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The Quality and the Destination of the Colombian Manufacturing Exports*

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Abstract

In this paper we describe the relationship between the quality of goods and inputs of Colombian manufacturing firms and the income level of their export markets. We show that there is a positive correlation between measures of product and input quality and measures of per capita income of export markets. These findings are consistent with the recent literature on the demand and supply of quality, and with evidence for other countries.

JEL Classification: F14, L6.

Keywords: Quality of Products, Quality of Inputs, Wages, Income of Countries.

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1 Introduction

The objective of this paper is the characterization of the relationship between the quality of goods and inputs produced and used by the Colombian manufacturing sector, with the income level of the countries where the goods are sold. We exploit rich data sets containing product- and firm-level information on quantities, prices, wages, input imports and export destinations over a twenty-year time span. The analysis follows a recent literature that connects the taste for quality in high income countries with the quality of exported goods and the technology used to produce them.

Our results show that there is a positive correlation between measures of the quality of exported products by Colombian manufacturing firms and the income level of the destination countries. In addition, there is evidence of a positive correlation between the quality of inputs and the income level of the export destination countries. These findings are robust to the inclusion of relevant controls and to the use of alternative measures of income.

We illustrate the mechanism that drives the correlations that we see in the data using the model of Brambilla and Porto (2016). The underlying notion is that the taste for quality is increasing in income, and that the efficient production of quality requires the use of higher quality inputs. The model implies that trade has differential effects depending on the income level of export markets and on the availability of high quality inputs, including labor.

The paper is organized as follows. In the next section we review the relevant literature and describe the model that generates the predictions that we test in the data. The third section contains the description of the data and the estimation results. The fifth section concludes.

2 Related literature and analytical framework

Related literature

There is a body of literature within the field of International Trade that studies the relationship between the quality of exported goods and their inputs, and the income level of export destination countries. The focus of this literature is whether firms export higher quality products to countries with higher incomes, and whether firms that export to these countries use higher quality inputs. The theory linking the differentiation of the exported products and the characteristics of export destination countries dates back to the the work of, for example, Linder (1961); Gabszewicz, Shaked, Sutton and Thisse (1981); Shaked and Sutton (1982); Markusen (1986); Flam and Helpman (1987). Recent work by Balat et al. (2016) links technology heterogeneity across firms with differences in input quality and export destinations, and shows consistent evidence from Chile. This is the only paper we are aware of formally linking input quality, product quality and the characteristics of export destination countries.

Recent empirical literature uses detailed trade data to study the relationship between product and input quality, and the characteristics of export markets. As we discuss in greater detail below, this literature uses the FOB value per unit of volume as the measure of product quality, under a tacit assumption of pure vertical differentiation. In the case of the relationship between product quality and the income level of export destination countries, papers showing a systematic correlation between both include Hallak (2006); Bastos and Silva (2010); Görg, Halpern and Murakozy (2010); Baldwin and Harrigan (2011); Manova and Zhang (2012); Martin (2012); Brambilla, Lederman and Porto (2012); Brambilla and Porto (2016). For example, Bastos and Silva (2010) use data from Portuguese manufacturing firms to show that the FOB values per unit of the exported products by Portuguese firms are positively correlated with the income per worker, the distance, and the size (i.e. national income and total population) of the export destination countries. Görg, Halpern and Murakozy (2010) and Martin (2012) find similar evidence for Hungarian and French exports, respectively. As shown in Bastos and Silva (2010); Baldwin and Harrigan (2011); Martin (2012), there is also evidence that product quality is positively correlated with the distance to export destination countries.

Our analysis is based on firm-level input, product and exports data of Colombian manufacturing firms over a period of 20 years. In addition to standard evidence, we show that the pattern of correlation between product quality and export countries income changes depending on the level of differentiation at which we analyze the data, which we argue is consistent with the hypothesis that quality differences are the determinants of price differences across export destination countries. We also show evidence that both imported inputs quality and labor quality are correlated with income levels in export destination countries.

The contribution of our paper is to show evidence supportive of the mechanisms connecting input quality, product quality and income levels of export destination countries for the Colombian manufacturing sector. The mechanism is based on a version of the model by Brambilla and Porto (2016) which we describe below. As pointed out by Bastos, Silva and Verhoogen (2016) an alternative explanation for the positive correlation between prices and country income would be that market power, and therefore markups, are correlated with country income with quality playing no role. A novel contribution of our paper is to estimate markups using recent developments in the literature (De Loecker and Warzynski; 2012) and show that they are not correlated with country income. Taken as a whole, our results support the theoretical mechanism of the model.

Theoretical framework

The main idea of this paper is that there is a connection between the quality of inputs and output, and the income level of export destination countries. In order to fix ideas regarding the mechanism that underpins this relationship, we briefly describe the model in Brambilla and Porto (2016), which generates the predictions of a range of recent papers that we can test in the data. In the model, consumers in export markets have a taste for quality which increases with income. On the supply side, higher quality inputs facilitate the production of higher quality products.

