F^{1-\alpha}}\right)^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{\alpha}\right)\left(\mathbf{a}_{jt}\left[\tau_t.\mathbf{Q}_{jt}\right]'\right)^{\frac{1}{\alpha}-2}\left[\mathbf{a}_{jt}\mathbf{\Lambda}^1_{hd}\right]\right]^2} *$$
$$\left\{\left[a_{jt}\mathbf{\Lambda}^2_{hd}\right](\frac{\mathbb{P}^{dI}_{lt}}{P^{dI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{dI}_{lt}mc_l}{\hat{\varphi}^2_{jt}} + \left[a_{jt}\mathbf{\Lambda}^3_{hd}\right](\frac{\mathbb{P}^{xI}_{lt}}{P^{xI}_{jlt}})^{\sigma_l}\left(\frac{\sigma_l}{\sigma_l-1}\right)\frac{\tau^{xI}_{lt}mc_l}{\hat{\varphi}^2_{jt}}\right\} > 0. \tag{C23}$$

We find similar effects: $\frac{\partial|\frac{dP^x_{jht}}{d\hat{\varphi}}|}{\partial\varphi} > 0$, $\frac{\partial|\frac{dP^d_{jlt}}{d\hat{\varphi}}|}{\partial\varphi} > 0$, and $\frac{\partial|\frac{dP^x_{jlt}}{d\hat{\varphi}}|}{\partial\varphi} > 0$. Thus, the magnitude of the effect on prices is larger for more productive firms. For quantities and revenues, the proof is similar and consists of replacing the results above relative to prices in the quantity and revenue equations.

C.6 Import Competition Shock in Only One Market

While the effects presented in Proposition 2 correspond to the full effects of an import competition shock in the low-quality segments of the domestic and export markets, one could be interested in the effect of a shock that only affected one of the destinations (either domestic or foreign). For example, for apparel, Chinese imports in Peru have increased extensively since 2001. However, in the United States, the increase in the influx of Chinese clothing was not vast up to 2005, with the end of the Multi-Fiber Arrangement. Therefore, from 2002 to 2005, it is possible to assume that the import competition shock for Peruvian apparel manufacturers only consisted of the increase in the available varieties of low-quality goods in the domestic economy, with no change in the export market.

The following corollaries yield the predictions of the model for two cases. Case 1 defines an import competition shock in the domestic market only: Chinese firms increased their productivity but could only export to country d. Case 2 defines an import competition shock in the export market only: Chinese firms increased their productivity but could only export to country x.

Corollary 3 *If there is an increase in import competition, as described in Case 1,*

1. $\frac{dP^{dI}_{jlt}}{d\hat{\varphi}_{jt}} < 0$ *when there are no goods from country I being exported to country x.*
2. $\frac{d\mathbb{P}^{dI}_{lt}}{d\hat{\varphi}_{jt}} < 0$.
3. *All other results in Proposition 2 hold except for the ambiguous results on low-quality goods. In particular,*
   - (a) Q^d_{jlt} *and* R^d_{jlt} *decrease.*
   - (b) Q^x_{jlt} *and* R^x_{jlt} *increase.*
   - (c) *High-quality shares increase.*

Proof. It follows from assuming that $\frac{d\mathbb{P}^{xI}_{lt}}{d\hat{\varphi}_{jt}} = 0$. ■

Corollary 4 *If there is an increase in import competition, as described in Case 2,*

1. $\frac{dP^{xI}_{jlt}}{d\hat{\varphi}_{jt}} < 0$ *when there are no goods from country I being exported to country d.*
2. $\frac{d\mathbb{P}^{xI}_{lt}}{d\hat{\varphi}_{jt}} < 0$.
3. *All other results in Proposition 2 hold except for the ambiguous results on low-quality goods. In particular,*
   - (a) Q^d_{jlt} *and* R^d_{jlt} *increase.*
   - (b) Q^x_{jlt} *and* R^x_{jlt} *decrease.*
   - (c) *High-quality shares increase.*

Proof. It follows from assuming that $\frac{d\mathbb{P}^{dI}_{lt}}{d\hat{\varphi}_{jt}} = 0$ ■

C.7 Additional Proofs

1. *(Price Indices)* Using the results in equations (C8) and (C9), the total change in price indices can be expressed by

$$
\begin{aligned}
d\mathbb{P}^d_{lt} &= \left(\frac{\mathbb{P}^d_{lt}}{P^d_{jlt}}\right)^{\sigma_l}\left[\frac{dP^d_{jlt}}{d\mathbb{P}^{dI}_{lt}}d\mathbb{P}^{dI}_{lt} + \frac{dP^d_{jlt}}{d\mathbb{P}^{xI}_{lt}}d\mathbb{P}^{xI}_{lt}\right] + \left(\frac{\mathbb{P}^d_{lt}}{P^{dI}_{jlt}}\right)^{\sigma_l} dP^{dI}_{jlt} && \text{(C24)}\\
d\mathbb{P}^x_{lt} &= \left(\frac{\mathbb{P}^x_{lt}}{P^x_{jlt}}\right)^{\sigma_l}\left[\frac{dP^x_{jlt}}{d\mathbb{P}^{dI}_{lt}}d\mathbb{P}^{dI}_{lt} + \frac{dP^x_{jlt}}{d\mathbb{P}^{xI}_{lt}}d\mathbb{P}^{xI}_{lt}\right] + \left(\frac{\mathbb{P}^x_{lt}}{P^{xI}_{jlt}}\right)^{\sigma_l} dP^{xI}_{jlt} && \text{(C25)}\\
d\mathbb{P}^d_{ht} &= \left(\frac{\mathbb{P}^d_{ht}}{P^d_{jht}}\right)^{\sigma_h}\left[\frac{dP^d_{jht}}{d\mathbb{P}^{dI}_{lt}}d\mathbb{P}^{dI}_{lt} + \frac{dP^d_{jht}}{d\mathbb{P}^{xI}_{lt}}d\mathbb{P}^{xI}_{lt}\right] && \text{(C26)}\\
d\mathbb{P}^x_{ht} &= \left(\frac{\mathbb{P}^x_{ht}}{P^x_{jht}}\right)^{\sigma_h}\left[\frac{dP^x_{jht}}{d\mathbb{P}^{dI}_{lt}}d\mathbb{P}^{dI}_{lt} + \frac{dP^x_{jht}}{d\mathbb{P}^{xI}_{lt}}d\mathbb{P}^{xI}_{lt}\right]. && \text{(C27)}
\end{aligned}
$$

   Since, by the equations in Appendix C.5.1 and $\frac{d\mathbb{P}^{cI}_{lt}}{d\hat{\varphi}_{jt}} < 0\ \forall c$, all price indices decrease with an import competition shock, this effect is higher than the initial decrease due to Chinese imports, as evidenced by the presence of the terms in brackets.

2. *(Welfare)* Differentiating the welfare equation,

$$
dW^c_t = \left[\omega_h\left(\frac{1-\sigma_h}{\sigma_h}\right)\left(\frac{X^c_{ht}}{\mathbb{P}^c_{ht}}\right)^{\frac{\sigma_h-1}{\sigma_h}}\frac{1}{\mathbb{P}^c_{ht}}\right]d\mathbb{P}^c_{ht} + \left[\omega_l\left(\frac{1-\sigma_l}{\sigma_l}\right)\left(\frac{X^c_{lt}}{\mathbb{P}^c_{lt}}\right)^{\frac{\sigma_l-1}{\sigma_l}}\frac{1}{\mathbb{P}^c_{lt}}\right]d\mathbb{P}^c_{lt}. \quad \text{(C28)}
$$

   Given that both terms in brackets are negative, and using the results in (1)—by which $\mathbb{P}^c_{ht}$ and $\mathbb{P}^c_{lt}$ decrease following an import competition shock—the effect on welfare is positive for both countries. As explained in (1), this reaction not only comes from a decrease in imported prices, but also from the subsequent decrease in prices of domestic producers that reallocate their productive factors to other production lines.

D Empirical Analysis

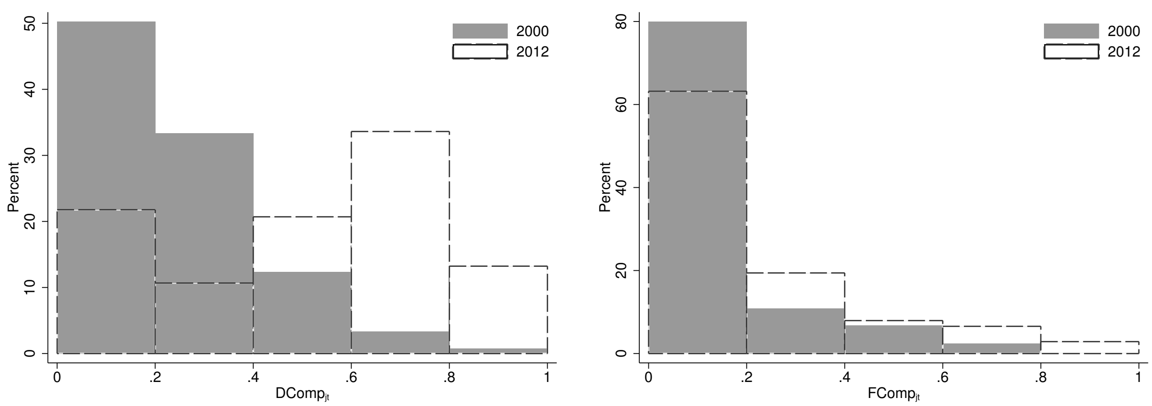
D.1 Firm-level Import Competition Summary Statistics

Table D1 presents the main descriptive statistics for $DComp_{jt-1}$ and $FComp_{jt-1}$. The main element to consider is that the size of the interquartile range of Chinese competition in the domestic market is 0.62, and in the case of Chinese competition in foreign destinations is 0.24. Most of the coefficients will be interpreted using a shock of this size.

Table D1: Firm-level Chinese Import Competition Summary Statistics

	Mean	SD	Min	p25	p50	p75	Max
DComp_{jt-1}	0.36	0.30	0.00	0.02	0.38	0.64	1.00
FComp_{jt-1}	0.17	0.22	0.00	0.00	0.06	0.24	0.98

In addition, to see the change over time, Figure D1 presents the histograms of $DComp_{jt}$ (Panel (a)) and $FComp_{jt}$ (Panel (b)) for 2000 and 2012,



(a) $DComp_{jt}$ (b) $FComp_{jt}$

Figure D1: Histograms of Firm-level Chinese Import Competition

Note: Source: Peruvian customs.

