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Competition and Quality Upgrading in Export Markets: The Case of Peruvian Apparel Exports

Renzo Castellares*

* Banco Central de Reserva del Perú

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Competition and Quality Upgrading in Export Markets: The Case of Peruvian Apparel Exports*

Renzo Castellares †

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Abstract

This paper uses the exponential growth in Chinese exports from 2001 to 2006 to evaluate the effects of a competition shock from a low-wage competitor on exporters from a developing country. In particular, this research considers heterogeneous quality upgrading strategies of Peruvian apparel firms in response to an influx of low-cost Chinese apparel goods. Using firm-level data from Peruvian customs and a survey of Peruvian manufactures, I find that more productive firms upgrade their product quality to differentiate them from low-cost and low-quality Chinese apparel goods. Conversely, less productive Peruvian firms, which are not able to increase their quality, react by reducing their prices. Finally, I also find evidence that the average quality of Peruvian apparel products increase during 2001 to 2007.

JEL Codes: F14, O14, O30

Keywords: Trade, competition, quality, trade finance

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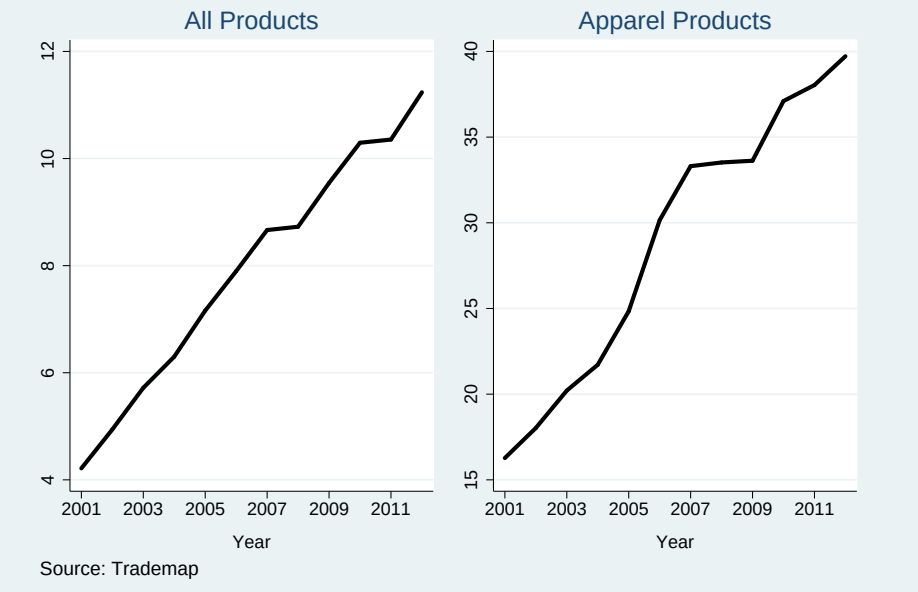
†Department of Economics; University of Virginia. Email: rcc9fa@virginia.edu

1 Introduction

China's exports grew more than 20 percent per year from 2001 to 2012. Their low cost in low-skilled-intensive products has been one of the main drivers of this exponential growth Amiti and Freund (2010), which has permitted China to capture more than 13 percent of total global exports by the end of 2012 (Figure 1). The evolution of China's apparel exports is an example of how China's global market share has increased from 10 percent to 40 percent in the last 12 years (Figure 1).

Figure 1: **China's Global Market Share (percentage)**



*Notes:*Apparel products include those classified under the Harmonized System (HS) in codes 60 (knitted or crocheted fabrics); 61 (articles of apparel & clothing accessories-knitted or crocheted); 62 (articles of apparel & clothing accessories-not knitted or crocheted) and 63 (made-up textile articles nesoi, needlecraft sets, worn clothing, rags)

Besides China's entry into the World Trade Organization (WTO), the end of the last stage of the Multifiber Agreement (MFA) and the corresponding elimination of the quota system accelerated the growth of China's apparel exports.[1] At the same time, this growth has produced a crowding out effect in the apparel production of other countries, mainly in high-middle income and Latin-American countries. The higher level of competition from

[1]At the time that the MFA was created, China was not a member of the WTO, so it was not part of the initial phases of the MFA. However, after China became a member of the WTO, it also became eligible for participation in the MFA quota elimination process.

Chinese apparel exports has also caused a lower price in the same products of some other apparel exporters. This research evaluates the heterogeneous quality upgrading strategies of Peruvian apparel firms in reaction to the lower prices of Chinese apparel. Firms competing against Chinese low-price apparel may prefer to differentiate their products vertically (quality) from their competitors and gain some monopoly power rather than start a price war. Gabszewicz and Thisse (1979); Shaked and Sutton (1982)

A recurring concern among other countries is whether China's export growth has displaced exports from other countries. Hanson and Robertson (2010) find that for the main developing countries in manufacturing exports, China's expansion has represented only a modest negative shock. However, this shock varies and is larger in low-skilled intensive sectors.[2] Greenaway et al. (2008) find that the displacement effect of Chinese exports on other Asian countries' exports varies, and is greater in high-income exporters such as Japan and South Korea. In the case of Latin American countries, Freund and Ozden (2006) find that Mexican exporters of industrial goods to the U.S. market have been negatively impacted by Chinese exports during the mid-1980s and the early 2000s. Chinese export growth in industrial products has led to 2 percentage point slower growth in Mexican exports to the US. Recently, Utar and Ruiz (2013) find a negative effect of Chinese imports in the US market on the total sales, value added and employment of Mexican maquiladoras, using plant-level data from 1990 to 2006.

The study of heterogeneous quality upgrading decisions in the Peruvian apparel industry is relevant for this economy since the apparel and textile industry has represented, on average, 20 percent of Peruvian manufacturing exports from 1993 to 2012. In addition, the apparel and textile sector represents around 10 percent of total employment in Peru, when considering both direct and indirect jobs.[3]

In this framework there are firms in two countries, Home (Peru) and Foreign (China),

[2]The authors find that if China's export supply capacity had been constant over the 1995-2005 period, the demand for exports would have been 0.8% to 1.6% higher in the 10 countries studied (Hungary, Malaysia, Mexico, Pakistan, the Philippines, Poland, Romania, Sri Lanka, Thailand, and Turkey).

[3]Paredes, Ricardo and Miluska Caceres (2004). "El Comercio Internacional sobre Textiles y Vestido y sus Perspectivas Futuras: El Caso del Peru" Montevideo, 2 de Junio del 2004.

exporting horizontally and vertically differentiated goods to the rest of the world. A Peruvian firm's ability of vertically differentiate its products depends on the firm's productivity. Most productive firms can upgrade their quality and avoid a price war with low-priced Chinese products and sell these high-quality goods at even higher prices. Conversely, less productive Peruvian firms, which are not able to increase their quality and differentiate their products, are forced to reduce their prices and their profits. The least productive firms have to leave the market since they have negative profits. Recent work on firms quality upgrading includes Antoniades (2014), which incorporates an endogenous firm's quality decision in a Melitz and Ottaviano (2008) framework. In this model, more productive firms produce higher quality goods at higher prices. Additionally, these firms decide to increase their quality and their prices after a trade liberalization, whereas the less productive firms reduce their prices and the quality of their products. The firm's decision to increase (decrease) product quality depends on how costly it is for the firm to increase quality and how large the scope for quality differentiation is in a specific sector in the other country.[4]

There is empirical evidence for product quality upgrading at the firm-level (Verhoogen (2008); Amiti and Khandelwal (2013); Iacovone and Javorcik (2012). Additional evidence includes Fernandes and Paunov (2009), who use data of Chilean manufacturing plants to find a positive and robust effect of import competition on product quality. In this and other works, a higher unit value is used as a measure of higher quality. Bugamelli et al. (2010) find that import competition from China affects Italian firms' pricing strategies, causing a reduction in prices and markups in less technologically advanced sectors. They also find a higher negative effect in prices for less productive firms within sectors. Martin and Méjean (2011) find that French firms increased the average quality of their products by 11% during 1995 through 2005 in response to low-wage country exports to third markets. However, their work, an extension of the Harrigan and Barrows (2009) framework but at

[4]See Khandelwal (2010). In that sense, a liberalization with a developed country, where the taste for quality is bigger than a developing country, give more chances of increasing the quality and more productive firms are able to recover the fixed cost of increasing the quality.

the firm level, assumes that firms are not able to change their product quality and that all quality changes are due to the composition of their high and low quality exports.[5] The present research, unlike these previous papers, considers a heterogeneous firm's quality upgrading reaction when the firm is exposed to tougher competition in a third market, and it is estimated empirically using Peruvian customs data and a survey of Peruvian manufactures.

The contribution of this paper is to show that firms from developing countries can also compete against low-price products by vertical differentiation when the cost of this differentiation is not expensive or if the firm has the ability to develop quality.[6] In the case of apparel goods, the use of better inputs such as high quality cotton and better designs permits firms to differentiate their products vertically, avoiding lower prices, which can take firms out of export markets. The lesson from this study can be applied in other industries where there is space for quality differentiation and the adoption of better quality is not so expensive. The quality upgrading strategy could smooth labor transition between industries for sectors exposed to low-price product competition.