As in Brambilla and Porto (2016), we model demand using a a multinomial-logit form. The preferences of household h in the country of destination d for consumption of the good j are given by:

$$U_{hj}^{d} = \alpha(y^{d})\theta_{j}^{d} - p_{j}^{d} + \epsilon_{hj}^{d}, \tag{1}$$

where $\alpha(y_d)$ is a function that captures the individual valuation of quality, which depends on country d income level y_d. This function satisfies the condition that higher country income is associated with a higher household-level valuations of quality, i.e. $\alpha'(y^d) > 0$. The variables θ_j^d and p_j^d are the quality and price of product j in country d, respectively. Finally, ϵ_{hj}^d is a random *iid* consumer- and product-level preference shock with type-I extreme value distribution.

Given the distributional assumption on ϵ, the aggregate demand for product j in country d arising from the households' utility maximization problem takes the usual multinomial-logit form:

$$x^{d}(\theta_{j}^{d}, p_{j}^{d}) = M^{d} \frac{\exp\left(\alpha(y^{d})\theta_{j}^{d} - p_{j}^{d}\right)}{\sum_{z \in Z^{d}} \exp\left(\alpha(y^{d})\theta_{z}^{d} - p_{z}^{d}\right)} \tag{2}$$

where M_d is the number of consumers in country d and Z_d is the set of available products for the country d.

Each market d is assumed to operate under monopolistic competition, in which each firm produces one good j, and chooses optimally the quality of its product θ_j^d and the price p_j^d. Unit production cost c_j is constant on the produced quantity, but depends on the quality of the finished product, such that $c_j(\theta_j)$ when $c'(\theta_j) > 0$ and $c''(\theta_j) > 0$. The profit function of firm j in market d is given by the following form:

$$\pi_{j}^{d} = \left[p_{j}^{d} - c_{j}(\theta_{j})\right] x^{d}(\theta_{j}^{d}, p_{j}^{d}) - F, \tag{3}$$

where F is a fixed cost which constant across firms.

The first order conditions of the maximization problem of firm j in market d with respect to quality and price are given by the following two equations:

$$p_j^d = 1 + c_j(\theta_j^d) \tag{4}$$

$$\alpha(y^d) = \frac{c_j'(\theta_j^d)}{\left(p_j^d - c_j(\theta_j)\right)} = c_j'(\theta_j^d) \tag{5}$$

As a consequence of (4) and (5), firms charge a constant markup over marginal costs. Given this markup, at the the optimal quality the marginal cost of quality matches the marginal valuation for quality. Given that the marginal valuation and the marginal cost of quality are assumed to be increasing in quality, equation (5) implies a positive relationship between the income-level of the given market with the optimal quality and price of the optimal product.

In order to connect the income level of export destination markets with the firms' choice of quality, we turn now to the details of the cost of quality, as proposed in Brambilla and Porto (2016). It is assumed that quality is produced using skilled labor, such that $\theta_j = \lambda_j S_j^\sigma$, S_j is the quantity of skilled labor used for producing quality θ_j, and λ_j the capacity of the firm which is assumed to be fixed. Given $\sigma > 0$, quality is increasing in the use of skilled labor. It is assumed that there is a direct relationship between the skill level S_j and the wage w_j paid by the firm, so that $S_j = w_j^\xi$, where $\xi > 0$.

The unit production cost c_j is just the cost of hiring $1/l$ units of workers with skill S_j. Under the assumptions above, the unit production cost equals the marginal cost and is given by the following equation:

$$c_j(\theta_j) = \frac{1}{l}\left(\frac{\theta_j}{\lambda_j}\right)^{\frac{1}{\xi\sigma}}, \tag{6}$$

where c_j represents the production cost of production of a unit of product with quality θ_j, which depends on the quality of the product and the capacity of the firm. If we assume that $0 < \xi\sigma < 1$, then the cost function of quality provision ($c_j(\theta_j)$) has increasing returns[1].

Under the given assumptions, the solution to the maximization problem of the firm exists and is unique. Specifically, the optimal choices of firm j shipping to destination d are:

$$\theta_j^d(\lambda_j, y^d) = \lambda_j(\xi\sigma\lambda_j l\alpha(y^d))^{\frac{\xi\sigma}{1-\xi\sigma}} \tag{7}$$

$$p_j^d(\lambda_j, y^d) = 1 + \frac{1}{l}(\xi\sigma\lambda_j l\alpha(y^d))^{\frac{1}{1-\xi\sigma}} \tag{8}$$

$$S_j^d(\lambda_j, y^d) = (\xi\sigma\lambda_j l\alpha(y^d))^{\frac{\xi\sigma}{1-\xi\sigma}} \tag{9}$$

[1] Notice that σ and ξ are parameters of the cost function of quality provision that together determine the returns of the quality provision.

$$w_j^d(\lambda_j, y^d) = (\xi\sigma\lambda_j l\alpha(y^d))^{\frac{1}{1-\xi\sigma}} \tag{10}$$