D.2 Firm-level Import Competition using Domestic Sales

To support the claim that $DComp_{jt}$ effectively captures Chinese import competition in the domestic market, I construct an alternative measure using the product shares of domestic sales as weights. In particular, I define

$$DComp_{jt}^{EEA} = \sum_{k} \frac{s_{jkt_0}}{s_{jt_0}} ChPen_{kt}^{Peru}, \tag{D1}$$

where k are all of the products Peruvian firms sell domestically, and $\frac{s_{jkt_0}}{s_{jt_0}}$ is the share of those products in the initial domestic basket of the firm.

These measures are positively and strongly correlated: 0.40 between 2000 and 2010. Moreover, Figure D2 compares the histograms of these two measures for the same period. As shown, both show the same trend of increasing import competition in the domestic market, and their distributions overlap significantly. Thus, I find that my baseline measure captures the fundamental exposure of firms to Chinese import competition in the local market.

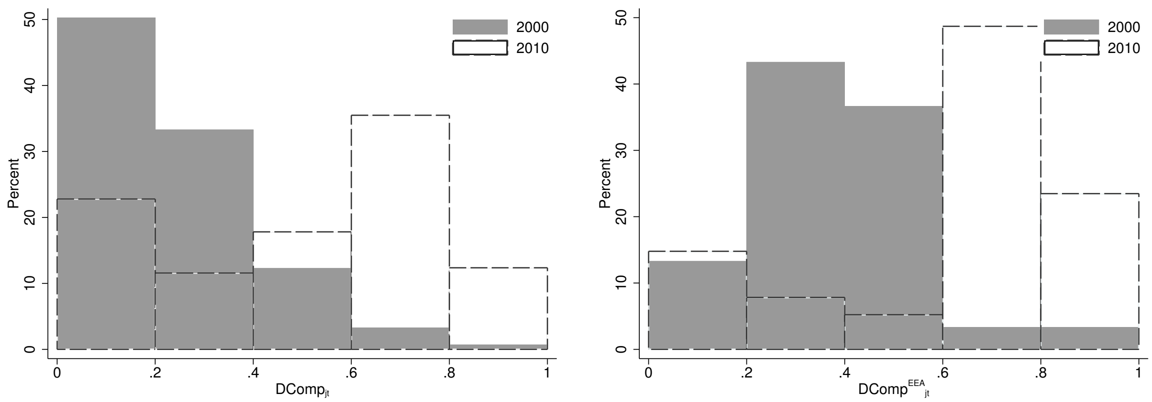


Figure D2: Histograms of Firm-level Chinese Import Competition

Note: Panel (a) shows the histogram for $DComp_{jt}$, which uses export weights, and Panel (b) shows the histogram for $DComp^{EEA}_{jt}$, which uses domestic sales weights. Source: Peruvian customs and EEA.

D.3 First-stage Results

Table D2 provides the first-stage regressions of the baseline specifications for the sample of all exporters, exporters of high-quality goods, and exporters of low-quality goods. The dependent variable is $DComp_{jt-1}$, and all regressions additionally include firm fixed effects, year fixed effects, and pre-trends by the firm's size. As shown, both instruments have good predictive power in all samples. They also pass the test of weak instruments using the Cragg-Donald Wald and the Kleibergen-Paap RK Wald F-statistics, as well as the tests of overidentifying restrictions. Hansen J statistic P-values do not reject the null hypothesis of valid instruments.

Table D2: First stage of IV Regressions

	(1) Total Sample	(2) HQ Sample	(3) LQ Sample
DCompBra$_{jt-1}$	0.425***	0.413***	0.415***
	(0.036)	(0.038)	(0.046)
DCompCol$_{jt-1}$	0.608***	0.637***	0.613***
	(0.035)	(0.039)	(0.049)
FComp$_{jt-1}$	0.122***	0.142***	0.139***
	(0.031)	(0.034)	(0.042)
Cragg-Donald Wald F	1,324.253	1,206.450	745.574
Kleibergen-Paap RK Wald F	399.785	473.404	165.907
Hansen J statistic P-value	0.841	0.290	0.380
Firms	1,192	1,106	740
Observations	5,663	5,178	2,954

D.4 Additional Results

This section includes results complementary to those of Section 4.2.1.

D.4.1 Exports

Table D3 reports the effects on quantities, measured by thousands of apparel units. Consistent with the evidence of export values and prediction (2) of Proposition 2, import competition in the domestic market increases export quantity overall. However, the increase is only significant for high-quality goods. In contrast, an increase in import competition in the foreign market decreases exported quantities, as it also did for exported values.

Table D3: Within-firm Responses: Export Quantities

	Export Quantity		
	(1) Total	(2) HQ	(3) LQ
A: OLS			
$DComp_{jt-1}$	0.390***	0.459***	0.294
	(0.091)	(0.121)	(0.228)
$FComp_{jt-1}$	-0.177	-0.114	-0.097
	(0.134)	(0.193)	(0.365)
R-Squared	0.054	0.040	0.044
B: IV Regressions			
$DComp_{jt-1}$	0.727***	0.852***	0.425
	(0.150)	(0.200)	(0.329)
$FComp_{jt-1}$	-0.341**	-0.324	-0.174
	(0.146)	(0.204)	(0.398)
F-stat	399.79	473.40	165.91
Hansen J P-value	0.90	0.43	0.31
Mean	256.35	251.07	29.55
Firms	1,192	1,106	740
Observations	5,663	5,178	2,954

Note: All outcome variables are in logs. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the variables is expressed in thousands of items. The sample size changes because not all firms export high- and low-quality garments.

All of these impacts not only translate into increases in percentage points of value, quantity, and product shares but also into percentage terms. Table D4 shows these results. An increase in the interquartile range of Chinese import competition in the domestic market leads to increases of 2.5%, 3.0%, and 2.7%, respectively, in the value, quantity, and product shares of high-quality goods. However, the impact of import competition abroad is not economically or statistically significant.

Table D4: Within-firm Responses: Log Shares

	Log Value Shares		Log Quantity Shares		Log N. Product Shares	
	(1) HQ	(2) LQ	(3) HQ	(4) LQ	(5) HQ	(6) LQ
A: OLS						
DComp_{jt-1}	0.029*	-0.042***	0.026	-0.038***	0.014	-0.034***
	(0.015)	(0.013)	(0.017)	(0.010)	(0.013)	(0.012)
FComp_{jt-1}	0.008	-0.012	-0.003	-0.022	0.026	0.006
	(0.019)	(0.017)	(0.021)	(0.015)	(0.019)	(0.017)
R-Squared	0.013	0.018	0.020	0.014	0.041	0.019
B: IV Regressions						
DComp_{jt-1}	0.041*	-0.060***	0.049*	-0.060***	0.044**	-0.057**
	(0.023)	(0.021)	(0.025)	(0.019)	(0.022)	(0.024)
FComp_{jt-1}	0.003	-0.003	-0.014	-0.011	0.012	0.017
	(0.020)	(0.018)	(0.022)	(0.013)	(0.020)	(0.018)
F-stat	399.79	399.79	399.79	399.79	399.79	399.79
Hansen J P-value	0.18	0.09	0.56	0.54	0.28	0.77
Mean	0.67	0.14	0.57	0.07	0.63	0.16
Firms	1,192	1,192	1,192	1,192	1,192	1,192
Observations	5,663	5,663	5,663	5,663	5,663	5,663

Note: All outcome variables are in logs and use the inverse hyperbolic sine transformation. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the variables is the shares' levels.

D.4.2 Domestic Sales

Tables D5 and D6 show the OLS regressions associated with Table 4 in the main text.

Table D5: Within-firm Responses: Total Sales

	Sales			Export Value			
	(1) D+X	(2) D	(3) X	(4) HQ	(5) LQ	(6) Share HQ	(7) Share LQ
DComp_{jt-1}	-0.061	0.596	0.497	-0.054	0.630	0.008	0.039
	(0.108)	(0.540)	(0.398)	(0.373)	(0.709)	(0.066)	(0.055)
FComp_{jt-1}	-0.193	-0.043	-0.278	0.341	1.498	0.062	0.084
	(0.173)	(0.360)	(0.570)	(0.533)	(1.433)	(0.070)	(0.060)
R-Squared	0.204	0.051	0.107	0.131	0.180	0.028	0.065
Mean	17538.92	15119.30	2429.21	2225.51	96.27	0.75	0.09
Firms	248	248	196	182	134	196	196
Observations	940	940	797	733	400	797	797

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. D refers to domestic sales, X to exports, HQ indicates high-quality goods, and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of all variables is in thousands of US dollars. The sample size changes because not all firms have export activity, and if they do, they do not export both high- and low-quality goods every year.

Table D6: Within-firm Responses: Production Factors

	(1) Labor Expenditure	(2) Material Expenditure	(3) Capital Stock
DComp_{jt-1}	0.001	-0.073	-0.071
	(0.102)	(0.156)	(0.100)
FComp_{jt-1}	-0.090	-0.157	0.077
	(0.215)	(0.195)	(0.191)
R-Squared	0.369	0.283	0.259
Mean	2327.97	8135.37	12447.30
Firms	248	248	248
Observations	940	940	940

Note: All outcome variables are in logs. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the variables is in thousands of US dollars.

Table D7 shows the results for the number of exported products. Even with this small sample, Columns 1-3 confirm the results in Table 2. Import competition in the domestic market raises the number of products exported; this effect comes almost entirely from high-quality goods.

Table D7: Within-firm Responses: Exports

	Number of Exported Products				
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ
A: OLS					
DComp_{jt-1}	0.129	0.036	-0.016	0.019	0.062
	(0.155)	(0.195)	(0.216)	(0.064)	(0.059)
FComp_{jt-1}	0.440**	0.466*	0.591*	0.093	0.009
	(0.210)	(0.236)	(0.355)	(0.062)	(0.049)
R-Squared	0.105	0.084	0.153	0.083	0.044
B: IV Regressions					
DComp_{jt-1}	0.559*	0.441*	-0.135	0.034	-0.001
	(0.288)	(0.259)	(0.267)	(0.108)	(0.138)
FComp_{jt-1}	0.319	0.377*	0.836**	0.037	0.072
	(0.237)	(0.229)	(0.417)	(0.071)	(0.058)
F-stat	34.57	52.06	22.80	34.57	34.57
Hansen J P-value	0.40	0.17	0.81	0.18	0.58
Mean	13.70	9.54	1.56	0.69	0.12
Firms	147	138	85	147	147
Observations	748	689	351	748	748

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of all variables is in counts of 10-digit HTS codes, and the mean of shares is expressed in levels. The sample size changes because not all firms export high- and low-quality garments.