The quality upgrading decision involves improvements along the supply chain. In that sense, under the presence of market failures, coordination problems, or incomplete contracts, there is the possibility of developing an apparel cluster, which permits firms to integrate with other parts of their supply chain in order to get higher quality inputs. If it is the presence of high sunk cost or the high cost of hiring fashion designers that allows only large firms to improve their quality, public policy actions can be oriented to subsidize or coordinate these expenditures.

[5] In that sense if the market share of the higher unit value exporters increases relative to the lower unit value exporters, then the average quality increases. This methodology can erroneously suggest an increase in quality even if in fact the firms have even reduced their quality but the market share of higher unit value exporters increases relative to the lower unit value exporters.

[6] This idea is also developed by Hallak and Sivadasan (2011).

2 Motivation

2.1 Interviews with Peruvian Apparel Managers and Apparel Imports in the US Market

The main motivation for this research is the early work, "Potencial y Limitantes de las Exportaciones No Tradicionales" (BCRP, 2008) which studies the potential and the limitations of Peruvian manufacturing exports. According to this document, Peruvian apparel firms had been exporting higher quality clothes in recent years.[7] Interviews with Peruvian apparel managers revealed that this behavior was in response to tougher competition from low-price but standard apparel goods exported from China and India. The US is one of the most important destinations for apparel exporters, making it the best market for analyzing some recent trends in apparel products. Figure 2 (graph A) shows the market share evolution of the four main groups of apparel exporters to the US. These four groups include, with the exception of two African countries, the 34 most relevant apparel goods providers to the US between 1996 and 2012.[8] The graph shows that China's market share has increased rapidly since 2001 and even faster since 2005, when the last stage of the Multifiber Agreement (MFA) was executed. At the same time, the market share of apparel exports from high-and middle-income countries decreased approximately 15 percent between 1995 and 2007. In the same direction, the market share of low-income Latin American exporting countries, mainly Central American countries, decreased only after 2002.[9] Different from the high-and middle-income apparel exporters, Central American countries still had competitive wages and the strategic advantage of being located closer to the US market, which permitted them to respond more quickly to changes in the market demand conditions Evans and Harrigan (2005). Looking at graph

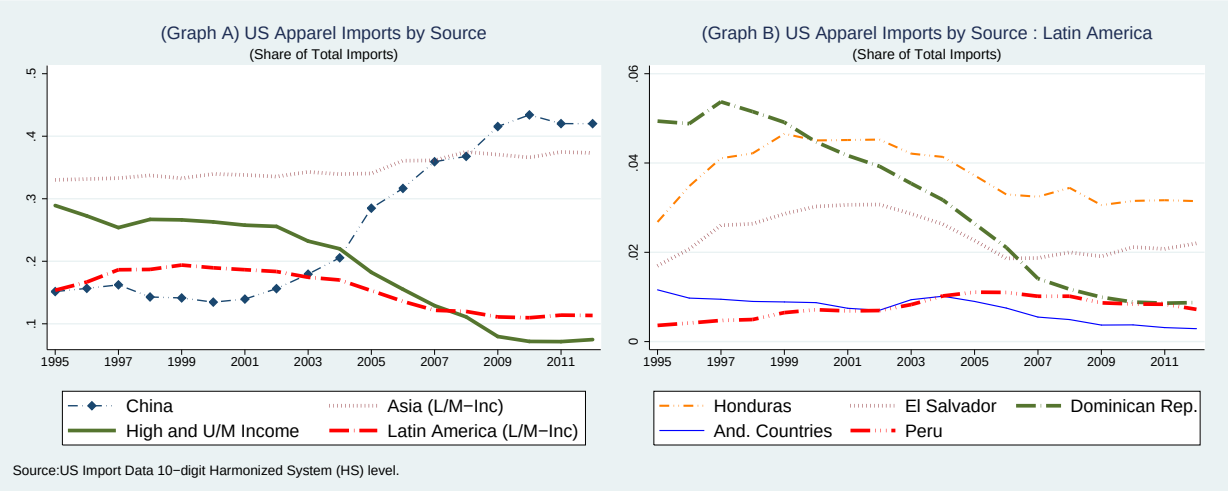
[7] Potencial y Limitantes de las Exportaciones No Tradicionales, page 36 paragraph 5. (Central Bank of Peru, 2008) http://www.bcrp.gob.pe/docs/Publicaciones/ Notas-Estudios/2008/Nota-Estudios-15-2008.pdf

[8] Kenya and Lesotho.

[9] One factor which explains the higher market share of Central American countries before 2003 was the US-Caribbean Basin Trade Partnership Act (CBTPA) signed in 2000. The agreement included an increase on textile tariff preferences for Central American and Caribbean countries.

B of Figure 2, almost all of the low-middle income Latin American exporters reduced their market share, Peru being an exception. Peru is a developing economy with an average GDP per capita of US$2300 from 1996 to 2006, close to other main Latin American apparel exporters to the US, including the Dominican Republic (US$2700), El Salvador (US$ 2300), and Guatemala (US$1900).[10]

Figure 2: **US Apparel Imports by Source**



Also, the tougher competition from low-middle income Asian countries and the gradual increase of quotas put pressure on apparel prices to fall. Harrigan and Barrows (2009) find that after the last stage of the MFA, the price of those products which were constrained by the quotas decreased considerably from 2004 to 2005.[11] Table 1 reports the estimates of the country fixed effects of a regression of the logarithm of the price of each HS10 apparel product exported for each country during 2001 and 2007 on product and country-time fixed effect. I choose this period after taking into account the year of China accession to the WTO and the Great Recession of 2008. The absolute change in the estimated country-time fixed effect is negative for China and for some of the low and middle income Asian countries during this period. Similar estimates are reported for the main Latin American exporting countries except Peru, Honduras and Guatemala. From these estimates, the difference in the price change of Peruvian apparel goods and those

[10]Source: World Development Indicators. GDP measured in current US dollars.

[11]For example, in the case of Chinese textiles subject to a binding quota in 2004 prices decreased 38 percent from 2004 to 2005.

exported by the main Latin American exporting countries is also positive. The latter implies that the average price of a Peruvian product also increases relative to the average price of these countries.

Table 1: **Average Price of the Main Apparel Exporters to the US**

	Estimated Country-Time Fixed Effects			
	Country	2001	2007	Change (2001-2007)
L/L-M Income Asian countries	**CHN**	**-0.48**	**-0.89**	**-0.41**
	KEN	-0.76	-0.86	-0.10
	PHL	-0.38	-0.47	-0.09
	PAK	-1.02	-1.07	-0.05
	BGD	-0.83	-0.87	-0.04
	EGY	-0.40	-0.43	-0.03
	IND	-0.47	-0.45	0.02
	IDN	-0.54	-0.51	0.02
	KHM	-0.58	-0.53	0.04
	LKA	-0.50	-0.34	0.16
	THA	-0.47	-0.28	0.20
	JOR	-0.72	-0.47	0.25
	VNM	-1.27	-0.59	0.68
L/L-M Income Latin American countries	**HTI**	-0.42	-0.94	-0.53
	SLV	-0.38	-0.43	-0.05
	NIC	-0.50	-0.53	-0.03
	DOM	-0.47	-0.48	-0.02
	GTM	-0.54	-0.50	0.04
	HND	-0.55	-0.50	0.05
	PER	0.11	0.23	0.12
	COL	-0.02	0.20	0.22
H/U-M Income countries	**KOR**	-0.48	-0.89	-0.41
	MYS	-0.23	-0.36	-0.13
	MAC	-0.25	-0.09	0.16
	MEX	-0.17	0.00	0.17
	ISR	0.18	0.40	0.22
	CRI	-0.24	0.02	0.26
	SGP	-0.13	0.24	0.37
	ITA	0.79	1.19	0.40
	PRT	0.36	0.79	0.42
	GBR	0.69	1.12	0.43
	TUR	-0.41	0.06	0.47
	FRA	0.82	1.31	0.48
	BRA	-0.09	0.40	0.49

Notes: 1/ World Bank country classification by level of Income between 2001 and 2007 .

2.2 Estimating the Average Quality Change in Apparel Products using US Apparel Imports

As a first step in calculating the average quality change in Peruvian apparel products in response to low-cost Chinese apparel products, I follow Amiti and Khandelwal (2013) framework. I calculate the unobserved quality per product using information from the Annual Survey of Manufactures (ASM) and the 10-digit HS code level of US imports and exports. I then I estimate the average apparel quality change per country from 2001 to 2007. According to their procedure, and keeping their notation, I estimate the following

equation:

$$ln(s_{cht}) - ln(s_{0t}) = \lambda_{1,ch} + \lambda_{2,t} - \alpha p_{cht} + \sigma ln(vs_{cht}) + lnpop_{ct} + \lambda_{3,cht}, \quad (1)$$

where s_{cht} represents the share of product h imported from county c in industry I (6-digit level of North American Industry Classification System (NAICS)) at time t in the US. s_{0t} is the "outside option" for the consumer; in this case, the market share of US producers of product in industry I. p_{cht} is the price of product h imported from country c, and vs_{cht} represents the share of country c in US total consumption of product h (10-digit HS code level). Finally, to control for the fact that larger countries generally export more varieties, which cannot be distinguished at the 10-digit product disaggregation level, I follow Amiti and Khandelwal and include the population in country c at time t , pop_{ct}, to capture this effect.