With the equations 7 to 10 and $0 < \xi\sigma < 1$ we can determine how the endogenous variables react to increments in income y^d:

$$\frac{\partial\theta_j^d}{\partial y^d} = \frac{\xi\sigma}{1-\xi\sigma}\lambda_j(\xi\sigma\lambda_j l)^{\frac{\xi\sigma}{1-\xi\sigma}}\alpha(y^d)^{\frac{\xi\sigma}{1-\xi\sigma}-1}\alpha'(y^d) > 0 \tag{11}$$

$$\frac{\partial p_j^d}{\partial y^d} = \frac{1}{1-\xi\sigma}\frac{1}{l}(\xi\sigma\lambda_j l)^{\frac{1}{1-\xi\sigma}}\alpha(y^d)^{\frac{1}{1-\xi\sigma}-1}\alpha'(y^d) > 0 \tag{12}$$

$$\frac{\partial S_j^d}{\partial y^d} = \frac{\xi\sigma}{1-\xi\sigma}(\xi\sigma\lambda_j l)^{\frac{\xi\sigma}{1-\xi\sigma}}\alpha(y^d)^{\frac{\xi\sigma}{1-\xi\sigma}-1}\alpha'(y^d) > 0 \tag{13}$$

$$\frac{\partial w_j^d}{\partial y^d} = \frac{1}{1-\xi\sigma}(\xi\sigma\lambda_j l)^{\frac{1}{1-\xi\sigma}}\alpha(y^d)^{\frac{1}{1-\xi\sigma}-1}\alpha'(y^d) > 0 \tag{14}$$

Equation 7 shows how the optimal quality chosen by the firm changes when the income of the destination country changes. Since λ_j, l and $\alpha(y^d)$ are positive, $0 < \xi\sigma < 1$ and $\alpha'(y^d) > 0$, the sign of 11 is positive and increasing in y^d. From equation 5 we know that an increase in the valuation of quality leads to higher marginal costs. Therefore, firms will decide to increase the quality of the products they sell in a given market up to the point where the marginal cost of quality provision equals the valuation of quality.

Similarly, equation 8 shows the change of the optimal price charged by the firm when the income of the destination country increases. The values of the variables λ_j, l and $\alpha(y^d)$ are positive, and the assumptions that $0 < \xi\sigma < 1$ and $\alpha'(y^d) > 0$ imply that the sign of 12 is positive. By increasing the income of the country d, 7 implies a greater quality of the products, θ_j^d). An increase in the quality of products implies higher production costs, $c_j(\theta_j)$). Since the firm charges a constant markup, an increase in production costs should increase the price of products. This prediction of the model is associated with the first hypothesis that we will test in the data: *The firms sell, on average, products of higher quality in countries with greater income.*

Equation 9 shows how the optimal demand of skilled labor chosen by the firm changes when the income of the country increases. The assumptions $0 < \xi\sigma < 1$ and $\alpha'(y^d) > 0$ imply that the sign of 13 is positive. An increase in the income of the export destination country, leads the firm to increase the quality of its products. To increase this quality, the firm must optimally hire more skilled labor ($\theta_j = \lambda_j S_j \sigma$).

Finally, equation 10 shows how the optimal wage paid at the firm level changes when the income of the destination country increases. The assumptions $0 < \xi\sigma < 1$ and $\alpha'(y^d) > 0$ imply that the sign of 14 is positive. Given $S_j = w_j \xi$, the increase in the demand for skilled labor can only be satisfied if higher wages are offered to workers. This prediction of the model is associated with the second hypothesis that we test in the data: *Firms pay, on average, higher wages per worker when their export destinations are high-income countries.*

In summary, the know-how of exporter firms about the demand and their value for quality leads them to produce goods with higher quality for exporting to countries with higher incomes. This involves charging higher prices to cover the higher costs associated with high quality production. In turn, the production of higher quality goods requires a demand for higher quality inputs by firms, which implies that firms that export to higher income countries should pay higher than average wages.

3 The Data

We study the relationship between product and input quality, and export destinations, using detailed firm-level information for a large sample of Colombian manufacturing firms. We use two different firm-level data sets: the first data set has detailed yearly international trade data during the years 1995-2015, while the second data set contains the detailed yearly financial information of individual firms for the years 2005-2013. Moreover we use a third country-level data set with the income information of the export's destinations.

The sources for the international trade data are the Colombian national customs agency (DIAN) and the national statistics agency (DANE). The data on international trade includes the firms exports and imports values (U.S. dollars) and their volume (in kilograms). We can identify firms by their tax identification number (by their Spanish acronym NIT). These data are detailed by destination/origin country, by 10-digit product according to the Nandina classification system (based on the Harmonized System), by the type of good according to the use or economic destiantion (by their Spanish acronym CUODE) and by the International Standard Industry Classification (ISIC). The data are available on a monthly basis, and for our analysis we aggregate the exports value and volume to the annual level. Notice that we are focusing only on products that are exported at some point during the time span of our data.