D.5 Robustness Tests

This section details the robustness checks mentioned in Section 4.2.2.

D.5.1 Alternative Measures of Import Competition

The first set of alternative measures of import competition is defined as

$$DCompImp_{jt} = \sum_{k} \frac{x_{jkt_0}}{x_{jt_0}} ChImp_{kt}^{Peru} \tag{D2}$$

and

$$FCompImp_{jt} = \sum_{c} \frac{x_{jt_0}^{c}}{x_{jt_0}} \sum_{k} \frac{x_{jkt_0}^{c}}{x_{jt_0}^{c}} ChImp_{kt}^{c}, \tag{D3}$$

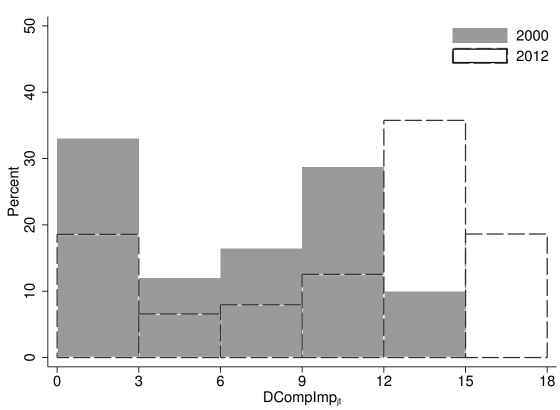
where $ChImp_{kt}^{Peru}$ and $ChImp_{kt}^{c}$ refer to log imports originated in China to Peru and Peru's main export destinations, respectively.

Table D8 shows the summary statistics. As in the original measures, there is large variety in firms' exposure to import competition. The size of the interquartile import competition in the case of Chinese competition in the domestic market is 12.65, and in the case of Chinese competition in foreign destinations is 15.14. This feature is consistent with foreign markets receiving a much more massive influx of Chinese import competition than Peru.

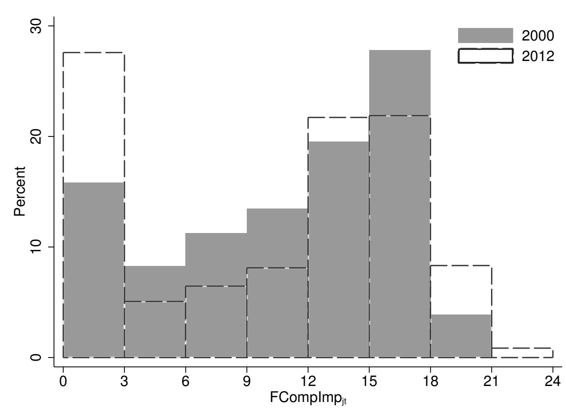
Table D8: Alternative Import Competition Summary Statistics

	Mean	SD	Min	p25	p50	p75	Max
DCompImp$_{jt-1}$	7.66	5.84	0.00	0.54	8.84	13.19	17.08
FCompImp$_{jt-1}$	8.69	7.16	0.00	0.00	9.95	15.14	21.98

Figure D3 shows the histograms of these measures in 2000 and 2012. Similar to the original ones, these measures seem to portray the same patterns. That is, import competition affects much more the domestic market than Peru's export destinations.



(a) $DCompImp_{jt}$



(b) $FCompImp_{jt}$

Figure D3: Firm-level Chinese Import Competition

Note: Panel (a) shows the histogram for $DCompImp_{jt}$ and Panel (b) for $FCompImp_{jt}$. Source: Peruvian customs.

Table D9 shows the first-stage results with the same set of instruments as in Section 4.2.1, but constructed for these measures. The dependent variable is $DCompImp_{jt-1}$, and all regressions also include firm fixed effects, year fixed effects, and pre-trends by the firm's size. As shown, both instruments have good predictive power in all samples. They also pass the test of weak instruments using the Cragg-Donald Wald and the Kleibergen-Paap RK Wald F-statistics, as well as the tests of overidentifying restrictions. Hansen J statistics P-values do not reject the null hypothesis of valid instruments.

Table D9: First-stage Instruments

	(1) Total Sample	(2) HQ Sample	(3) LQ Sample
$\text{DCompImpBra}_{jt-1}$	0.179***	0.075	0.086*
	(0.063)	(0.050)	(0.049)
$\text{DCompImpCol}_{jt-1}$	0.590***	0.720***	0.730***
	(0.067)	(0.054)	(0.059)
FCompImp_{jt-1}	-0.044***	-0.043***	-0.028
	(0.016)	(0.016)	(0.022)
Cragg-Donald Wald F	1,915.3	1,926.098	1,373.908
Kleibergen-Paap RK Wald F	607.871	672.018	366.975
Hansen J statistic P-value	0.132	0.277	0.967
Firms	1,192	1,106	740
Observations	5,663	5,178	2,954

Table D10 and D11 show the main results of the paper regarding Proposition 2 using the alternative measures. All of the effects of domestic import competition hold throughout. Firms increase exports, quantities, and the number of exported products following an increase in domestic import competition, as predicted in points (2) and (3) of Proposition 2, with all of these effects coming from high-quality goods, wihich increases the shares of these products (point (4)). Finally, domestic import competition also decreases firm-level prices, as in point (1) of Proposition 2.

Table D10: Within-firm Responses: Exports

	Export Value					Export Quantity	
	Total	HQ	LQ	Share HQ	Share LQ	Share HQ	Share LQ
A: OLS							
DCompImp_{jt-1}	0.015**	0.012	0.009	0.001	-0.003***	0.001	-0.002***
	(0.006)	(0.008)	(0.017)	(0.001)	(0.001)	(0.001)	(0.001)
FCompImp_{jt-1}	0.002	0.012**	0.009	0.001	-0.000	-0.000	-0.001
	(0.004)	(0.005)	(0.013)	(0.001)	(0.001)	(0.001)	(0.000)
R-Squared	0.067	0.044	0.090	0.014	0.017	0.021	0.013
B: IV Regressions							
DCompImp_{jt-1}	0.018**	0.017*	-0.004	0.002	-0.003***	0.002	-0.002***
	(0.008)	(0.010)	(0.019)	(0.002)	(0.001)	(0.002)	(0.001)
FCompImp_{jt-1}	0.001	0.009	0.015	0.000	-0.000	-0.000	-0.000
	(0.005)	(0.006)	(0.013)	(0.001)	(0.001)	(0.001)	(0.000)
F-stat	607.87	672.02	366.98	607.87	607.87	607.87	607.87
R-Squared	0.07	0.04	0.09	0.01	0.02	0.02	0.01
Mean	1,478.67	1,296.81	106.46	0.67	0.14	0.57	0.07
Firms	1,192	1,106	740	1,192	1,192	1,192	1,192
Observations	5,663	5,178	2,954	5,663	5,663	5,663	5,663

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

Table D11: Within-firm Responses: Exports

	Number of Exported Products					Unit Prices		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total	HQ	LQ	Share HQ	Share LQ	All	HQ	LQ
A: OLS								
DCompImp_{jt-1}	0.018***	0.017***	0.012*	0.000	-0.002**	-0.007***	-0.009***	-0.006
	(0.004)	(0.004)	(0.006)	(0.001)	(0.001)	(0.003)	(0.003)	(0.005)
FCompImp_{jt-1}	0.005*	0.007**	0.001	0.001	0.000	0.003*	0.005**	-0.000
	(0.003)	(0.003)	(0.004)	(0.001)	(0.000)	(0.002)	(0.002)	(0.004)
R-Squared	0.036	0.032	0.028	0.043	0.018	0.200	0.163	0.158
B: IV Regressions								
DCompImp_{jt-1}	0.016***	0.018***	0.009	0.002	-0.003**	-0.009***	-0.007*	-0.009
	(0.006)	(0.006)	(0.008)	(0.001)	(0.001)	(0.003)	(0.004)	(0.006)
FCompImp_{jt-1}	0.005*	0.006*	0.002	0.000	0.000	0.004*	0.004*	0.001
	(0.003)	(0.003)	(0.005)	(0.001)	(0.001)	(0.002)	(0.002)	(0.004)
F-stat	607.87	672.02	366.98	607.87	607.87	607.87	672.02	366.98
R-Squared	0.04	0.03	0.03	0.04	0.02	0.20	0.16	0.16
Mean	13.29	7.93	2.56	0.63	0.16	28.31	12.55	10.69
Firms	1,192	1,106	740	1,192	1,192	1,192	1,106	740
Observations	5,663	5,178	2,954	5,663	5,663	5,663	5,178	2,954

Note: All outcome variables are in logs, except for shares that take values between 0 and 1 and the dummy variable of exit exporting. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is expressed in counts of 10-digit HTS codes, the mean for shares is in levels and the mean of unit values in US dollars. The sample size changes because not all firms export high- and low-quality garments.

The second set of alternative measures of domestic import competition is defined as,

$$DCompAbs_{jt} = \sum_k \frac{x_{jkt_0}}{x_{jt_0}} ChPenAb_{kt}^{Peru}, \tag{D4}$$

where $ChPenAb$ refers to the share of imports originated in China to Peru relative to total Peruvian imports and exports of a particular product k.

Table D12: Within-firm Responses: Exports

	Export Value					Export Quantity	
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ	(6) Share HQ	(7) Share LQ
$DComp_{jt-1}$	0.756***	0.836**	0.349	0.089*	-0.115***	0.103**	-0.121***
	(0.275)	(0.344)	(0.422)	(0.046)	(0.042)	(0.049)	(0.031)
$FComp_{jt-1}$	-0.180	-0.026	-0.080	0.011	-0.022	-0.004	-0.029*
	(0.132)	(0.189)	(0.356)	(0.022)	(0.019)	(0.024)	(0.015)
R-Squared	0.066	0.041	0.089	0.014	0.016	0.022	0.013

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

Table D13: Within-firm Responses: Exports

	Number of Exported Products					Unit Prices		
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ	(6) All	(7) HQ	(8) LQ
$DComp_{jt-1}$	0.613***	0.603***	0.507**	0.070	-0.067*	-0.170	-0.195	0.001
	(0.175)	(0.192)	(0.215)	(0.044)	(0.035)	(0.116)	(0.128)	(0.167)
$FComp_{jt-1}$	0.294***	0.345***	-0.030	0.024	-0.005	-0.038	0.034	-0.104
	(0.097)	(0.111)	(0.134)	(0.023)	(0.018)	(0.051)	(0.072)	(0.122)
R-Squared	0.030	0.025	0.026	0.043	0.016	0.198	0.160	0.158

Note: All outcome variables are in logs, except for shares that take values between 0 and 1 and the dummy variable of exit exporting. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is expressed in counts of 10-digit HTS codes, the mean for shares is in levels and the mean of unit values in US dollars. The sample size changes because not all firms export high- and low-quality garments.