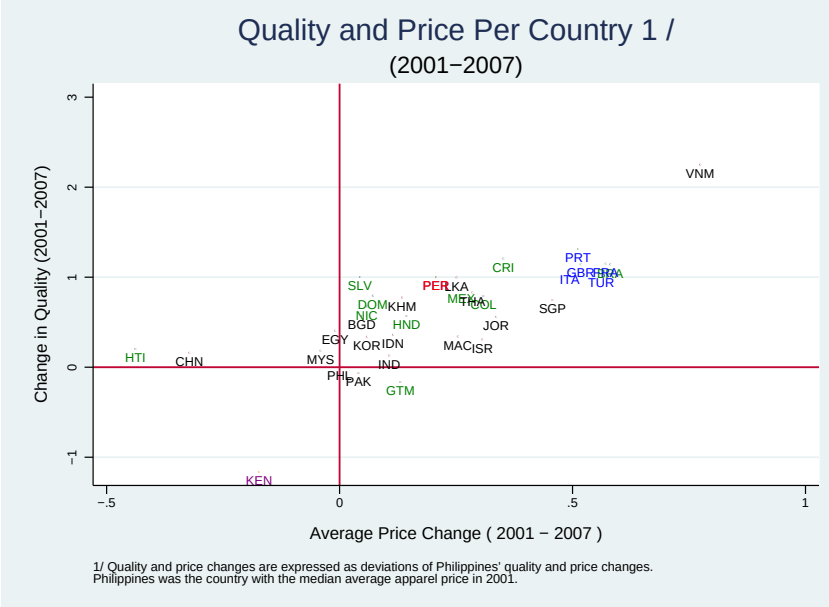
The regression from equation (1) also controls for country and product fixed effect λ_{1ch} and a time fixed effect $\lambda_{2,t}$. The resulting estimated residuals, $\hat{\lambda}_{3,cht}$, capture the qualities of the products. As well as Amiti and Khandelwal (2013) framework I use tariffs and trade costs as instruments for price, because there may exist a positive correlation between prices and quality.

The difference in the residuals, $\Delta\hat{\lambda}_{3,cht}$, measures the change in quality for a product h imported from country c between 2001 and 2007. I estimate the average quality change per country by regressing $\Delta\hat{\lambda}_{3,cht}$ on country fixed effects. Figure 3 shows the relationship between the change in the average price and the average quality during 2001 and 2007 for the top apparel exporters to the US.[12] Both axes are expressed as deviations with respect to the estimates for the Philippines, the country with the median average apparel price in 2001. The graphs show the expected positive relationship between changes in price and quality since higher market shares and higher prices are only consistent with positive changes in quality. All of the European countries show a positive change in quality. There

[12]To calculate the average price per country in apparel products, I regress the logarithm of the price of each HS10 apparel product exported to the US during 2001 and 2007 on product and country-time fixed effects.

are similar results in some of the Latin American countries, whereas most of the Asian countries, with the exception of Vietnam, present smaller changes in quality and prices.

Figure 3: **Quality and Price**



3 Heterogeneous firms

The recent literature of heterogeneous firms suggests firms follow different quality upgrading/downgrading strategies after a trade liberalization Antoniades (2014). Even though the change in the average quality of Peruvian apparel exports was positive between 2001 and 2007, this change might imply heterogeneous quality upgrading decisions across firms. In the next section I describe a model that explains different quality upgrading strategies of firms in reaction to competition from low-price and low-quality goods.

3.1 Model

The model considers a representative consumer with quasilinear preferences for J different varieties of one good. The consumer has different quality preferences within varieties but similar preferences between varieties. Firms from two countries, Home and Foreign,

produce only one variety of a good, which also differs in quality. These variety-quality pairs are exported to a third country; or, to generalize, the rest of the world.

Consumers

There is a representative consumer in the rest of the world with quasilinear J preferences who can buy different varieties (e.g. colors) of one good (e.g. t-shirts) and for each variety j, three different types of qualities: low ($y_{j,l}$), medium ($y_{j,m}$), and high quality ($y_{j,h}$). The utility that the consumer gets from different qualities of the variety j is the following:

$$W_j = \alpha_l y_{j,l} - \frac{1}{2}\beta_l y_{j,l}^2 + \alpha_m y_{j,m} - \frac{1}{2}\beta_m y_{j,m}^2 + \alpha_h y_{j,h} - \frac{1}{2}\beta h y_{j,h}^2 - \gamma y_{j,l} y_{j,m}$$

The parameters α_l , α_m and α_h are the qualities associated with each type of variety y_l, y_m and y_h, respectively, with $\alpha_l < \alpha_m < \alpha_h$; $\beta_h < \beta_m < \beta_l$ and $\beta_m\beta_l - \gamma^2 > 0$. According to these preferences, the low, l, and medium, m, quality varieties are imperfect substitutes within varieties because of the presence of the parameter γ, whereas the demand for the high quality variety, h, is independent of the other two qualities of the same variety. Additionally, given the quasilinear preferences, the demand for any variety j is independent of any other variety $j^{'}$. Finally, the quasilinear utility function of the representative consumer can also be expressed as:

$$U = \sum_{j \epsilon J} W_j + z.$$

The demand of the representative consumer for each type of variety low, medium and high is given respectively by:[13]

$$y_{_l} = \frac{\beta_m \alpha_{_l} - \gamma\alpha_m}{\beta_{_m}\beta_l - \gamma^2} - \frac{\beta_m}{\beta_m\beta_l - \gamma^2} p_{_l} + \frac{\gamma}{\beta_m\beta_l - \gamma^2} p_{_m};$$

[13]Given that consumers have quasilinear preferences, I assume that the representative consumer has a positive consumption of the numeraire good.

$$y_m = \frac{\beta_l \alpha_m - \gamma \alpha_l}{\beta_m \beta_l - \gamma^2} - \frac{\beta_l}{\beta_m \beta_l - \gamma^2} p_m + \frac{\gamma}{\beta_m \beta_l - \gamma^2} p_l;$$

and

$$y_h = \frac{\alpha_h}{\beta_h} - \frac{p_h}{\beta_h}.$$

The market demand for each quality variety is given by the corresponding representative consumer's demand times the size of the rest of the world, L. I normalize L to 1 for simplicity in order to keep the notation simple.

Firms

Each firm in country H (Home) and in country F (Foreign) produces one variety (color) of a good. Firms from both countries export all of their production to a third country, X or in general, the rest of the world (ROW). Also, firms must choose one of three different types of qualities for their variety: high, medium and low quality. There exists a large set of varieties J (colors) that can be produced, but each firm only produces one variety-quality pair which differs from another firm's variety.

Firms in country H are heterogeneous in productivity. After paying a fixed market entry fee, F_E^H , firms in country H draw a productivity parameter that determines their marginal cost, c. The distribution of c is $G(c)$ with support on $[0, c_{max}]$.

The production of each type of quality involves different levels of fixed costs, which also differ across countries. The investment cost associated with each type of quality in each country is increasing in the level of quality; therefore $F_h^c > F_m^c > F_l^c$, for $c = H, F$. I assume that firms in country F do not have the technology for producing medium and high-quality varieties. Equivalently, I can assume that the fixed costs F_m^F and F_h^F are high enough to that forces firms in country to produce only low-quality varieties. Conversely, I assume that firms in country H only produce medium-or high-quality varieties.[14]

Finally, I assume that all firms in country F are equally productive, with a marginal

[14]This assumption can be replaced by a result of the model if the profits of producing the lowest quality variety in country H are dominated by the profits of producing varieties of the two other qualities for any level of productivity. I can also assume that $F_m^H \simeq F_l^H$ so firms in home country always prefers to produce medium quality goods rather than low quality goods.

cost equal to c^F. Since I am only interested in the effect of lower prices of foreign goods on home country firms' profits, this assumption is not restrictive.

Home Country Firm Maximization Problem

Firms in the home country produce the medium-or high-quality varieties.

a. Producers of a high quality variety, y_h. From the consumer maximization problem, a producer of this type of quality-variety good is a monopolist because the demand for their type of variety depends only on its own price:

$$y_h = \frac{\alpha_h}{\beta_h} - \frac{1}{\beta_h} p_h$$

Profits from producing a high-quality variety for firm i with marginal cost c_i are:

$$\pi_h = (\frac{\alpha_h}{\beta_h} - \frac{p_h}{\beta_h})(p_h - c_i) - F_h^H$$

and the optimal price that maximizes monopolist's profits and its corresponding profits are respectively:

$$p_h = \frac{\alpha_h + c_i}{2},$$

and

$$\pi_h = \frac{1}{4\beta_h}(\alpha_h + c_i)^2 - F_h^H.$$

b. Producers of medium quality variety, y_m. From the consumer maximization problem, the corresponding demands for low-, y_l, and medium-, y_m, quality varieties are:

$$y_l = A - b_1 p_l + b_3 p_m$$

and

$$y_m = D - b_2 p_m + b_3 p_l$$

where $A = \frac{\beta_m \alpha_l - \gamma \alpha_m}{\beta_m \beta_l - \gamma^2}$; $D = \frac{\beta_l \alpha_m - \gamma \alpha_l}{\beta_m \beta_l - \gamma^2}$; $b_1 = \frac{\beta_m}{\beta_m \beta_l - \gamma^2}$; $b_2 = \frac{\beta_l}{\beta_m \beta_l - \gamma^2}$ and $b_3 = \frac{\gamma}{\beta_m \beta_l - \gamma^2}$.