Our data on firms' characteristics come from *Superintendencia de Sociedades* (henceforth Supersociedades), which is the national agency in charge of supervising corporations. The set of firms in this data set is smaller, because it excludes small firms[2]. The information in this data set is self-reported

[2] Firms must report their financial data if their assets and/or income are grater than 30000 times the current legal monthly minimum wage, if their external liability is greater than the total assets, if their financial expenditures are at least 50% of their income, if their cash flow is negative, or if their losses reduce the net equity below 70% of the social

by the firms, and includes the public balance sheet, the public income statement, the public statement of cash flows and the confidential data included in the annexes used for filling the public data. As we will describe below, in some regressions we also use the Total Factor Productivity measure estimated in Casas and Gonzalez (2016), based on the same data. These estimates are obtained using the total payroll by firm, number of workers hired, total revenues, and the total value of intermediate consumption by firm.

Throughout the paper, we focus on manufacturing firms and in some cases we omit firms producing commodities such as refined petroleum products (ISIC 23) and basic metals (ISIC 27). In order to define whether a firm was a manufacturing firm or not in the Supersociedades data set, we use the firms' deflated incomes at 4-digit product code (ISIC). We define a firm as a manufacturing firm when the firm reports a positive income from a manufacturing product in all years it appears in the sample. We then assign firms to the 2-digit ISIC sector that yields the largest share of (deflated) manufacturing output throughout our sample period.

We merge both data sets using the firms' NIT numbers. We perform two types of analysis. On the one hand, we use only the firm-level trade data which is available for the years 1995-2015. On the other hand, we use the merged data set for the years 2005-2013. Additionally, we merge these data with information of the World Bank in order to classify the destination countries of the Colombian exports. The classification system of the World Bank organizes the countries in categories of income according to whether it is low, medium-low, medium-high and high income. The countries are divided among income groups according to 2013 gross national per capita income, calculated using the World Bank Atlas method.[3]

We now refer to our measures of quality and destination income. As we have already indicated, we follow the literature and use the price per volume of product as our measure of product quality, based on the FOB values in U.S. dollars and the annual exported volume. We calculate the annual value of exports in Colombian pesos, using the monthly average exchange rate and then add the values in Colombian pesos to get the yearly values.

Similarly, we measure the quality of labor using wages under the assumption that the price of labor reflects its quality. Specifically, our measure of firm-level labor quality is the total payroll divided by the number of workers, both of which are reported in the data. The trade data that we use to study the destination of exports also contains detailed information of imported inputs. We can therefore use

capital. During our sample period the minimum monthly wage oscillated between 165 dollars in 2005 and 315 dollars in 2012 and 2013.

[3]The income groups are: low income, $\$1,035$ or less; lower middle income, $\$1,036 - 4,085$; upper middle income, $\$4,086 - 12,615$; and high income, $\$12,616$ or more.

these data to examine the relationship between the quality of imported inputs and the destination of exported goods. To do so, we also compute the ratios of value of imported inputs over volume.

As pointed out by Bastos, Silva and Verhoogen (2016), differences in prices per volume across export destination countries may be a reflection of markups, instead of quality. And if markups are correlated with the country´s income level, a positive correlation between income levels and prices per unit would arise, but not as a reflection of quality differences. Keep in mind that prices are measured at the FOB level, so they do not include any retail cost which could be correlated with the countries' income levels. Therefore, if there are differences in markups they should arise at the wholesale level. In order to rule out this potential endogeneity problem, we estimate the firms' markups as proposed by De Loecker and Warzynski (2012) and show that they do not vary across firms with different export destination patterns.

We use several measures of income of the export destination countries. When running product-destination-level regressions we can correlate product quality directly with country income levels or with a categorical variable that indicates whether the country is a high income country according the World Bank country income classification. When running firm-level regressions, such as the input quality or markup regressions, we use measures of average income across the firms' exports destination countries or categorical variables indicating if the exporter firm exports to high income countries.

3.1 Descriptive Analysis

In this section we do a first approximation to the data on product quality and wages. We use simple statistics to show the relationship between our measures of product and input quality and the income level of the export destination countries. We also address the specialization of exporting firms in countries with different income levels. The running hypothesis is that there exists a relationship between output and input quality with the income of the export destination country. We want to test this hypothesis in the Colombian case using firm level data of the type illustrated in the following example:

Year	Country	nit	HI	10-HS	Fob Value	Volume	Quality-Proxy
2006	Costa Rica	XX	0	6006230000	3915.84	1755.12	2.23
2006	United States	XX	1	6006230000	1.23	0.24	5.12

HI is a dummy variable that takes the value of 1 if the firm exports to high income countries in any year and zero otherwise.

On the table above, we can see that our proxy quality indicates that the value per kilogram charged per firm XX in 2006 for the same product (product code: 6006230000) was higher for the *high income* country (United States) that for the other country (Costa Rica).