D.5.2 An Alternative Set of Instruments

This section considers alternative instruments for the measure of $DComp_{jt-1}$. I use both Turkey and Malaysia to predict import penetration from China to Peru. Table D14 shows the first-stage results. The dependent variable is $DComp_{jt-1}$, and all regressions also include firm fixed effects, year fixed effects, and pre-trends by the firm's size. As shown, both instruments have good predictive power in all samples. They also pass the test of weak instruments using the Cragg-Donald Wald and the Kleibergen-Paap RK Wald F-statistics, as well as the tests of overidentifying restrictions. Hansen J statistics P-values do not reject the null hypothesis of valid instruments.

Table D14: First-stage Instruments

	(1) Total Sample	(2) HQ Sample	(3) LQ Sample
DCompTur_{jt-1}	0.985***	1.180***	1.028***
	(0.086)	(0.091)	(0.104)
DCompMal_{jt-1}	0.274***	0.242***	0.301***
	(0.038)	(0.040)	(0.055)
FComp_{jt-1}	0.233***	0.263***	0.265***
	(0.036)	(0.037)	(0.050)
Cragg-Donald Wald F	668.532	653.122	398.260
Kleibergen-Paap RK Wald F	199.828	241.071	137.970
Hansen J statistic P-value	0.589	0.598	0.036
Firms	1,192	1,106	740
Observations	5,663	5,178	2,954

Table D15 and D16 show the main results of the paper regarding Proposition 2 using the original measures of import competition and alternative instruments. As before, all of the effects of domestic import competition remain. Firms increase exports, quantities, and the number of exported products following an increase in domestic import competition, as predicted in points (2) and (3) of Proposition 2, with all of these effects coming from high-quality goods, which increases the shares of these products. Finally, domestic import competition also decreases firm-level prices, as in point (1) of Proposition 2.

Table D15: Within-firm Responses: Exports

	Export Value					Export Quantity	
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ	(6) Share HQ	(7) Share LQ
A: OLS							
DComp$_{jt-1}$	0.353***	0.381***	0.216	0.032*	-0.047***	0.027	-0.041***
	(0.090)	(0.118)	(0.230)	(0.018)	(0.015)	(0.020)	(0.011)
FComp$_{jt-1}$	-0.259**	-0.122	-0.151	0.006	-0.014	-0.004	-0.024
	(0.129)	(0.192)	(0.364)	(0.022)	(0.019)	(0.024)	(0.016)
R-Squared	0.069	0.042	0.090	0.014	0.018	0.021	0.013
B: IV Regressions							
DComp$_{jt-1}$	0.638***	0.702***	0.094	0.073**	-0.066**	0.093**	-0.074***
	(0.167)	(0.255)	(0.389)	(0.036)	(0.030)	(0.038)	(0.025)
FComp$_{jt-1}$	-0.397**	-0.293	-0.079	-0.014	-0.005	-0.036	-0.008
	(0.154)	(0.219)	(0.421)	(0.024)	(0.020)	(0.027)	(0.013)
F-stat	199.83	241.07	137.97	199.83	199.83	199.83	199.83
R-Squared	0.07	0.04	0.09	0.01	0.02	0.02	0.01
Mean	1,478.67	1,296.81	106.46	0.67	0.14	0.57	0.07
Firms	1,192	1,106	740	1,192	1,192	1,192	1,192
Observations	5,663	5,178	2,954	5,663	5,663	5,663	5,663

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

Table D16: Within-firm Responses: Exports

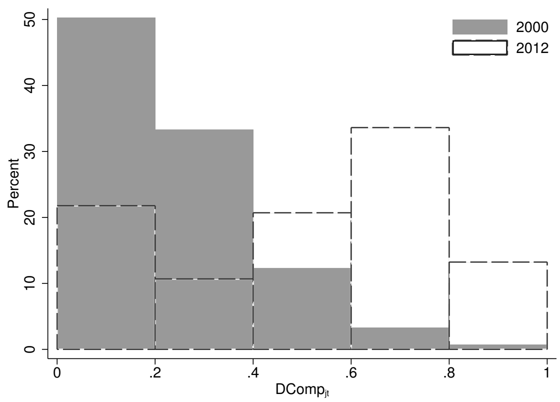
	Number of Exported Products					Unit Prices		
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ	(6) All	(7) HQ	(8) LQ
A: OLS								
DComp_{jt-1}	0.263***	0.289***	0.209**	0.015	-0.037***	-0.062*	-0.082**	-0.040
	(0.062)	(0.066)	(0.089)	(0.016)	(0.012)	(0.037)	(0.040)	(0.072)
FComp_{jt-1}	0.242**	0.268**	-0.072	0.025	0.005	-0.029	0.053	-0.081
	(0.097)	(0.111)	(0.137)	(0.023)	(0.018)	(0.050)	(0.074)	(0.123)
R-Squared	0.033	0.029	0.027	0.043	0.018	0.198	0.160	0.158
B: IV Regressions								
DComp_{jt-1}	0.494***	0.559***	0.186	0.085***	-0.072***	-0.106	-0.146*	-0.063
	(0.111)	(0.126)	(0.163)	(0.032)	(0.027)	(0.071)	(0.080)	(0.137)
FComp_{jt-1}	0.129	0.124	-0.059	-0.009	0.022	-0.007	0.087	-0.067
	(0.108)	(0.125)	(0.159)	(0.026)	(0.019)	(0.059)	(0.082)	(0.139)
F-stat	199.83	241.07	137.97	199.83	199.83	199.83	241.07	137.97
R-Squared	0.03	0.02	0.03	0.04	0.02	0.20	0.16	0.16
Mean	13.29	7.93	2.56	0.63	0.16	28.31	12.55	10.69
Firms	1,192	1,106	740	1,192	1,192	1,192	1,106	740
Observations	5,663	5,178	2,954	5,663	5,663	5,663	5,178	2,954

Note: All outcome variables are in logs, except for shares that take values between 0 and 1 and the dummy variable of exit exporting. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is expressed in counts of 10-digit HTS codes, the mean for shares is in levels, and the mean of unit values in US dollars. The sample size changes because not all firms export high- and low-quality garments.

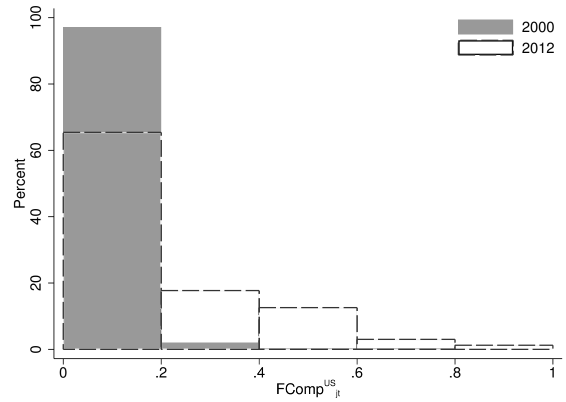
D.5.3 Endogeneity of $FComp_{jt-1}$

To alleviate the concerns of $FComp_{jt-1}$ biasing the results for domestic competition, I do two things. I first construct a new measure of $FComp_{jt-1}$ based on the Chinese import competition to the largest Peruvian export market, the United States. In this case, the weights and the import penetration used in the measure are coming from products exported to the United States and import penetration from China to the United States. Figure D4 shows the histogram of this new measure compared with the first measure of import competition in the domestic market. As previously, the impact of Chinese competition in the United States was not as pronounced as that observed in Peru.

Tables D17 and D18 show the main results of the paper regarding Proposition 2 using both competition measures instrumented. The main results for the effects of import competition in the domestic market hold. Firms increase exports, quantities, and the number of exported products following an increase in domestic import competition as, predicted in points (2) and (3) of Proposition 2, with all of these effects are coming from high-quality goods, which increases shares of these products. In particular, the effects that result from this correction are even stronger. On the other hand, the effects of foreign import competition do not change much and remain systematically not statistically significant.



(a) $DComp_{jt}$



(b) $FComp^{US}_{jt}$

Figure D4: Firm-level Chinese Import Competition

Note: Panel (a) shows the histogram for $DComp_{jt}$ and Panel (b) for $FComp^{US}_{jt}$. Source: Peruvian customs.