The demand for a medium-quality variety, which is only produced in country H, also depends on the price of the low-quality variety which is only produced in country F. Firms of these two types of quality-varieties compete in a Bertrand competition, selling their products in a third country. The corresponding profits for each firm from producing a low-quality variety, y_l, or medium-quality variety, y_m, in countries F and H, respectively are:

$$\pi_l^F = (A - b_1 p_{_l} + b_3 p_m)(p_{_l} - c^F) - F_l^F$$

and

$$\pi_{m,i}^H = (D - b_2 p_{_m} + b_3 p_l)(p_{_m} - c_i) - F_m^H$$

Profits from producing the low-quality variety, produced exclusively in country F, are decreasing in the marginal cost of producing them, c^F.[15] Similarly, profits for firm i in country H from producing the medium-quality variety are decreasing in the marginal cost of producing them, c_i.

The corresponding firm's reaction functions for producing a low-quality variety in country F and medium quality in country H are:

$$p_{_l} = \frac{A}{2b_1} + \frac{b_3 p_{_m}}{2b_1} + \frac{c^F}{2} \quad and \quad p_{_m} = \frac{D}{2b_2} + \frac{b_3 p_{_l}}{2b_2} + \frac{c_i}{2}.$$

The correspondent profits for producing each type of quality are:

$$\pi_l^F = b_1 \left(\frac{2Ab_2 + Db_3 + b_2 b_3 c_i - (2b_1 b_2 - b_3^2)c^F}{4b_1 b_2 - b_3^2} \right)^2 - F_l^F$$

$$\pi_{m,i}^H = b_2 \left(\frac{2Db_1 + Ab_3 + b_1 b_3 c^F - (2b_1 b_2 - b_3^2)c_i}{4b_1 b_2 - b_3^2} \right)^2 - F_m^H$$

[15] I intentionally omit the subscript for the foreign firms because all of them share the same marginal cost.

Which firms produce medium and high quality varieties in country H?

Given the values of the parameters $\alpha_l, \alpha_m, \alpha_h, \beta_l, \beta_m, \beta_h$ and γ, the threshold that determines which firms produce the high-or the medium-quality varieties is defined by the marginal cost c_i, which makes a home country firm i indifferent between producing any of these two types of varieties:

$$\pi(i)_h^H = \pi(i)_m^H$$

Then, the marginal cost cut-off for producing the high-quality variety, c_h^*, is defined by:

$$\frac{1}{4\beta_h}(\alpha_h + c_i)^2 - F_h^H = b_2\left(\frac{2Db_1 + Ab_3 + b_1b_3c^F - (2b_1b_2 - b_3^2)c_i}{4b_1b_2 - b_3^2}\right)^2 - F_m^H,$$

whereas the marginal cost cut-off for producers of the medium quality, c_m^*, is defined by the marginal cost that makes zero profits:

$$\pi(i)_m^H = b_2\left(\frac{2Db_1 + Ab_3 + b_1b_3c^F - (2b_1b_2 - b_3^2)c_i}{4b_1b_2 - b_3^2}\right)^2 - F_m^H = 0.$$

Given the parameters, more productive firms produce high quality varieties, because their lower per-unit cost permits them to recover the higher fixed cost of producing high-quality varieties. Figure 4 (graph A) depicts the cut-offs for each type of quality.

Effect of a Reduction in the Low-Quality Variety Price

Suppose that firms in country F have to pay a per-unit tariff, τ^F, to sell their goods in the rest of the world. Then, a tariff reduction to foreign firms allows them to sell their products at lower prices. The optimal price for the low-quality producers in country F is:

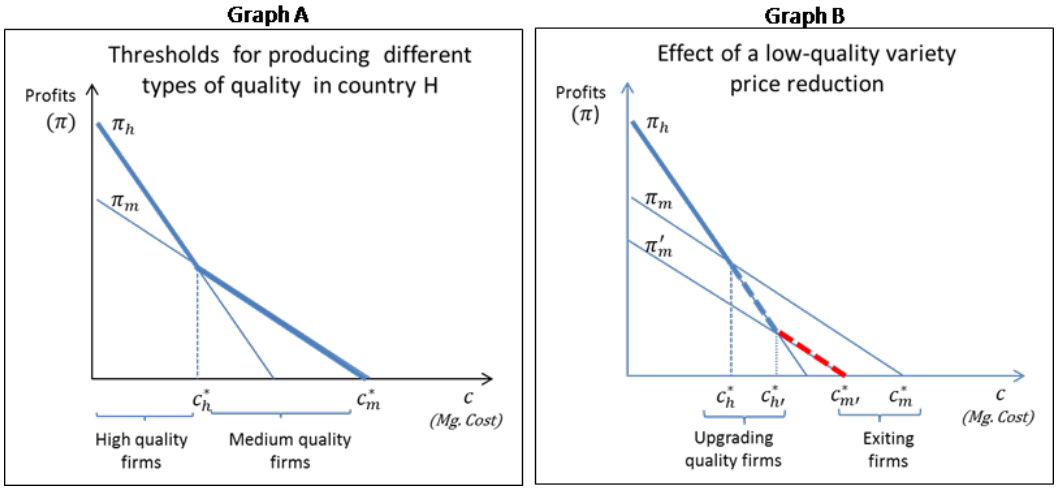
$$p_l = \left(\frac{A}{2b_1} + \frac{b_3D}{4b_1b_2} + \frac{b_3c_m^H}{4b_1} + \frac{c^F + \tau^F}{2}\right)\left(\frac{4b_14b_2}{4b_1b_2 - b_3^2}\right),$$

and the derivative with respect to the tariff, τ^F, is:

$$\frac{\partial p_{_l}}{\partial \tau^F} = \frac{2b_1 b_2}{4b_1 b_2 - b_3^2} > 0$$

since by assumption $\beta_m \beta_l - \gamma^2$.

Figure 4: **Productivity Thresholds**



The effect of a lower tariff for foreign firms, τ^F, on firms producing in country H is depicted in Figure 4 (graph B). The lower tariff and the corresponding lower price of low-quality varieties, p_l, reduces the profits from producing medium-quality varieties in country H (see appendix 1). The least productive firms make negative profits and they stop producing. The new cut-off for producing a medium-quality variety in country H changes from c_m^* to $c_{m'}^*$. The more productive firms among those producing medium-quality varieties (firms whose marginal cost are between c_h^* and $c_{h'}^*$ switch to the production of high-quality varieties to avoid lower profits due to the price competition. Finally, the group of firms with marginal costs between $c_{h'}^*$ and c_m^* keep producing the medium-quality varieties at lower prices and make lower profits. This reallocation in firms' quality production increases the average quality of the varieties produced in country H.

4 Data and Empirical Strategy

I use information on Peruvian apparel exports provided by the Superintendencia Nacional de Administracion Tributaria (SUNAT). This dataset is classified at the 6-digit HS for all trading partners. Each observation in the raw data contains information on the exporting firm, the importing country and the total weight and f.o.b. value for each exported item. I use information for Chinese exports by destination and product at HS6-digit level from Trademap.[16] Table 2 presents some summary statistics of Peruvian apparel exports between 2000 and 2008. There is a significant increase in the number of exporting firms and the total exported value during this period, as well as in the average number of exported products per firm. The average number of destinations and firms per product increased considerably during this period as well.

[16] http://www.trademap.org/SelectionMenu.aspx

Table 2: **Peruvian Exports, summary statistics at 6-digit product level 1/**

Year	# of Firms	# of Products	Average # of products p/firm	Average # of firms p/product	Average # of destinations p/firm	Average # of destinations p/product	Total Exported Value (Millions of US$)	Total Exported Weight) (Millions of KG.)
2000	415	234	7.9	14.1	3.1	6.9	504.9	22.9
2001	536	222	9.1	22.0	2.7	8.4	506.0	23.8
2002	626	253	9.3	23.0	2.6	7.7	537.1	26.7
2003	725	257	9.1	25.8	2.5	8.7	657.5	28.7
2004	827	261	10.2	32.2	2.6	10.0	891.4	39.0
2005	1024	268	11.0	41.9	2.5	10.9	1069.8	43.0
2006	1148	271	11.4	48.1	2.5	11.9	1220.7	47.4
2007	1220	274	10.7	47.8	2.6	11.7	1440.1	51.7
2008	1458	279	10.0	52.4	2.5	12.5	1736.8	60.1

Notes: 1/ This calculus do not consider any registered export in the data (firm-product-destination-year) below US$ 5000.