In Table 1 we present the descriptive statistics of the dummy variable HI that takes the value of 1 if the firm exports to high income destinations the year t, and zero otherwise. The panel on the left refers to the full DANE/DIAN dataset which, as indicated above, contains export and import data of *all* Colombian manufacturing firms between the years 1995 and 2015. The panel on the right refers to the subsample of firms which is contained both in the DANE/DIAN and the Supersociedades datasets. We define countries to be high-income depending on the country income classification of the World Bank.

The table shows that the total number of manufacturing firms that are directly engaged in international trade falls from around 9700 in 1995 to less than 8000 in 2015. Even so, the proportion of firms exporting to high income countries increases from 65% in 1995 to almost 75% in 2015. Results show that on average 78.2% of manufacturing firms exported to high income countries between 1995 to 2015. The firms exporting to high income countries export around USD185.000/year in average, whereas those that export only to non-high income countries export around USD58.000/year. On the other hand, the Supersociedades subsample contains bigger firms that export more than USD2 million/year in average. Nevertheless, in contrast to the full sample, the share of these firms that export to high income countries falls from 77% in 2005 to 65% in 2013.

In Table 2 we show the exported manufactured products classified according to Nandina 2 to 10 digits and the proportions of these that were exported to countries to high income in any year. In the case of goods at the Nandina's two-digit product classification, all products were exported to at least one high income country in any year of the sample period. Notice that as the product definition becomes finer (a product is defined at a level of disaggregation according to Nandina major) the percentage of products that are sent to high income countries decreases, which means that although all kinds of goods are exported to high income countries, some specific versions of them tend to only be exported to lower income countries.

In Table 3 we show the average wages per worker among all the firms for each year and according to whether or not they exported to at least one high income market. The results show that the average wage paid by Colombian manufacturing firms tends to be higher when they export to high-income countries. This first approximation suggests a possible positive relation between the quality of the labor input hired by the exporting firms and the income of the destination countries.

In Table 4 we show the average of the FOB values per unit of exports and the CIF values per unit of imported inputs, for each year and by income category. Both measures are weighted using the share of each firm in the total FOB/CIF value or in the total volume. As shown, the average FOB value per unit of exports of Colombian manufacturing firms is higher for firms that export to high-income countries.

The same happens with the volume-weighted average, except for the years 2001, 2002, 2003, 2006 and 2015. In this case the differences are certainly non-informative since they make no distinction bteween goods of all sorts.

Table 4 also shows that the average CIF value per unit of imported inputs of Colombian manufacturing firms tends to be higher when they serve high-income countries. Te exceptions are the year 2002 for the volume-weighted average and the years 2005, 2008, 2010 and 2014 for the CIF value-weighted average. We also calculated the descriptive statistics on Table 4 excluding divisions 23 (manufacture of coke, petroleum refining products and nuclear fuel) and 27 (Manufacture of common metals), which are really commodities with volatile prices and production levels, and the results (not shown) are similar.

This first approximation is suggestive of a positive relationship between the quality of imported inputs and the income of the export destination countries. It must be remembered, though, that these averages pool data corresponding to very heterogeneous inputs. Therefore, we now perform a more detailed econometric analysis in which we compare quality of similar goods and inputs.

4 Econometric Analysis

In this section we perform a more rigorous analysis of the data using regression analysis. In the following subsections we describe results of regressions in which we control for factors that are not taken into account by the descriptive statistics shown in Tables 3 and 4. This section is divided into two subsections: the analysis of the input quality and the analysis of the product quality.

4.1 Input quality

In this subsection we test the following prediction of the models discussed above:

$$\mathbb{E}\Big(q \mid D=1,\mathbf{Z}\Big) - \mathbb{E}\Big(q \mid D=0,\mathbf{Z}\Big) > 0 \tag{15}$$

where q is our measure of the input quality, D is a dummy variable that takes the value of 1 if the firm export to at least one high income country and zero otherwise, and $\mathbf{Z}$ are control variables. The inequality above indicates that the input quality chosen by the exporting firms is, on average, higher when the firm export at least one high income country compared to otherwise, controlling for other factors $\mathbf{Z}$ that affect the both the determination of the wages paid by the firms and the destination of exports.

Informally, what we want to do is to compare the quality of the inputs hired by similar firms producing similar products but which differ in the destination of their exports. As indicated above, our measure of input quality is the price per unit of volume, or the wage per worker. In $\mathbf{Z}$ we include controls for the firms' size, including as control the total number of workers, the export value in the local currency (COP), and the total sales of the firm. We include the firms' intermediate consumption as a measure of the vertical structure of the firm, and we also include the firms' total factor productivity (TFP)estimated in Casas and Gonzalez (2016). Finally, we also included fixed-sector, -year and -firm effects.