Table D17: Within-firm Responses: Exports

	Export Value					Export Quantity	
	Total	HQ	LQ	Share HQ	Share LQ	Share HQ	Share LQ
A: OLS							
DComp$_{jt-1}$	0.417***	0.451**	0.530	0.006	-0.008	-0.005	-0.012
	(0.148)	(0.180)	(0.325)	(0.022)	(0.018)	(0.024)	(0.013)
FComp$_{jt-1}$	-0.193	-0.075	-0.684	0.042	-0.073**	0.058	-0.070**
	(0.346)	(0.395)	(0.591)	(0.043)	(0.033)	(0.055)	(0.033)
R-Squared	0.030	0.027	0.105	0.007	0.012	0.009	0.011
B: IV Regressions							
DComp$_{jt-1}$	1.696***	1.450***	1.259**	0.056	-0.030	0.029	-0.048
	(0.411)	(0.493)	(0.520)	(0.044)	(0.041)	(0.048)	(0.043)
FComp$_{jt-1}$	-2.338**	-1.471	-1.145	-0.030	-0.065	-0.005	-0.039
	(0.990)	(0.980)	(1.040)	(0.098)	(0.074)	(0.116)	(0.063)
F-stat	15.08	15.06	13.20	15.08	15.08	15.08	15.08
Hansen J P-value	0.03	0.07	0.30	0.63	0.08	0.26	0.57
Mean	885.21	775.51	63.89	0.59	0.13	0.50	0.08
Firms	771	654	383	771	771	771	771
Observations	3,850	3,270	1,636	3,850	3,850	3,850	3,850

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

Table D18: Within-firm Responses: Exports

	Number of Exported Products					Unit Prices		
	Total	HQ	LQ	Share HQ	Share LQ	All	HQ	LQ
A: OLS								
DComp_{jt-1}	0.303***	0.324***	0.189	0.017	-0.020	0.048	-0.057	0.153
	(0.081)	(0.085)	(0.117)	(0.021)	(0.015)	(0.063)	(0.062)	(0.096)
FComp_{jt-1}	0.123	0.172	-0.220	0.036	-0.083**	-0.013	0.148	0.079
	(0.205)	(0.222)	(0.242)	(0.050)	(0.041)	(0.139)	(0.121)	(0.173)
R-Squared	0.025	0.029	0.046	0.029	0.021	0.095	0.108	0.143
B: IV Regressions								
DComp_{jt-1}	0.780***	0.602**	0.151	0.091*	-0.056	0.080	-0.142	0.494**
	(0.242)	(0.259)	(0.241)	(0.051)	(0.052)	(0.145)	(0.167)	(0.193)
FComp_{jt-1}	-0.186	0.208	0.047	-0.076	-0.045	0.115	0.167	-0.589
	(0.529)	(0.497)	(0.418)	(0.117)	(0.080)	(0.347)	(0.311)	(0.412)
F-stat	15.08	15.06	13.20	15.08	15.08	15.08	15.06	13.20
Hansen J P-value	0.81	0.53	0.88	0.72	0.70	0.70	0.57	0.04
Mean	9.53	5.45	1.75	0.56	0.15	22.14	11.12	11.10
Firms	771	654	383	771	771	771	654	383
Observations	3,850	3,270	1,636	3,850	3,850	3,850	3,270	1,636

Note: All outcome variables are in logs, except for shares that take values between 0 and 1 and the dummy variable of exit exporting. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is expressed in counts of 10-digit HTS codes, the mean for shares is in levels and the mean of unit values in US dollars. The sample size changes because not all firms export high- and low-quality garments.

Second, I show in Tables D19 and D20 that all main results of the paper hold considering only the measure of import competition in the domestic market. All of the main results remain quantitatively and qualitatively comparable to those in Section 4.2.1.

Table D19: Within-firm Responses: Exports

	Export Value					Export Quantity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total	HQ	LQ	Share HQ	Share LQ	Share HQ	Share LQ
A: OLS							
DComp$_{jt-1}$	0.303***	0.357***	0.185	0.033*	-0.050***	0.026	-0.046***
	(0.089)	(0.114)	(0.219)	(0.017)	(0.015)	(0.019)	(0.011)
R-Squared	0.068	0.042	0.089	0.014	0.017	0.021	0.013
B: IV Regressions							
DComp$_{jt-1}$	0.527***	0.629***	0.286	0.045*	-0.069***	0.047*	-0.072***
	(0.138)	(0.178)	(0.291)	(0.025)	(0.021)	(0.027)	(0.021)
F-stat	496.00	605.92	211.23	496.00	496.00	496.00	496.00
Hansen J P-value	0.87	0.31	0.37	0.19	0.09	0.67	0.57
Mean	1,478.67	1,296.81	106.46	0.67	0.14	0.57	0.07
Firms	1,192	1,106	740	1,192	1,192	1,192	1,192
Observations	5,663	5,178	2,954	5,663	5,663	5,663	5,663

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

Table D20: Within-firm Responses: Exports

	Number of Exported Products					Unit Prices		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total	HQ	LQ	Share HQ	Share LQ	All	HQ	LQ
A: OLS								
DComp$_{jt-1}$	0.310***	0.342***	0.195**	0.020	-0.036***	-0.067*	-0.072*	-0.056
	(0.060)	(0.064)	(0.085)	(0.016)	(0.012)	(0.036)	(0.038)	(0.070)
R-Squared	0.030	0.027	0.027	0.042	0.018	0.198	0.160	0.158
B: IV Regressions								
DComp$_{jt-1}$	0.516***	0.560***	0.197	0.050**	-0.058**	-0.105**	-0.100*	-0.068
	(0.092)	(0.097)	(0.123)	(0.024)	(0.025)	(0.051)	(0.059)	(0.091)
F-stat	496.00	605.92	211.23	496.00	496.00	496.00	605.92	211.23
Hansen J P-value	0.63	0.70	0.98	0.21	0.77	0.35	0.54	0.60
Mean	13.29	7.93	2.56	0.63	0.16	28.31	12.55	10.69
Firms	1,192	1,106	740	1,192	1,192	1,192	1,106	740
Observations	5,663	5,178	2,954	5,663	5,663	5,663	5,178	2,954

Notes: All outcome variables are in logs, except for shares that take values between 0 and 1 and the dummy variable of exit exporting. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is expressed in counts of 10-digit HTS codes, the mean for shares is in levels, and the mean of unit values in US dollars. The sample size changes because not all firms export high- and low-quality garments.

I also show that this is the case even considering the period before 2005, the year in which the Multi-Fiber Arragenment ended (Table D21). Again, all of the main results remain quantitatively and qualitatively comparable to those in Section 4.2.1.

Table D21: Within-firm Responses: Exports

	Export Value					Export Quantity	
	(1) Total	(2) HQ	(3) LQ	(4) Share HQ	(5) Share LQ	(6) Share HQ	(7) Share LQ
A: OLS							
DComp_{jt-1}	0.424**	0.502**	0.602	-0.008	0.017	-0.005	-0.013
	(0.183)	(0.242)	(0.508)	(0.038)	(0.030)	(0.039)	(0.020)
R-Squared	0.046	0.026	0.032	0.004	0.005	0.005	0.005
B: IV-Regressions							
DComp_{jt-1}	0.293	1.155*	0.010	0.106	-0.004	0.107	-0.020
	(0.365)	(0.592)	(0.935)	(0.087)	(0.073)	(0.084)	(0.060)
F-stat	53.57	50.44	43.46	53.57	53.57	53.57	53.57
Hansen J P-value	0.36	0.04	0.41	0.18	0.78	0.25	0.74
Mean	1659.37	1563.52	28.96	0.70	0.08	0.62	0.04
Firms	333	313	146	333	333	333	333
Observations	1196	1107	403	1196	1196	1196	1196

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

D.5.4 Endogeneity on the t_0 bundle

I conduct two robustness checks. First, I consider only firms that were present in 2000. In this case, the bundle of products and weights used to construct the measures of import competition are less exposed to contamination due to within-firm responses to this phenomenon. Tables D22 and D23 show the results for this subsample. Notice that we lose a significant number of observations for this restriction. However, all main results hold with this specification.

Table D22: Within-firm Responses: Exports

	Export Value					Export Quantity	
	Total	HQ	LQ	Share HQ	Share LQ	Share HQ	Share LQ
A: OLS							
DComp_{jt-1}	0.238	0.175	0.871**	-0.020	-0.001	-0.003	-0.017
	(0.156)	(0.187)	(0.398)	(0.022)	(0.019)	(0.026)	(0.013)
FComp_{jt-1}	-0.180	-0.113	0.397	0.012	0.011	-0.010	-0.010
	(0.201)	(0.278)	(0.696)	(0.026)	(0.019)	(0.032)	(0.018)
R-Squared	0.085	0.058	0.152	0.016	0.015	0.026	0.009
B: IV Regressions							
DComp_{jt-1}	0.893**	0.839*	0.781	0.000	0.036	0.028	-0.015
	(0.389)	(0.505)	(0.655)	(0.051)	(0.050)	(0.053)	(0.060)
FComp_{jt-1}	-0.348	-0.253	0.151	0.010	0.002	-0.017	-0.010
	(0.236)	(0.317)	(0.706)	(0.030)	(0.028)	(0.037)	(0.022)
F-stat	63.20	73.76	29.58	63.20	63.20	63.20	63.20
Hansen J P-value	0.40	0.47	0.61	0.52	0.35	0.92	0.98
Mean	885.21	775.51	63.89	0.59	0.13	0.50	0.08
Firms	262	249	154	262	262	262	262
Observations	1,947	1,797	898	1,947	1,947	1,947	1,947

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

Table D23: Within-firm Responses: Exports

	Number of Exported Products					Unit Prices		
	Total	HQ	LQ	Share HQ	Share LQ	All	HQ	LQ
A: OLS								
$DComp_{jt-1}$	0.132	0.184*	0.266*	-0.010	-0.019	0.033	-0.053	0.349***
	(0.095)	(0.110)	(0.155)	(0.024)	(0.021)	(0.070)	(0.075)	(0.132)
$FComp_{jt-1}$	0.238*	0.182	0.133	0.026	0.017	0.007	0.041	0.257
	(0.143)	(0.157)	(0.208)	(0.033)	(0.025)	(0.082)	(0.121)	(0.160)
R-Squared	0.042	0.022	0.071	0.061	0.029	0.201	0.161	0.177
B: IV Regressions								
$DComp_{jt-1}$	0.619**	0.601**	0.399	0.035	-0.037	0.039	-0.080	0.320
	(0.251)	(0.277)	(0.258)	(0.057)	(0.079)	(0.154)	(0.183)	(0.228)
$FComp_{jt-1}$	0.083	0.040	0.085	-0.006	0.034	-0.020	0.061	0.146
	(0.144)	(0.155)	(0.241)	(0.035)	(0.033)	(0.106)	(0.147)	(0.167)
F-stat	63.20	73.76	29.58	63.20	63.20	63.20	73.76	29.58
Hansen J P-value	0.52	0.43	0.28	0.62	0.95	0.61	0.83	0.72
Mean	9.53	5.45	1.75	0.56	0.15	22.14	11.12	11.10
Firms	262	249	154	262	262	262	249	154
Observations	1,947	1,797	898	1,947	1,947	1,947	1,797	898

Note: All outcome variables are in logs, except for shares that take values between 0 and 1 and the dummy variable of exit exporting. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of the number of products is expressed in counts of 10-digit HTS codes, the mean for shares is in levels and the mean of unit values in US dollars. The sample size changes because not all firms export high- and low-quality garments.

Second, I create a new measure of domestic import competition using the self-declared bundle of products of Peruvian firms in the EEA, as opposed to the export bundle. This classification only exists for a small subset of these firms; therefore, it is not surprising that results are noisy. However, they are all qualitatively consistent with the baseline results in Section 4.2.1.