4.1 Empirical Strategy

In this section I describe the empirical strategy for testing one of the main implications derived from the model: bigger and more productive firms stayed in the market, but with higher quality products and higher prices. This implication is evaluated by estimating the following regression:

$$\Delta P_{pf(q)ct} = \beta_1 \Delta Comp_{pct} + \sum_{q=2}^{5} \beta_q d_q \Delta Comp_{pct} + \Delta\alpha_{ct} + \Delta e_{pf(q)ct}, \tag{2}$$

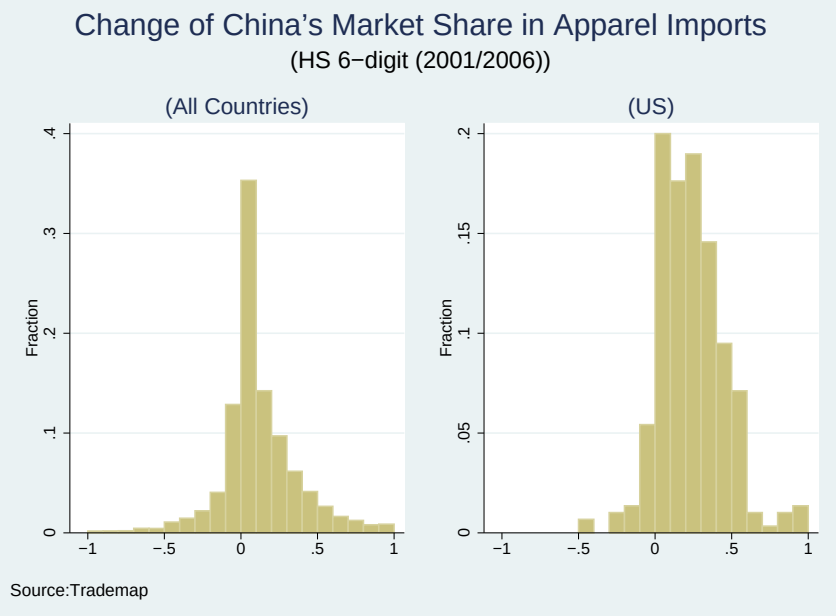
where $\Delta P_{pf(q)ct}$ represents the change in unit values (quality) of product p exported by firm f, which belongs to quantile q, to country c during 2001 and 2007.[17] $\Delta Comp_{pct}$ captures the competition of Chinese products and is measured as the change in the Chinese share of total imports of product p to country c during 2001 and 2006. Figure 5 depicts the change in China's market share in apparel imports from the rest of the world and in the US. δ_q is a dummy variable that equals 1 if the firm belongs to the quantile q . Finally, $\Delta\alpha_{ct}$ accounts for any difference in aggregate shocks between period $t-1$ and t, i.e. during 2001 and 2007 in country c. A large value of β_q as q increases suggests that more productive firms increased the quality of their products and were therefore able to charge a higher price. To evaluate heterogeneous quality upgrading decisions I test $\beta_5 - \beta_2 > 0$, $\beta_4 - \beta_2 > 0$, and $\beta_3 - \beta_2 > 0$.

I use unit values as a proxy for quality even though higher unit values could be capturing higher market power instead of higher quality. Despite this potential pitfall, the use of unit values of domestic or exported products as a proxy for quality is a common convention in the literature.[18] I trim unit values in order to avoid the effect of outliers in the final estimates. In particular, I regress the unit value (price) of product exported to country on product and country fixed effects and use the resulting residuals. I drop observations that have residuals outside of the $1^{st}-99^{th}$ confidence interval of the empirical

[17] As I mention earlier, I choose this period after taking into account the year of China accession to the WTO and the Great Recession of 2008.

[18] Fernandes and Paunov (2010); Iacovone and Javorcik (2012); and Kugler and Verhoogen (2012).

Figure 5



distribution of the error term. Finally, to evaluate how different firms behaved differently, firms are classified by their level of productivity.

I use firm sales as a proxy for productivity, as has been previously used in the literature.[19] Particularly, I classify firms in five different quantiles, with the first quantile being the smallest and the fifth being the largest. The quantiles are calculated based and weighted on firm sales; therefore, not all the quantiles have the same number of firms. I calculate the maximum annual level of exports of each firm between 2000 and 2010 and then classify the firm in one of the five quantiles. I eliminate from the sample any reported export value which is less than US$ 5000.

[19] Aitken et al. (1997); Roberts and Tybout (1997);Bernard and Jensen (2004); Hanson and Xiang (2008); Helpman et al. (2008); Helpman et al. (2008); Eaton et al. (2011); Chaney (2008), and Crozet and Koenig (2010).

5 Results

5.1 Quality Upgrading

Table 3 reports the estimates for equation (2) . The first 6 columns use information about apparel exports to the top 32 destinations, which covers 99 percent of total Peruvian apparel exports, whereas the last 3 columns of the same table consider only products exported to the US, the main destination of Peruvian apparel exports.[20]

As is expected, columns 1 to 4 show a negative effect of $\Delta Comp_{pct}$ (or the competition shock) on the price of Peruvian apparel products. However, the estimates of the interaction of $\Delta Comp_{pct}$ and d_q (or the firm size q) show different quality upgrading strategies by firm size. According to the estimates in columns 1-3 of Table 3, firms in the third and fourth quantiles show a net positive effect of the competition shock on product prices.

[20]The destination countries are: Argentina, Australia, Belgium, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Finland, France, Germany, Guatemala, Honduras, Hong Kong, Ireland, Italy, Japan, Luxembourg, Mexico, Norway, New Zealand, Netherlands, Panama, United Kingdom, Singapore, South Korea, Spain, Sweden, Switzerland, United States, Venezuela.

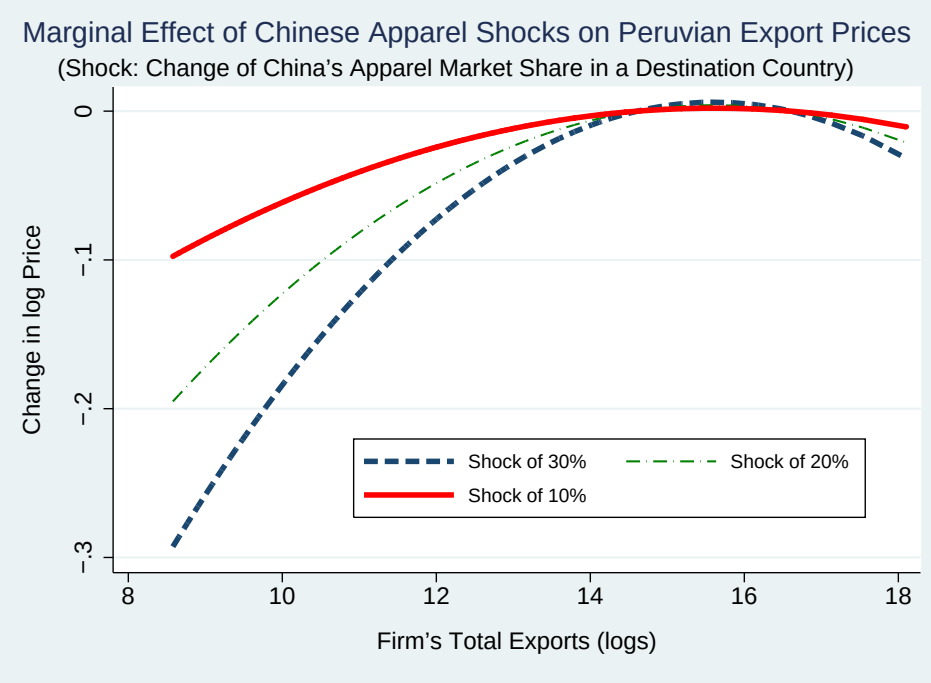
Table 3: **Competition and Quality Upgrading**
Dependent Variable: Change in log Price (2001-2007)

	Full Sample						**US**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Competition Shock	-0.548***	-0.572***	-0.404**	-0.320**	-3.961**	-4.892***	-0.615***	-4.788**	1.136
	(0.128)	(0.127)	(0.172)	(0.134)	(1.648)	(1.695)	(0.139)	(1.874)	(2.023)
(F.size 2)*(Competition Shock)	0.365**	0.345**	0.306**	0.117			0.369**		
	(0.155)	(0.150)	(0.150)	(0.218)			(0.162)		
(F.size 3)*(Competition Shock)	0.594***	0.608***	0.530***	0.177			0.523***		
	(0.157)	(0.161)	(0.158)	(0.204)			(0.149)		
(F.size 4)*(Competition Shock)	0.663***	0.698***	0.664***	0.312			0.854**		
	(0.225)	(0.231)	(0.243)	(0.237)			(0.336)		
(F.size 5)*(Competition Shock)	0.411***	0.393***	0.314**	0.241			0.415**		
	(0.148)	(0.145)	(0.157)	(0.170)			(0.160)		
(Firm size)*(Competition Shock)					0.500**	0.629**		0.586**	-0.235
					(0.241)	(0.248)		(0.276)	(0.297)
(Firm size square)*(Competition Shock)					-0.0158*	-0.0202**		-0.0180*	0.0100
					(0.00866)	(0.00885)		(0.0101)	(0.0108)
Firm size					0.0474***	0.0281		0.0592***	0.421***
					(0.00819)	(0.0240)		(0.0126)	(0.0722)
Firm size square					-0.00172***	-0.00113		-0.00239***	-0.0147***
					(0.000491)	(0.000910)		(0.000774)	(0.00239)
Observations	1,321	1,321	1,321	1,321	1,321	1,321	546	546	546
R-squared	0.391	0.408	0.427	0.412	0.404	0.407	0.469	0.460	0.475
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-
HS2 FE	No	Yes	No	Yes	No	Yes	Yes	No	Yes
HS4 FE	No	No	Yes	No	No	No	No	No	No
Firm Size FE	No	No	No	Yes	-	-	No	-	-

Notes: Country-product clustered standard errors in parenthesis. in parentheses with ***,** ,* respectively denoting significance at the 1%, 5% and 10% levels.