The estimating equation is as follows:

$$q_{it} = \beta_0 + \beta_1 HI_{it} + \boldsymbol{\beta_2}\mathbf{x'_{it}} + \boldsymbol{\theta_{1i}} + \boldsymbol{\theta_{2t}} : \boldsymbol{\theta_{3i}} + \varepsilon_{it} \tag{16}$$

Equation 16 relates a measure of input quality q_{it} in firm i and in year t with an indicator of the income category of the export destination countries HI_{it}, and with controls for the characteristics of the firm $\mathbf{x}$ and a fixed effect $\boldsymbol{\theta_{it}}$ which varies across specifications. The variable HI_{it} is a measure of the income of the export destinations countries. As indicated above, we will use a dummy variable that takes the value of 1 if the firm i exports in year t to at least one high-income country according to the World Bank classification in 2013 and zero otherwise. In some specifications we will also use the average income of the destination countries.

Wages

First, we focus on wages as our input quality measure using the wage per worker per firm contained in our data set, so that $q_{it} = w_{it}$. In Table 5 we summarize the estimation results 16. We use data at the firm-year level for the period 2005-2013. In columns 1 through 7, the dependent variable is the wage per worker paid by firm i in t. All regressions include the number of workers as a control variable. In columns 1 to 4 the destination income measure HI is the dummy variable that takes the value of 1 if the firm i exports in year t to at least one high-income country according to the World Bank classification in 2013. The results in column 1 do not include fixed effects or control variables. Column 2 includes fixed effects by year and firms' sector. Column 3 adds control variables and column 4 adds firm-fixed effects[4].

The results show that firms that exported to at least one high-income country pay, on average, significantly higher wages to their workers than similar firms that do not export to high income countries.

[4]The control variables used are the productivity of the firms, the value of total exports of the firm in Colombian Pesos (*expo*), the value of total revenue of the firm (*revenues*), and total value of the intermediate consumption of the firm (*interm_consm*).

This result is maintained when we include fixed effects by year-sector and control variables. The inclusion of fixed effects by firm leads to the coefficient estimated for HI to be non-significant. This is not surprising given that wages do not vary much over time for a given firm, and we cannot separate workers within each firm depending on the type of goods that they are producing.

In columns 5 to 7 we used an income indicator other than HI. In the column 5 we use as explanatory variable *VFOB_HI*, which represents the ratio of firms exports to High Income destination over total export. The results show a positive correlation, which nevertheless is statistically not significant. We get similar result in Column 6 and 7 when we change the HI variable by the average per capita income of countries that are the destination of a firm's exports in a given year, *income_avg*, or by the average per capita income of countries that are export destinations weighted by export share for a firm in a given year, *income_weight*.

The positive correlation correlation between average wages and the income of the export destination countries suggests that the production of goods for export to high-income countries requires a more skilled labor than the average, as implied by our model. An alternative interpretation would be that firms that export to high-income countries pay more for their employees because they use them more intensively (for example, because they have more shifts). However, this is unlikely since we control by the total sales (revenues) and intermediate purchases (intermediate consumption) of the firm: that is, we are comparing firms that have similar levels of total sales and similar levels of value added.

Table 6 is similar to regressions of Table 5 but uses the differences in the values of the variables between 2013 and 2005. The idea of this exercise is to check the robustness of the results in Table 5. The 2013-2005 differences are taken to evaluate how changes in wages respond to changes in export exposure to high-income countries. Column 1 corresponds to a regression of the change in the average wage per worker with the variable ΔHI on fixed effects by sector (product category according to two-digit ISIC) and control variables in differences. The variable of interest ΔHI is a variable that takes value 1 if the firm does not export to at least one high income country in 2005 but did it in 2013, and takes a value zero if there was no change in the export status of the firm, whether exporting or not exporting to high-income countries. ΔHI takes the value of -1 if the firm exported at least one high-income country in 2005 but did not do so in 2013. In column 3 we add the initial values of the control variables in levels.

The results in columns (1) and (3) show that changes in firm-level wages were significantly correlated with changes in their export status, conditional on controls. In columns 2 and 4 we use as the dependent variables the change in the share of total FOB value of exports to high income countries, $\Delta VFOB\_HI$. Similarly to the results in Table 5 the estimated coefficients are positive, albeit not statistically significant.

Imported Inputs

The results presented in Tables 5 and 6 show evidence supportive of the hypotheses of this paper regarding the correlation of labor quality and the income of export destination countries. Now we analyze the correlation of imported input prices and the income of export destination countries, under the understanding that input prices are indicative of their quality. In order to make sure that prices reflect quality we control for the characteristics of inputs using their detailed Nandina classification.

We use data at the firm-year level for the period 1995-2015. We estimate a variant of equation 16, using as dependent variable the average price of imported inputs at the firm-year level. We approximate the price of the imported inputs with the CIF[5] value per unit of imported inputs divided by total volume in kilograms of imported inputs at the firm-year level.

Table 7 summarizes the results of the estimation. In Panel A we use the full data for the period 1995-2015 on inputs imported by manufacturing firms (classified by the CUODE classification). Column names indicate the level of disaggregation at which imported inputs are defined. Regressions include fixed effects by year and fixed effects by imported input. The results show that the price per volume of the inputs imported (defined according to Nandina at 2, 4, 6, 8 and 10 digits) by firms exporting to high-income countries is on average higher than those of firms that do not produce to high-income countries.