Table D24: Within-Firm Responses: Exports

	Export Value					Export Quantity	
	Total	HQ	LQ	Share HQ	Share LQ	Share HQ	Share LQ
A: OLS							
DComp$_{jt-1}$	0.087	0.108	-0.248	0.061*	-0.038	0.091**	-0.029
	(0.223)	(0.259)	(0.567)	(0.034)	(0.027)	(0.046)	(0.018)
FComp$_{jt-1}$	-0.572	0.388	0.480	0.028	0.055	-0.030	-0.052
	(0.635)	(0.710)	(1.392)	(0.068)	(0.053)	(0.070)	(0.080)
R-Squared	0.281	0.245	0.188	0.041	0.053	0.051	0.082
B: IV Regressions							
DComp$_{jt-1}$	0.146	0.121	-0.523	0.074*	-0.043	0.128**	-0.019
	(0.268)	(0.277)	(0.669)	(0.039)	(0.030)	(0.057)	(0.014)
FComp$_{jt-1}$	-0.577	0.387	0.527	0.027	0.055	-0.033	-0.053
	(0.624)	(0.696)	(1.360)	(0.067)	(0.053)	(0.069)	(0.079)
F-stat	178.12	182.60	83.47	178.12	178.12	178.12	178.12
Hansen J P-value	0.63	0.92	0.94	0.77	0.57	0.45	0.62
Mean	1,478.67	1,296.81	106.46	0.67	0.14	0.57	0.07
Firms	119	117	70	119	119	119	119
Observations	556	534	274	556	556	556	556

Note: All outcome variables are in logs, except for shares that take values between 0 and 1. HQ indicates high-quality goods and LQ low-quality ones. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export values is expressed in thousands of US dollars, while the mean for shares is in levels. The sample size changes because not all firms export high- and low-quality garments.

D.5.5 Survival Bias

To analyze some potential exit bias of the exporter sample, I merge the Peruvian customs data with the Peruvian firm registry described in Appendix A.1. The latter includes the list of all firms operating in apparel, with their start date of operation. I extend the dataset in the following way. For all exporters, I add observations until I see them no longer operating in the Peruvian registry. For example, if a firm appears in the customs data until 2004, but is on the registry until 2010, the extended sample will include the firm during 2000-2010. From 2005 to 2010, though, exports for this firm will be zero.

Next, I create all variables for the analysis. To accommodate the zeros, I use the hyperbolic sine transformation to interpret the coefficients as semi-elasticities and make them comparable with the results in the main text. Shares of non-exporters are replaced by 0, which is not ideal but, if anything, this will go in the direction of not finding effects. Moreover, since export shares are fixed to the first year of exporting, I can easily construct firm-level import competition measures for firms beyond their exporting exit date.

This extension does not consider the entry of new firms, since to construct the measures of import competition, export shares in the initial year of export are necessary. That is, firms that start exporting later than 2000 will not have additional observations before the first year of exporting. In this sense, the analysis focuses on the bias due to the differential exit of firms from exporting.

Table D25 replicates results in Tables 1 and 2 using the hyperbolic sine transformation, but without extending the sample.

Table D25: Within-firm Responses: Hyperbolic Sine Transformation

	Export Value			Number of Prodducts		
	(1) Total	(2) HQ	(3) LQ	(4) Total	(5) HQ	(6) LQ
A: OLS						
DComp_{jt-1}	0.353***	0.384***	0.187	0.259***	0.254***	0.107
	(0.090)	(0.117)	(0.171)	(0.060)	(0.063)	(0.070)
FComp_{jt-1}	-0.259**	0.157	0.054	0.234**	0.387***	0.158
	(0.129)	(0.181)	(0.226)	(0.093)	(0.105)	(0.103)
R-Squared	0.069	0.035	0.096	0.033	0.032	0.050
B: IV Regressions						
DComp_{jt-1}	0.674***	0.849***	0.333	0.453***	0.499***	0.188
	(0.152)	(0.203)	(0.268)	(0.095)	(0.104)	(0.118)
FComp_{jt-1}	-0.415***	-0.069	-0.017	0.140	0.267**	0.119
	(0.145)	(0.187)	(0.241)	(0.095)	(0.110)	(0.106)
F-stat	399.79	399.79	399.79	399.79	399.79	399.79
Hansen J P-value	0.84	0.88	0.79	0.60	0.58	0.73
Mean	6.11	5.16	2.24	2.85	2.25	1.03
Firms	1,192	1,192	1,192	1,192	1,192	1192
Observations	5,663	5,663	5,663	5,663	5,663	5,663

Note: This table replicates the results of Table 1 and 2 using the hyperbolic sine transformation on the dependent variables instead of logs. Additional controls include linear trends by the firm's size and year and firm fixed effects. Clustered standard errors at the firm level are shown in parentheses. The mean of export variables is in thousands of US dollars, and for the number of products in number of 10-digit HTS codes.

E Policy Experiments

E.1 Model for Structural Estimation

The main difference with the model presented in Section 3 is that firms make static and dynamic production decisions. Conditional on a product mix, firms statically choose their optimal pricing vector $\mathbf{P}_{jt}$ to maximize their static profits as in Section 2. However, now there are no fixed costs of including a variety in the mix; instead, these costs are sunk.

Dynamically, firms choose in every period the product mix with the highest expected discounted profit. A cost is associated with adding a new combination to the product mix: one-time irrecoverable sunk costs, $\gamma_k^c \in \Gamma(.)$. To choose $\mathbf{a}_{jt}$, firms consider their productivity, market variables in each quality-destination segment, the fixed factor, and sunk costs. Let s_{jt} be the set of these state variables. The Bellman equation for firm j is

$$V(s_{jt}) = \max_{a \in \mathbf{A}} \quad \pi_{jt}(a, s_{jt}) - \Gamma(a, h_{jt-1}) + \beta \int V(s_{jt+1}) dF(s_{jt+1}|s_{jt}), \tag{E1}$$

where π_{jt} is the static profit net of sunk costs, β is a discount factor, and $F(s_{jt+1}|s_{jt})$ is the transition probability of the state variables. Finally, I further assume that ψ_{jt} evolves over time following a Markov process, and price indices and aggregate expenditures follow some nonstationary process.

E.1.1 Structural Estimation

The full set of parameters to estimate are demand elasticities (σ_h, σ_l), technological parameter (α), productivity process parameters (ρ_0, ρ_1, σ_ξ^2), price index processes parameters ($\mathbf{\Theta_P}$), aggregate expenditure processes parameters ($\mathbf{\Theta_X}$), and sunk costs ($\mathbf{\Gamma}$).

As noted in the main text, to bring the model to the data, I restrict the set of possible product mixes in the domestic market to be low-quality goods. Moreover, in the dynamic problem specified in equation (E1), I allow the static profits $\pi(a, s_{jt})$ to be appended by an action-specific *iid* error term $\eta_{jt}(a)$. This error term reflects unobserved reasons why a firm will choose a particular product mix. η_{jt} is assumed to be independently drawn from a Type 1 extreme value distribution. Thus, the problem in equation E1 is equivalent to a multinomial choice model. Its value function can be expressed by the integrated value function $\bar{V}_{jt}(s_{jt})$, as in **?**:

$$\bar{V}_{jt}(s_{jt}) = log \left(\sum_{a=0}^{J} exp \left[\Pi(a, s_{jt}) + \beta \sum_{s_{jt+1}} \bar{V}(s_{jt+1}) dF(s_{jt+1}|a, s_{jt}) \right] \right), \tag{E2}$$

where $\Pi(a, s_{jt}) = \pi(a, s_{jt}) - \Gamma(a, h_{t-1})$.

A full estimation of the model requires solving the dynamic model for each potential value of the parameters and state space, having no analytical solutions for the main key variables. This solution method is extremely time-consuming. To circumvent that problem, I proceed in two steps. First, I take observed price indices, aggregate expenditures, and wages as equilibrium outcomes. Conditional on their values, I first separately estimate elasticities (σ_h, σ_l), technological parameters (φ_{jt}, α, ρ_0, ρ_1, σ_φ), and processes for price indices and aggregate expenditures ($\mathbf{\Theta_P}, \mathbf{\Theta_X}$). This method is feasible, given that neither of these parameters requires knowledge of the dynamic parameters (i.e., the sunk costs). Next, I estimate sunk costs using a conditional choice probability approach (CCP).

Elasticities To recover elasticities, I use information from the first-order conditions of multi-product exporters. Combining the two versions of equation (3) for a multi-product exporter, it follows that, in logs,

$$\hat{p}^x_{jht} = \beta_1 \hat{p}^x_{jlt} + \beta_2 (m_{ht} - m_{lt}), \tag{E3}$$

where $\beta_1 = (\frac{\sigma_l - 1}{\sigma_l})(\frac{\sigma_h}{\sigma_h - 1})$, $\beta_2 = (\frac{\sigma_h}{\sigma_h - 1})$, $\hat{p}^x_{jkt} = (\frac{1}{\tau_{kt}}) p^x_{jkt}$, and all variables are known except for the elasticities.

Based on equation (E3), I use the following empirical specification:

$$\hat{p}^x_{jht} = \beta_1 \hat{p}^x_{jlt} + \beta_2 (m_{ht} - m_{lt}) + \epsilon_{jt}, \tag{E4}$$

where ϵ_{jt} corresponds to an *iid* shock, reflecting unobserved firm-level differences in the production of high-quality relative to low-quality garments.[46]

This identification strategy allows me to overcome the limitations of the data. Equation (E4) identifies the elasticities without a full estimation of domestic demand for high- and low-quality apparel. It also does not need data on firm-level prices by quality in the domestic market. To see that, note that the combination of first-order conditions in the domestic market gives the same expression as equation (E3). That is, one combination is redundant. The prices of exported goods provide the same information as domestic prices. Thus, elasticities can be identified using only custom data.

This strategy is possible, given the specific production process of the apparel industry. In this case, the final quality is only determined by material quality, and the only cost difference is due to the material unit price. Thus, differences in prices respond only to changes in differences in material costs and mark-ups. Given the CES demand assumption, elasticities could be backed up from the implicit mark-ups.[47]

Production Function To estimate φ_{jt}, I follow De Loecker (2011). First, I use the demand structure to define revenues as a function of physical production. Second, in reality, firms produce not only high- and low-quality goods, but different lines of these products.[48] Thus, I assume that firms are multi-product and multi-line and aggregate production from the line to the firm level. Lines are defined at the 10-digit HTS level, while products are high- and low-quality apparel. Finally, I consider unobserved demand shocks and simultaneity concerns. To control for unobserved demand shocks, I use differences in exposure to Chinese import competition in the domestic market, $DComp_{jt}$, across firms and over time. $DComp_{jt}$ directly impacts a firm's residual demand, and thus firm-level prices. To correct for unobserved productivity shocks, I follow De Loecker (2011). I detail the procedure below.