This effect is consistent with the production of higher quality products. Table 3 also shows the results of a formal test of heterogeneous responses to the competition of Chinese apparel products by firm size. The null hypothesis of equal price reaction from both large and small firms is rejected, supporting the idea that more productive firms increased their qualities more than less productive firms in response to the Chinese competition in foreign markets. The fact that firms from the third and fourth quantiles report the largest changes in prices is consistent with figure 4 (graph B), since firms with a median productivity are those that decided to increase their quality and therefore their prices.

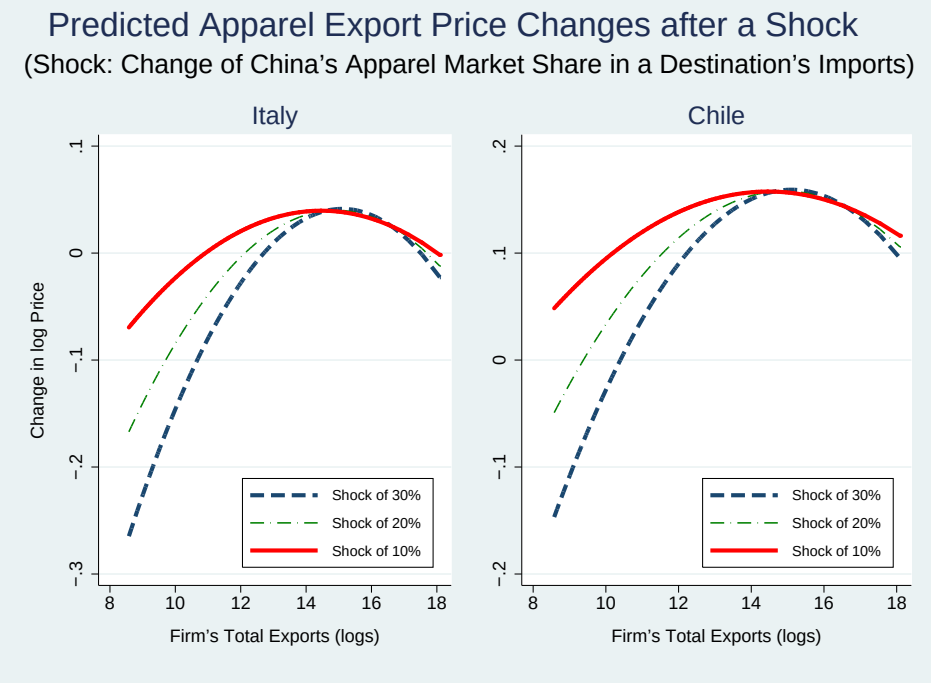
Figure 6



Another way to measure the heterogeneous response at the firm level is using a continuous measure of firm size instead of classifying firms in quantiles. The results of this specification are presented in columns 5,6,8 and 9 of Table 3 and are similar to the previous findings; bigger firms are able to increase the prices (qualities) of their products. The coefficient of the interaction term firm size and competition shock is positive and statistically significant in columns 5, 6, and 8. Using the estimates of column 6 of Table 3, Figure 6 shows the heterogeneous impact of the competition shock depending of the firm size (firm's total exports). After some threshold, the effect of the competition on

firm's export prices stops being negative. Figure 7 shows the same marginal effect on prices of products exported to Chile and Italy.

Figure 7



5.2 Input Prices: Intermediate Inputs

There is empirical evidence of quality upgrading strategies in response to import competition; however, many of these papers use only the change in unit values to infer changes in quality. However, changes in product quality should also be consistent with changes in the quality of inputs used by firms (Verhoogen (2008);Kugler and Verhoogen (2012)). Then, it should also be the case that more productive firms switched to the use of higher quality inputs during 2001 and 2007. This higher demand for high quality inputs in turn, would lead to an increase in these input prices. To formally estimate a heterogeneous change in input prices by firm size, I use information on apparel inputs collected by the Instituto Nacional de Estadistica e Informatica (INEI) in the annual survey Encuesta Economica Anual (EEA) from 2001 to 2008. One chapter of the survey collects information on input prices from exporting and non-exporting apparel firms. These firms report the name of

the input they bought during the previous year, the number of units and the price per unit of each input. Some common inputs in the survey are cotton (Tanguis, Pima, others), buttons, elastics, labels and threads. Unfortunately, not all firms answered the survey during the whole period of analysis, reducing the number of observations in the sample. Like the previous section, I classify firms in five quantiles based on their total sales. Even though I am not able to join this data set with the customs data to evaluate the direct impact of the Chinese competition shock, according to Table 4, the average export by quantile in the two sources is quite similar.

Table 4: **Descriptive Statistics by Firm Size**

	Custom Data				EEA Survey					
Quantile	Avg. Firm Exports US$		Stock of Capital US$		Avg. Firm Exports US$		Avg. Number of Workers Full Sample		Avg. Number of Workers Exporters	
	2001	2007	2001	2007	2001	2007	2001	2007	2001	2007
1	47,768	48,618	66,400	73,574	145,028	166,663	6.8	8.0	3.2	13.7
2	228,694	268,897	67,919	63,670	214,615	187,279	18.8	12.1	18.3	13.6
3	449,938	1,039,879	81,522	77,548	345,330	1,003,901	34.7	36.1	30.6	39.5
4	1,703,756	4,689,059	129,467	132,228	1,589,092	4,111,254	123.7	174.5	133.3	187.8
5	15,626,960	34,703,150	1,386,464	2,109,372	15,339,800	26,446,130	408.8	333.4	427.4	338.5

The following equation estimates the average effect of firm size, $\alpha_{f(s)}$, on the change in the price of input i, measured in units u, used by firm of size s, $\Delta Price_{iuf(s)}$, between 2001 and 2007, after controlling for input and unit of measure fixed effects.

$$\Delta Price_{iuf(s)} = \alpha_{f(s)} + \alpha_i + \alpha_u + e_{iuf(s)} \tag{3}$$

Table 5 reports the estimates of equation (3). It shows an increasing average effect by firm size, $\alpha_{f(s)}$, implying that more productive firms (larger firms) pay more for their inputs. This result is consistent with the quality upgrading decision taken by more productive firms. Also, according to the test reported in the same table, the estimated fixed effects $\alpha_{f(s)}$ are statistically different between bigger (quantiles 3, 4, and 5) and smaller firms (quantiles 1 and 2). Similarly to the previous section, I also estimate the same regression with $FirmSize$ as a continuous variable, and the results reported in columns 3 and 4 of Table 5 are consistent with the previous findings.

Table 5: **Inputs: Quality and Productivity**
Dependent Variable Change in the log price of input (i) (2001-2007)

	(1)	(2)	(3)	(4)			
	Exp.	**Full**	**Exp.**	**Full**	**Tests**		
F. size 1	0.104	-0.886***			**Null**		**Full**
	(0.392)	(0.240)			**Hypothesis H0:**	**Exp.**	**Sample**
F. size 2	0.237	-0.888***				Prob	Prob
	(0.420)	(0.224)			F. size 3 ¡= F. size 1	0.33	0.43
F. size 3	0.181	-0.874***			F. size 4 ¡= F. size 1	0.09	0.16
	(0.437)	(0.215)			F. size 5 ¡= F. size 1	0.04	0.05
F. size 4	0.336	-0.807***					
	(0.398)	(0.223)			F. size 3 ¡= F. size 2	0.65	0.42
F. size 5	0.392	-0.756***			F. size 4 ¡= F. size 2	0.22	0.14
	(0.407)	(0.223)			F. size 5 ¡= F. size 2	0.09	0.03
Firm Size (logs)			0.0346*	0.0223*			
			(0.0190)	(0.0119)			
Observations	248	479	248	479			
R-squared	0.557	0.440	0.547	0.436			
Product FE	Yes	Yes	Yes	Yes			
Units FE	Yes	Yes	Yes	Yes			

Notes: Full regressions include exporters and domestic firms. Robust standard errors in parentheses in parentheses with ***,** ,* respectively denoting significance at the 1%, 5% and 10% levels.