In Panel B and Panel C we use only data between 2005 and 2013 on imports of inputs by manufacturing firms. This is the time span of the data for which we have detailed firm characteristics. As in Panel A, column names indicate the level of disaggregation to which imported inputs are defined. Regressions include fixed effects by year and by imported good. The results in panel B are consistent with the results in the panel A, but the coefficients are smaller- showing the loss of precision given a shorter panel. Finally, in panel C, we restrict our sample to the 2005-2013 time span but look only at firms that report their financial statement to Supersociedades. These are the firms for which we observe detailed characteristics which is the sample that we use to obtain additional results below. Notice that the estimated coefficient for our variable of interest is still positive and becomes more significant as we condition on more specific types of inputs.

In other words, the positive correlation between input prices and export destination income is sharper

[5]Cost, Insurance and Freight value refers to the sales value of the imported inputs in their place of destination with taking into account the cost of freight, insurance and other expenses necessary to get the goods to the customs office of the country of destination.

when we focus on very specific inputs, which is just what we expected.As we indicated above, the reason why we restrict the sample is to make sure that the results are comparable to the results that we show below, which will be based on the restricted sample.

4.2 Quality of Products

We now test the prediction of the model regarding the positive correlation of quality and the income of consumers in the export destination countries. The prediction of the model can be formally tested as:

$$\mathbb{E}\Big(uv \mid D = 1, \mathbf{X}\Big) - \mathbb{E}\Big(uv \mid D = 0, \mathbf{X}\Big) > 0 \tag{17}$$

where expectations are taken of our measure of product quality uv and conditioned on a dummy variable D that takes the value of 1 if the product is exported to a country classified as high-income and zero otherwise, and a set of controls $\mathbf{X}$. The above inequality states that the quality of products of export firms is, on average, higher when the destination country is high-income than when it is not.

We use a measure of product quality similar to the one used in the case of inputs, i.e. the price per volume, conditional on the products' characteristics. The idea, again, is that differences in prices across products that are classified as similar reflect differences in quality. Moreover, our measure of quality is based on the FOB value of products which should not contain the possible differences in the markups added by local distributors in the final export markets.

We test (17) using the following linear equation:

$$uv_{ijkt} = \beta_0 + \beta_1 HI_k + \boldsymbol{\theta_{1,t}} + \boldsymbol{\theta_{2,j}} + \varepsilon_{ijkt}, \tag{18}$$

where uv_{ijkt} is the FOB value per kilogram j charged by the firm i for the destination country k in the year t, HI_k is a variable dummy that takes the value of 1 if the country k is classified as high income according to the World Bank classification and zero otherwise (*high income*); $\boldsymbol{\theta_{1,t}}$ and $\boldsymbol{\theta_{2,j}}$ represent a vectors of fixed effects by year and by products, respectively. The product-level fixed effects depend on the level of disaggregation according to the Nandina classification. The level of disaggregation refers to the number of digits (up to 10 digits for Nandina and two digits for ISIC) with which a product category is defined. We use two, four, six, eight and ten digit classifications for Nandina and two digits for ISIC. Finally, ε_{ijkt} is an uncorrelated error term.

We show the results of the estimation in Table 8. Columns 1 to 3 show estimates based on the data from Supersociedades. For the estimates in columns 4 to 7, we use the data from DANE/DIAN. As we pointed out, data from Supersociedades is available for 2005-2013 and contains firms' characteristics. On the other hand, data from DANE/DIAN are available at the firm-year-product-country level for the period 1995-2015, but do not contain firms' characteristics. Columns 6 and 7 correspond to the regressions of columns 4 and 5 excluding the data associated with ISIC divisions 23 and 27, which as we have already indicated, are mostly commodities with virtually no quality variation, which is precisely the focus of this paper.

The results in column 1 show that the FOB values per unit of weight of exports are significantly higher for high income countries in the Supersociedades data, controlling for year and product (defined by the ISIC code). These results are statistically insignificant however, when we add fixed-firm effects, as shown in column 2. In column 3, the difference in value per weight is again positive and significant when we replace the firm effects by an array of firm characteristics. In other words, there is evidence that quality and the income of destination countries are positively correlated, but we cannot fully rule out the possibility that the correlation is the result of intrinsic firm attributes.

In columns 4-7 we investigate the matter in the larger DANE/DIAN data set. Columns 4 and 7 show the correlation of value per weight and export destination income is positive and significant. When fixed-firm effect are added, the coefficient is much smaller but still positive and significant, as predicted by our model.

Since the DANE/DIAN data has a much finer definition of products we can also see how this positive correlation varies as we use a more precise product definition. Our prejudice is that as we increase the level of detail at which the product is defined, the correlation should be lower. The reason is that at a sufficiently level of detail, the description of the product *is* the quality of the product. In other words, if the product is described with enough detail, the description of the product should include the quality. For example, a hand-made product may have higher quality than a machine-made one, but the hand-made vs machine-made distinction is only made when products are classified with a lot of detail.