The production function for firm j for product line i at time t can be written as

$$\begin{aligned} Q^i_{jt} =& (n^i_{jt} L_{jt})^{\alpha_L} (n^i_{jt} K_{jt})^{\alpha_K} (n^i_{jt} \bar{F})^{\alpha_F} \varphi_{jt} \exp(u_{jt}) \\ =& N^{-1}_{jt} Q_{jt}, \end{aligned} \tag{E5}$$

where n^i_{jt} is the share of product i in firm's j input usage, $n^i_{jt} = N^{-1}_{jt}$ and u_{jt} refers to the

[46]For example, some firms might have an unobserved "ability" to produce only one type of product for a particular market, given their network of consumers or technology. Though this is observed by the firm, it is unobserved by the econometrician.

[47]There might be some threats to the identification. First, firm-level prices could have measurement error. If so, β_1 would be biased downward, and β_2 would be biased following $cov(\text{measurement error}, m_{ht} - m_{lt})$. If this covariance is negative, σ_h will be biased downward, while the effect on σ_l is ambiguous. Second, there could be sample selection, even within exporters. Thus, I perform the same regression using all of the customs data, with no significant changes in the estimated values.

[48]In my data, 97% of firms sell more than one apparel type, and 55% sell both products.

unanticipated productivity component unobserved by the firm and the econometrician.

Given the CES structure of preferences, the demand system for line i of product k is given by $Q^i_{jt} = \frac{Q_{kt}(P^i_{jt})^{-\sigma_k}}{P_{st}^{-\sigma_k}}\exp(\xi_{jt})$, where ξ_{jt} is an unobserved demand shock for firm j. Thus, revenues per product line are[49]

$$R^i_{jt} = (Q^i_{jt})^{1-\frac{1}{\sigma_k}} Q_{kt}^{\frac{1}{\sigma_k}} P_{kt}\exp(\xi_{jt})^{\frac{1}{\sigma_k}}. \tag{E6}$$

Including input proportionality and the production function definition stated in equation (E5), firm-level revenue is

$$R_{jt} = \sum_i R^i_{jt} = (n^i_{jt})^{\frac{1}{\sigma_k}}(L_{jt}^{\alpha_L} K_{jt}^{\alpha_K} \bar{F}^{\alpha_F} \varphi_{jt}\exp(u_{jt}))^{1-\frac{1}{\sigma_k}} Q_{kt}^{\frac{1}{\sigma_k}} P_{kt}\exp(\xi jt)^{\frac{1}{\sigma_k}} \tag{E7}$$

or, in logs,

$$\tilde{r}_{jt} = \beta_{np} np_{jt} + \beta_L l_{jt} + \beta_K k_{jt} + \beta_{\bar{F}} + \sum_k \beta_k s_{jkt} q_{kt} + \varphi^*_{jt} + \xi^*_{jt} + u^*_{jt}, \tag{E8}$$

where $\tilde{r}_{jt}$ are logs of deflated revenues, $np_{jt} = ln(N_{jt})$, and the demand shifter q_{kt} is weighted by the importance of the product in the firm's total output; it aims to serve as a proxy for the different demand conditions firms might face in the high- and low-quality segments.

Given the absence of data on output per product to control for demand shifters, I follow De Loecker (2011) to construct total demand for product k as a market-share weighted average of deflated revenue, such that $q_{kt} = \sum_{i=1}^{M_{kt}} ms_{jkt}\tilde{r}_{jst}$, where M_{kt} is the number of firms selling product k at time t, ms_{jkt} is the market share of firm j in product k at time t, and $\tilde{r}_{jkt}$ is the log-deflated revenue of firm j in product k at time t.[50]

Even with this construction, there are still several issues with equation (E8). To get consistent estimates, both demand and productivity unobserved shocks should be accounted for. First, input coefficients might be biased if unobserved demand factors are driving firm-level prices. In this case, differences in exposure to Chinese import competition across firms and over time directly impact a firm's residual demand, and thus firm-level prices. Therefore, I follow De Loecker (2011) and decompose the demand shock ξ_{jt} in an unobservable and observable component such that

$$\xi_{jt} = \delta DComp_{jt} + \tilde{\xi}_{jt}, \tag{E9}$$

where $DComp_{jt}$ is the exposure to Chinese import competition at the firm level, defined in Section 4, and $\tilde{\xi}_{jt}$ corresponds to a firm-specific iid shock.

Thus,

$$\tilde{r}_{jt} = \beta_{\bar{F}} + \beta_{np} np_{jt} + \beta_L l_{jt} + \beta_K k_{jt} + \sum_k \beta_k s_{jkt} q_{kt} + \varphi^*_{jt} + \delta DComp_{jt} + \epsilon_{jt}, \tag{E10}$$

[49] For the aggregation, I follow De Loecker (2011). First, I assume identical production functions for all lines and products. This is reasonable in apparel production, where the difference is in material price rather than technology. Also, I assume firms use inputs in exact proportion to the total number of lines produced by the firm, N_{jt}.

[50] These two terms are also not typically observed and are constructed as $r_{jkt} = ln(R_{jt}\frac{n_{jkt}}{N_{jt}})$ and $ms_{jkt} = \frac{R_{jkt}}{\sum_j R_{jst}}$. See De Loecker (2011) for a detailed discussion.

where $\epsilon_{jt} = \tilde{\xi}_{jt} + u^*_{jt}$.

Second, input coefficients might also be biased by simultaneity concerns. Simultaneity bias arises because the productivity innovation term is correlated with labor decisions, if firms are able to observe the productivity innovation term before they optimize labor. Similar to Olley and Pakes, I assume investment in machinery (i_{jt}) is a strictly increasing function of productivity. Moreover, following De Loecker (2011), I assume that it takes time for Chinese import competition to impact productivity due to investment reactions. Therefore, $i_{jt} = i_t(k_{jt}, \varphi_{jt}, DComp_{jt})$. Considering that $DComp_{jt}$ is an exogenous variable with support from 0 to 1, the invertibility of $i_t(.)$ is preserved, and thus $\varphi_{jt} = h_t(k_{jt}, i_{jt}, DComp_{jt})$.[51]

To estimate this, in practice, I proceed in two steps. First, I estimate the firm-level revenue equation in logs,

$$\tilde{r}_{jt} = \beta_{np} np_{jt} + \beta_L l_{jt} + \sum_k \beta_k s_{jkt} q_{kt} + \phi_t(i_{jt}, k_{jt}, DComp_{jt}) + \epsilon_{jt}, \tag{E11}$$

where np_{jt} is firm's number of products; s_{jkt} is the firm-level share of product k; i_{jt} is firm's investment; and $\phi_t(i_{jt}, k_{jt}, DComp_{jt}) = \beta_F + \beta_K k_{jt} + \delta DComp_{jt} + h_t(k_{jt}, i_{jt}, DComp_{jt})$. This stage yields consistent coefficients for number of products, labor, and demand per product.

Then, with the estimated coefficients and $\varphi_{jt} = g(\varphi_{jt-1}) + \xi_{jt}$, the coefficients of capital and import competition are nonparametrically identified in

$$\begin{aligned} \tilde{r}_{jt} - \hat{\beta}_{np} np_{jt} - \hat{\beta}_L l_{jt} - \sum_k \hat{\beta}_k s_{jkt} q_{kt} = \beta_{\bar{F}} + \beta_K k_{jt} + \delta DComp_{jt} + \\ g(\hat{\phi}_{t-1}, i_{jt-1}, k_{jt-1}, DComp_{jt-1}) + \epsilon_{jt}, \end{aligned} \tag{E12}$$

where g(.) is a non-parametric function of $\hat{\phi}_{t-1}$, i_{jt-1}, k_{jt-1}, and $DComp_{jt-1}$.

Price Indices Processes Price indices ($\mathbb{P}^c_{kt}$) are assumed to follow a nonstationary process, as in

$$\mathbb{P}^c_{kt} = \rho_0^{k,c} + \rho_1^{k,c} \mathbb{P}^c_{kt-1} + \delta^{k,c} \mathbf{D}_t + \upsilon_{it}, \tag{E13}$$

where $k \in \{h, l\}$, $c \in \{d, x\}$, υ_{it} is a normally distributed *iid* shock with mean zero and variance $\sigma^2_{P_i}$ and, $\mathbf{D}_t$ refers to a vector of time dummies. Therefore, $\mathbf{\Theta_P} = \{\rho_0^{l,d}, \rho_1^{l,d}, \delta^{l,d}, \sigma_{l,d}, \rho_0^{h,x}, \rho_1^{h,x}, \delta^{h,x}, \sigma_{h,x}, \rho_0^{l,x}, \rho_1^{l,x}, \delta^{l,x}, \sigma_{l,x}\}$.[52]

Aggregate Expenditure Processes Similarly, I estimate the process of aggregate expenditures (X^c_{kt}), assuming it follows a nonstationary process,

$$\mathbb{X}^c_{kt} = \rho_0^{k,c} + \rho_1^{k,c} \mathbb{X}^c_{kt-1} + \delta^{k,c} \mathbf{D}_t + \varepsilon_{it}, \tag{E14}$$

where $k \in \{h, l\}$, $c \in \{d, x\}$, ε_{it} is a normally distributed *iid* shock with mean zero and variance $\sigma^2_{X_i}$, and $\mathbf{D}_t$ refers to a vector of time dummies. Therefore, $\mathbf{\Theta_X} = \{\rho_0^{l,d}, \rho_1^{l,d}, \delta^{l,d}, \sigma_{l,d}, \rho_0^{h,x}, \rho_1^{h,x}, \delta^{h,x}, \sigma_{h,x}, \rho_0^{l,x}, \rho_1^{l,x}, \delta^{l,x}, \sigma_{l,x}\}$.

Second-stage Estimation In the second stage, I estimate sunk costs (γ_d, γ_h, γ_l) using a CCP approach. To do this, I rely on the fact that firms can choose to exit during all time periods. Since *exit* is a terminal choice for firms, the expectation term on the conditional choice value functions,

[51] See De Loecker (2011) for an extensive proof.