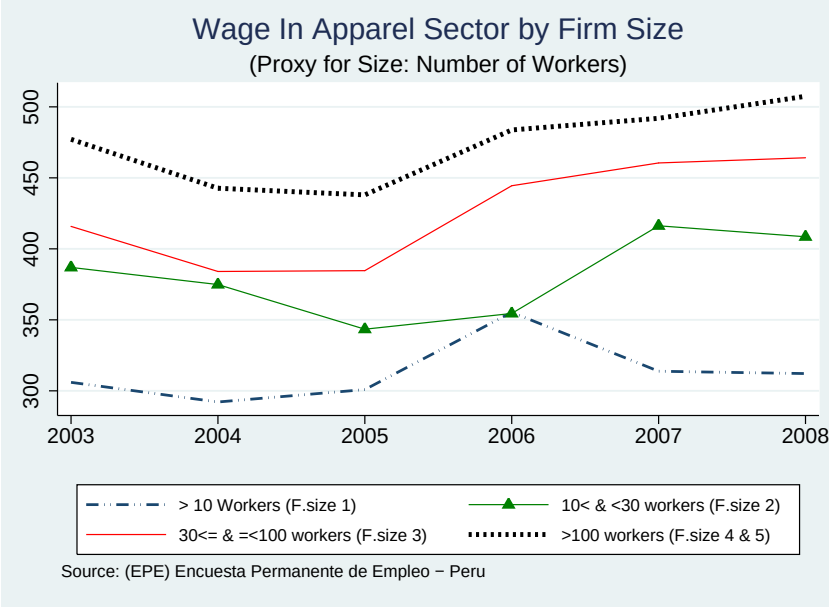
5.3 Other Inputs

Wages: One of the main inputs in the apparel industry is labor. I use information on wages reported by workers in the Encuesta Permanente de Empleo (EPE), which is also collected by the INEI, to calculate the change in the average wage per firm size. Workers report in this survey the exact number of employees in their work if the firm has fewer than 100 workers. I classify workers in four groups based on the total number of coworkers they have and to be consistent with the average number of workers by quantile from the EEA survey, which is reported in Table 4. The smallest group includes firms with 10 or fewer workers; a second group comprises employees working with more than 10 but fewer than 30 coworkers. The third group is individuals working in firms with more than 30 but fewer than or equal to 100 employees, and finally the fourth group includes workers in firms with more than 100 employees. Unfortunately, the survey does not report the exact number of workers when a firm has more than 100 employees. There is also no information about workers' occupations before 2002, so the initial year for estimating the average wage by firm size is 2002. I estimate the following equation using individual level data of occupations in the apparel sector to calculate the average wage by firm size:

$$wage_{iotf(s)} = \alpha_{f(s)t} + demog_{it} + \alpha_o + e_{iotf(s)},$$

where $wage_{iotf(s)}$ is the real wage of employee i working in occupation o in firm f of size s . The regression controls for individual demographic characteristics, $demog_{it}$, and occupation fixed effects, α_o. Then, the estimated size-time fixed effect, $\alpha_{f(s)t}$, captures the average wage per firm size. Figure 8 shows different trends for the average wage by firm size; more productive and larger firms, those in the third and fourth groups, increased their wages after 2004. A different trend is observed for small firms. Those with fewer than 10 workers registered a consistent reduction in their wages along the sample period.

Figure 8



Imports of Capital Goods: Another potential source for product quality upgrading is the acquisition of more sophisticated machines. I use information on Peruvian imports of capital goods acquired by apparel exporters, which is also provided by the Superintendencia Nacional de Administracion Tributaria (SUNAT).[21] I calculate the stock of capital in period as the stock of capital in the previous period plus investment expenditures. Since I only have information about imported capital goods, I can only use this information

[21]Imports classified in the 4-digit HS codes 8444 to 8453.

to calculate the stock of capital, and I ignore information on domestic capital goods. I consider an initial stock of capital of \$100000 when the firm was established, and I assume a depreciation rate of 10 percent per year. Then, the stock of capital at time is calculated using the following law of motion for capital:

$$K_t = (1 - \delta)K_{t-1} + I_t$$

To estimate different responses by firm size at the firm level, I first calculate a weighted average Chinese competition shock per each firm, ΔW_Comp_f.

$$\Delta W\_Comp_f = \sum_{c=1}^{c} \sum_{p=1}^{p} \left(\frac{X_{pcf}}{X_f} \right) \Delta Comp_{p,c},$$

where $\Delta Comp_{pc}$, as before, is the change in the market share of the Chinese apparel product p in country c, and the firm weights are the initial shares of product p in country c of firm f on firm $f's$ total exports, $\frac{X_{pcf}}{X_f}$. I estimate the following equation to evaluate heterogeneous responses for different firm size.

$$\Delta \log K_{f(q),2001-2007} = \sum_{q=1}^{5} \beta_q d_q \Delta W\_Comp_{f(q)} + \log K_{f(q),2001} + e_f(q), \tag{4}$$

where d_q is a dummy variable which takes the value of 1 if the firm is of size q. Column 1 of Table 6 reports the estimates of equation (4), which shows an increasing marginal effect β_q as a response to the weighted average Chinese competition shock. More productive firms, those which belong to size five, increased their stock of capital in response to the Chinese apparel shock, differently from the less productive firms (quantiles 1 and 2). Additionally, I also estimate equation (4) with the size of the firm as a continuous variable, and the results of this regression, which are reported in column 2 of Table 6, are consistent with the previous findings. The coefficient of the interaction term of the $FirmSize$ and the weighted competition shock is positive and significantly different from zero.

Table 6: **Investment:Quality and Productivity**
Dependent Variable: Change in log of the Stock of Capital
(2001-2007)

	(1)	(2)
(F.size 1)*(Weighted Comp. Shock)	-0.495**	
	(0.245)	
(F.size 2)*(Weighted Comp. Shock)	-0.421*	
	(0.236)	
(F.size 3)*(Weighted Comp. Shock)	0.697	
	(0.666)	
(F.size 4)*(Weighted Comp. Shock)	0.395	
	(0.554)	
(F.size 5)*(Weighted Comp. Shock)	6.510***	
	(1.868)	
Weighted Comp. Shock		-6.257***
		(2.137)
(Firm Size)*(Weighted Comp. Shock)		0.508**
		(0.197)
Firm Size (logs)		0.0294**
		(0.0123)
Stock of Capital in 2001 (logs)	0.00159	-0.0274**
	(0.00382)	(0.0115)
Observations	202	202
R-squared	0.197	0.136
Null Hypothesis H0:	Prob	
(F.size 3)*(Weighted Comp. Shock)¡=(F.size 1)*(Weighted Comp. Shock)	0.030	-
(F.size 4)*(Weighted Comp. Shock)¡=(F.size 1)*(Weighted Comp. Shock)	0.049	-
(F.size 5)*(Weighted Comp. Shock)¡=(F.size 1)*(Weighted Comp. Shock)	0.000	-
(F.size 3)*(Weighted Comp. Shock)¡=(F.size 2)*(Weighted Comp. Shock)	0.039	-
(F.size 4)*(Weighted Comp. Shock)¡=(F.size 2)*(Weighted Comp. Shock)	0.065	-
(F.size 5)*(Weighted Comp. Shock)¡=(F.size 2)*(Weighted Comp. Shock)	0.000	-

Notes: Robust standard errors in parentheses in parentheses with ***,** ,* respectively denoting significance at the 1%, 5% and 10% levels.

Alternative Hypothesis: Exchange Rate Appreciation and Pass-Through?

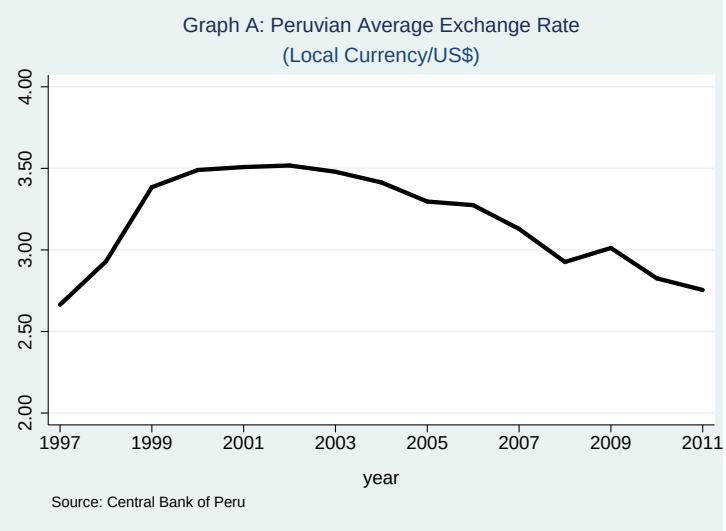
Higher changes in product prices of some group of firms is also consistent with the hypothesis of a Peruvian exchange rate appreciation and the ability of more productive (larger) firms to increase their prices to compensate for the negative effects of a lower exchange rate (pass-through) on revenues. Figure 9 shows a 10 percent appreciation of the Peruvian currency, Nuevo Sol, relative to the US dollar from 2001 to 2007. However, assuming that the exchange rate pass-through explains the heterogeneous price change during this period, I should not necessarily observe heterogeneous changes in the input prices by firm size as was depicted in the previous section.[22]

5.4 Exit Rate

According to the theoretical model, less productive firms leave the market after the competition shock from the Chinese apparel products, since these firms would produce negative profits. To evaluate this prediction I calculate the share of exiting firms by product p

[22] An exchange rate appreciation could also explain a lower price of inputs for small firms relative to large firms if the former firms are more intensive in imported inputs.