[52] Given the short time span of price data, I estimate equation (E13) as a dynamic panel on product-year observations at the HS6-digit level, where the working assumption is that all average import prices by product share the same underlying process.

$v(a|s_{jt})$, can be expressed only as a function of the probability of *exit* (p_0) and the Euler constant (C) such that

$$v(a|s_{jt}) = \pi(s_{jt}) - \Gamma(a_{jt}, a_{jt-1}) - \beta \sum_{s_{jt+1}} ln(p_0(s_{jt+1})f(s_{jt+1}|s_{jt}) + \beta C. \tag{E15}$$

Given the parameters estimated in the first stage, variables such as prices, profits net of sunk costs, and transition probabilities, $f(s_{jt+1}|s_{jt})$, can be calculated outside the optimization procedure for each possible state space value of the data. Moreover, the exit probabilities, $p_0(s_{jt+1})$, can also be nonparametrically estimated outside of the optimization process. Therefore, CCPs can be constructed depending only on the value of sunk costs, as in $p(a|s_{jt}) = \frac{\exp(v(a|s_{jt})}{\sum_{a'} \exp(v(a'|s_{jt}))}$.

Thus, the log-likelihood function can be expressed as

$$L(\gamma) = \sum_j \sum_t \sum_a (d_{jt} = a)[ln(p(a|s_{jt})) + ln(f(s_{jt+1}|s_{jt}))], \tag{E16}$$

where d_{jt} are the choices observed in the data, This, in turn, is equivalent to maximizing $L(\gamma) = \sum_j \sum_t \sum_a (d_{jt} = a)[ln(p(a|s_{jt}))]$. The variation in product-mix switching identifies sunk costs (γ_d, γ_h, γ_l), and the entry cost f_e is determined from the average value of a firm in the market.

E.2 Results

The following tables summarize the estimated parameters of the model. Table E1 shows the estimates for demand elasticities. Consistent with the non-homotheticity assumption that $\sigma_h > \sigma_l$, the coefficient β_1 is positive and less than one (0.82). Moreover, the coefficient on the difference in material costs, β_2, is positive and larger than one (1.65), a fact that is also consistent with $\sigma_h > 1$. Both of these are encouraging results, as no constraints were imposed on the estimation. With these coefficients, the implied elasticities are $\sigma_h = 2.53$ and $\sigma_l = 1.98$.

Table E1: Elasticities

Stage	**Estimation**	**Parameters**	**Coef.**	**SD**	**Obs.**
First	Elasticities	σ_h	2.53	(1.53)	685
		σ_l	1.98	(0.82)	

Table E2 shows the output elasticities, which are 0.72 for labor and 0.13 for capital. I use these estimates to predict firm-level productivity and estimate the parameters on the AR1 process of productivity. The coefficients on the AR1 process show moderate productivity persistence over time, but considerable heterogeneity between firms.

Table E2: Productivity

Stage	Estimation	Parameters	Coef.	SD	Obs.
First	Production Function	α_l	0.72	(0.02)	511
		α_k	0.13	(0.03)	
First	Production Process	ρ_0	0.25	(0.03)	404
		ρ_1	0.22	(0.08)	
		σ_φ^2	0.41		

Moreover, Table E3 shows the estimates for the price indices and aggregate expenditure processes. Finally, the estimates for sunk costs (γ_d, γ_h, γ_l) are shown in Table E4. They are expressed in millions of U.S. dollars and are in line with the common empirical fact of substantial sunk costs related to exporting and starting a business.

Table E3: Market Environment

Stage	Estimation	Parameters	Coef.	SD	Obs.
First	Price Index Processes	$\rho_0^{P_d}$	6.36	(0.84)	339
		$\rho_1^{P_d}$	0.27	(0.06)	
		$\sigma_{P_d}^2$	3.35		
		$\rho_0^{P_1}$	4.89	(0.47)	1,240
		$\rho_1^{P_1}$	0.54	(0.03)	
		$\sigma_{P_1}^2$	2.90		
		$\rho_0^{P_2}$	5.58	(0.55)	1,630
		$\rho_1^{P_2}$	0.46	(0.02)	
		$\sigma_{P_2}^2$	3.92		
First	Aggregate Expenditure Processes	$\rho_0^{X_d}$	16	(8)	48
		$\rho_1^{X_d}$	0.39	(0.19)	
		$\sigma_{X_d}^2$	16		
		$\rho_0^{X_1}$	40.83	(508.93)	25
		$\rho_1^{X_1}$	0.87	(0.13)	
		$\sigma_{X_1}^2$	62.73	(8.35)	
		$\rho_0^{X_2}$	-17.13	(17.81)	25
		$\rho_1^{X_2}$	0.88	(0.11)	
		$\sigma_{X_2}^2$	7.22	(1.41)	

Table E4: Sunk Costs

Stage	**Estimation**	**Parameters**	**Coef.**	**SD**	**Obs.**
		γ_d	6.08	(2.30)	
Second	Sunk Costs	γ_1	7.10	(1.27)	222
		γ_2	3.85	(3.87)	

E.3 Model Fit

To assess the model fit, I use the estimated parameters and fully solve the model to simulate industry dynamics for 400 firms during the period 2001-2012. With the simulated industry, I calculate several relevant criteria the model should be able to explain and compare them with what is observed in the data. The model fits well with both the main qualitative features of the data and also accurately matches the levels of industry sales.

The main criteria for model fit are summarized in Table E5. In particular, I calculate the correlation between the observed price indices and the price indices resulting from aggregation of the firm-level prices in the model simulation. As shown in the first row of Table E5, for each market, the correlations are considerably high, since the model can precisely capture the dynamics of the price indices. The same is true for the correlation between the logs of aggregate expenditures, as shown in the second row. In addition, the model does a good job of predicting the patterns of the ratio of export sales of high-quality relative to low-quality garments—a key feature given that, as seen in Section 1, most of the export growth was associated with a growth in high-quality clothes, instead of other types of apparel.

Table E5: Model Fit

Criteria	**Variable**	**Data-Model**
	$\mathbb{P}_t^d$	0.9879
Correlation Price Indices	$\mathbb{P}_t^h$	0.9995
	$\mathbb{P}_t^l$	0.9680
	$\mathbb{X}_t^d$	0.8653
Correlation Log Aggregate Expenditures	X_t^h	0.8228
	$\mathbb{X}_t^l$	0.9994
Correlation Ratio High-Low Quality	$\frac{\mathbb{X}_t^h}{X_t^l}$	0.9571

Estimation of the model in Section 3 assumed that the observed price indices were already equilibrium objects. However, given that a change in the fundamentals in the model would necessarily imply changes in the aggregate price indices due to firm-level reactions, the model must be fully solved to perform any simulation.

Two critical comments are in order. First, departing from the estimation procedure, I do not consider nonstationary processes for price indices or aggregate expenditures when fully solving the model. To keep the simulations tractable, I instead assume AR1 stationary processes. This allows me to compute the value functions for each state space value outside of the iterative processes that look for a convergence of price indices and firm level. This strategy generates substantial gains in computing time. The main caveat is that the model will potentially predict effects that are not as sharp as those observed in the data. Second, because of the stationary environment assumption, I do not include data for the year 2004 in my simulations. Because the Peruvian government imposed temporary tariffs that largely affected industry performance that year, the observed values for price indices, as well as for aggregate expenditures, will not be consistent with firms that form expectations in a stationary environment.

E.4 Solution Algorithm

Table E6 presents an outline for the method used to fully solve for the new equilibrium. The implemented algorithm takes all of the fundamental parameters ($\mathbf{\Sigma}$) as inputs and the state of the industry at time zero, and returns the equilibrium states for each period t where $t = \{1, ..., T\}$. These equilibrium outcomes correspond to the sequence of actions of each firm ($\{a_{jt}\}_{t=1}^{T}$), as well as the industry price indices for every period ($\{\mathbf{P}\}_{t=1}^{T}$).

The algorithm starts with an assumption of parameters of the price indices processes, where the value function can be computed at every grid of the state space. Then, it proceeds to simulate the vector of actions and consistent price indices that clear the market of goods in each period. At period T, it computes the price indices processes that result from the simulated sequence of price indices. The algorithm ends when all actions, price indices' sequences, and price indices' processes parameters are self-fulfilling and consistent with the equilibrium conditions. Given that the algorithm is based on a simulation of firm decisions, given a set of errors for productivity, price indices processes, and choice-specific value functions, this process is repeated S times.

Table E6: Solution Algorithm

	Algorithm:
1.	Set parameters $\Sigma = \{\sigma_h, \sigma_l, m_h, m_l, r, \bar{F}, \rho_x\}$.
2.	Set errors for productivity process, price indices processes, and value functions.
2.	Set counter $iterar1 = 0$.
3.	Guess price indices processes: Θ^0.
4.	Compute $V(S_{jt})$ given Θ^0 for each value of grid of s_{jt}.
5.	For $t = 1$ to T:
6.	Get X_{dt}, X_{ht}, X_{lt}, φ_{jt}:
7.	Set counter $itera = 0$.
8.	Guess actions a^0_{jt}:
9.	Set counter $iterp = 0$.
10.	Guess price indices $\mathbb{P}^0_{dt}$, $\mathbb{P}^0_{ht}$, $\mathbb{P}^0_{lt}$:
11.	Compute firm-level prices p_{jt}.
12.	Compute $\mathbb{P}^1_{dt}$, $\mathbb{P}^1_{ht}$, $\mathbb{P}^1_{lt}$.
13.	Stop if $\lvert P^1_{\kappa t} - P^0_{\kappa t} \rvert < \epsilon \ \forall \kappa$; otherwise update $P^0_{\kappa t}$, $iterp = iterp + 1$ and repeat (10)-(13).
14.	Solve the dynamic decisions of firms and compute a^1_{jt}.
15.	Stop if $\lvert a^1_{jt} - a^0_{jt} \rvert < \epsilon$; otherwise update a^0_{jt}, $itera = itera + 1$ and repeat (8)-(15).
16.	End and move to $t = t + 1$.
17.	Using all sequences $\{\mathbb{P}^0_t, \mathbb{P}^0_{ht}, \mathbb{P}^0_{lt}\}^T_t$, compute price indices processes $\Theta^1 = \{\rho_d\}$.
18.	Iterate until $\lvert \Theta^1 - \Theta^0 \rvert < \epsilon$.