Figure 9



and country c, $ExitShare_{pc}$, which reports the percentage of firms which were exporting product p to country c at the initial period of the sample but not at the end of it.[23] I also calculate the relative average productivity at product-country level, defined as:

$$RelProductivity_{pc} = \frac{\sum_f w_f Size_{fpc}}{\sum_f w_f Size_f},$$

where w_f is the weight of firm f, and then the numerator represents the weighted average size of firms exporting product p to country c whereas the denominator is the average size of all apparel firms. Therefore if the relative productivity is greater than one, firms exporting the product-country pair (p, c) are on average more productive than the average apparel exporters and are less reluctant to exit after the competition shock. In that sense, the share of exiting firms is not only higher when the competition shock, $\Delta Comp_{pc}$, is higher, but also when there is a lower relative productivity exporting product p to country c. I estimate the following equation using a two-limit Tobit model, since the $ExitShare_{pc}$ is bounded between 0 and 1.

[23] I use the proportion of exiting firms rather than a binary variable which reports if the firm is still exporting product p to country c because larger firms export more products to more destinations. Even controlling for firm size, product and destination country, less important products for larger firms exported to less attractive destinations might be taken out of the market and small firms which produce the same product to the same destination may keep exporting its main product. The use of the share of exiting firms avoids this problem.

$$ExitShare_{pc} = \beta_1 \Delta Comp_{pc} + \beta_2 RelProductivity_{pc} * \Delta Comp_{pc} + \beta_3 RelProductivity_{pc} + \alpha_p + \alpha_c + \epsilon_{pc} \quad (5)$$

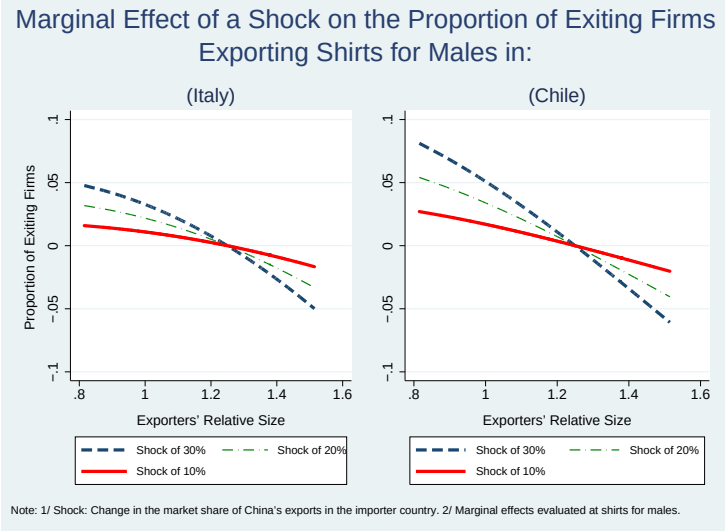
Table 7: **Exit and Productivity**
Dependent Variable: Proportion of Exiting firms

	(1)	(2)
Competition Shock	0.637***	1.656***
	(0.0832)	(0.0786)
(Relative Firms' Size)*(Competition Shock)	-0.389***	-1.325***
	(0.0688)	(0.0650)
Relative Firms' Size	-0.772***	-0.445***
	(0.0161)	(0.0147)
Sigma	0.697***	0.622***
	(0.00460)	(0.00432)
Observations	659	659
Country FE	Yes	Yes
HS2 FE	Yes	No
HS4 FE	No	Yes

Notes: Robust standard errors in parentheses in parentheses with ***,** ,* respectively denoting significance at the 1%, 5% and 10% levels. Comp. Shock: Competition Shock.

The results reported in Table 7, in columns 4 and 5, confirm that the effect of the competition shock on the proportion of firms exiting the export markets is lower when the relative productivity of those firms is higher. In fact, the estimated coefficient β_2 in both regressions is negative (-0.389 and -1.325). Using the estimates of columns 5, Figure 10 shows, a predicted decreasing effect of the competition shock on the proportion of exiting firms in two countries, Italy and Chile, as long as the relative productivity of the exporters to those destinations is higher.

Figure 10



Note: 1/ Shock: Change in the market share of China's exports in the importer country. 2/ Marginal effects evaluated at shirts for males.

6 Final Remarks

In this paper I find evidence of heterogeneous quality upgrading strategies of Peruvian apparel firms in reaction to lower prices of Chinese apparel. More productive firms upgraded the qualities of their products, avoiding a price war with low-priced Chinese products. Differently from previous works, I also find evidence for changes in input prices consistent with the quality upgrading strategy. More productive firms pay higher wages and buy more expensive intermediate inputs to produce higher quality goods in response to the low-cost Chinese apparel products. Finally, following Amiti and Khandelwal (2013) framework, I find evidence that the average quality of Peruvian apparel products increased between 2001 and 2007.

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A Appendix

A.1 Demand Functions: First Order Conditions

$$\alpha_l - \beta_l y_l - \gamma y_m = \lambda p_l$$

$$\alpha_m - \beta_m y_m - \gamma y_l = \lambda p_m$$

$$\alpha_h - \beta_h y_h = \lambda p_h$$

$$\lambda = 1$$

A.2 Effect of a foreign tariff reduction on the low and medium quality producers

The new profit function for a firm in a country F after including a per-unit tariff τ^F is given by:

$$\pi_l^F = (A - b_1 p_l + b_3 p_m)(p_l - c^F - \tau^F) - F_l^F$$

Then the corresponding reaction functions for producing low and medium qualities are respectively:

$$p_l = \frac{A}{2b_1} + \frac{b_3 p_m}{2b_1} + \frac{c^F + \tau^F}{2} \quad and \quad p_m = \frac{D}{2b_2} + \frac{b_3 p_l}{2b_2} + \frac{c_m^H}{2}$$

and the optimal prices for low- and medium-quality varieties are:

$$p_l = \left(\frac{A}{2b_1} + \frac{b_3 D}{4b_1 b_2} + \frac{b_3 c_m^H}{4b_1} + \frac{c^F + \tau^F}{2}\right)\left(\frac{4b_1 4b_2}{4b_1 b_2 - b_3^2}\right) \quad and$$

$$p_m = \left(\frac{D}{2b_2} + \frac{b_3 A}{4b_1 b_2} + \frac{b_3 c^F + b_3 \tau^F}{4b_2} + \frac{c_m^H}{2}\right)\left(\frac{4b_1 4b_2}{4b_1 b_2 - b_3^2}\right),$$

The effect of a lower tariff for firms producing goods at country F on low and medium-quality variety prices is:

$$\frac{\partial p_{_l}}{\partial \tau^F} = \frac{2b_1 b_2}{4b_1 b_2 - b_3^2} > 0 \quad and \quad \frac{\partial p_{_m}}{\partial \tau^F} = \frac{b_1 b_3}{4b_1 b_2 - b_3^2} > 0$$

since by assumption $\beta_m \beta_l - \gamma^2$.

The effect of a lower tariff for firms producing goods at country F on medium-quality producer's profits is negative. Clearly, profits of producing medium-quality varieties at home country are increasing in foreign firm's marginal cost c^F and the tariff τ^F, since both increases p_l. Profits of producing the medium-quality are given by:

$$\pi_{m,i}^H = b_2 \left(\frac{2Db_1 + Ab_3 + b_1 b_3 c^F - (2b_1 b_2 - b_3^2) c_i}{4b_1 b_2 - b_3^2} \right)^2 - F_m^H$$

Then the effect of an increase in the marginal cost c^F or the tariff τ^F paid by foreign firm in country X is the same:

$$\frac{\partial \pi_{m,i}^H}{\partial \tau^F} = \frac{\partial \pi_{m,i}^H}{\partial c^F} = \frac{2b_1 b_3}{4b_1 b_2 - b_3^2} \left(b_2 \left(\frac{2Db_1 + Ab_3 + b_1 b_3 c^F - (2b_1 b_2 - b_3^2) c_i}{4b_1 b_2 - b_3^2} \right)^2 \right)$$

and replacing the values for b_1, b_2 and b_3:

$$\frac{\partial \pi_{m,i}^H}{\partial \tau^F} = \frac{\partial \pi_{m,i}^H}{\partial c^F} = \frac{2\beta_m \gamma}{4\beta_l \beta_m - \gamma^2} K > 0$$

Since by assumption $\beta_l \beta_m - \gamma^2 > 0$ and $K = b_2 \left(\frac{2Db_1 + Ab_3 + b_1 b_3 c^F - (2b_1 b_2 - b_3^2) c_i}{4b_1 b_2 - b_3^2} \right) > 0$, because profits should be greater than zero to produce a positive number of units.