In Table 9, we show the results of the regression at different levels of product aggregation. In other words, we run (18) with fixed-product effects with increasing level of detail, i.e. at the 2-, 4-, 6-, 8- and 10-digit Nandina classification level of detail (ISIC classification from 15 to 37 excluding commodity sectors 23 and 27). We show results for all firms in the data (Panel A) and also for the subsample of firms exporting to both high income and non-high income countries. The reason we show these restricted results is to avoid basing our conclusions on firms that are specialized on exporting only to specific markets and, therefore, may produce systematically different types of products. By using firms who export to all kinds of destinations, we make sure that we are really comparing similar products that are just tailored to specific markets.

The results on Table 9 correspond to the *high income* coefficient and imply, again, that value per unit of weight is positively correlated with the income of the destination countries. The coefficient is significantly different from zero only at the highest levels of aggregation and becomes indistinguishable from zero as we increase the level of detail at which we control for product characteristics. Notice that at higher level of characteristics detail, the estimated coefficient shifts toward zero without an increase in its variance. This means that the insignificance of the coefficients at the higher levels of detail is not due to a loss of precision, but rather a shift of the whole distribution of the estimate.

In Tables 10 and 11 we show estimates of (18) by product at the 2-digit ISIC level, so that within each regression we are focusing on broadly the same type of product. The columns indicate the additional fixed effects included in the specification of the regression equation (18). The estimates in Table 10 correspond to the full sample of manufacturing firms, whereas results in Table 11 correspond to the subsample of firms that export to both types of destinations.

We can see in both Tables 10 and 11 that the *high income* dummy coefficient is either positive and significant, or non-significant. In the regressions witout additional fixed effects in the leftmost columns, 11 and 12 out of the 23 manufacturing categories show a positive and significant correlation of values per unit and destination country income. Therefore, this negative correlation seems to be driven by a portion of the product categories and does not seem to be correlated with the number of observations in each sector. Similarly as before, as we add year effects and control for more detailed product characteristics up to the 4-digit Nandina classification, the correlation decreases but is still positive and significant for 9 and 10 categories, in Tables Tables 10 and 11. It is also the case that for no category the correlation is negative and significant.

We next show some robustness analysis, addressing the issue of the exports to Venezuela. As is well known, the Venezuelan economy faced peculiar circumstances during the time span of our data. In particular, it experienced an oil export boom and political conditions that favored massive imports from Colombia. At its peak in 2008, exports to Venezuela constituted 16% of total Colombian exports, and 27% of manufacturing exports in particular. On the other hand, a very distorted exchange rate market favored also the mispricing and misreporting of imports. Therefore, it is reasonable to doubt the reliability of these data.

In panel A of Table 12 we reproduce the results of the estimates in Table 9, when excluding exports to Venezuela. The results are qualitatively the same as those in Table 9, in the sense that the *high income* coefficient is positive and statistically significant at the highest levels of product aggregation, but shrinks and becomes statistically indistinguishable from zero as we condition on finer product categories. Notice also that the the magnitude of the coefficients is larger than in Table 9.

In panel B we show the results of a similar regression, except that we do not use the *high income* dummy to measure the income of export destinations, but instead use the directly the log income of the destination country. The use of this variable may be problematic because the composition of the sample changes endogenously as the composition of exports by country changes over time. The results nevertheless are positive and statistically significant at *all* levels of product aggregation. The magnitude of the coefficients also decreases as we increase the level of product detail, which is exactly what we expected.

We have shown that there is positive and generally significant correlation between value per unit of weight and the income of the export destination countries. The evidence is consistent with the model that predicts that quality and income in export markets are positively are positively correlated. The evidence goes beyond what what the previous literature has shown, in the sense that we have also shown that the correlation decreases as we increase the level of product detail.

As we have already suggested above, an alternative explanation for the positive correlation of value per unit and the income of the export destination countries is that the correlation is driven by markups and not quality. For example, it may be the case that market regulations and country income are positively correlated, *and* that market regulations are correlated with markups. In this case we may observe a positive correlation between value per unit and country income caused by market power and totally unrelated to quality. We have already pointed out that much of this concern is alleviated by the use of FOB values which should exclude retail markups. Moreover, we believe that the joint evidence of both output and input quality being correlated with export destinations is compelling and compelling enough.

In order to further solve doubts about the reliability of our inference we use recent developments in the empirical literature on the estimation of production functions to estimate the markup of firms and investigate its effects on our results. We obtain markup estimates using the techniques described in De Loecker and Warzynski (2012) which do not require price data. Since we need input data, we use the subsample that contains the Supersociedades data to obtain input usage which we can match to the trade data. Notice that with these data we can only obtain firm-level markups, not product-level markups. The estimation of the production functions of firms is described in Casas and Gonzalez (2016)[6].

We use the estimated markups to perform two types of analysis. First, we use the markups as controls in the estimation of the correlation of prices per weight and export destination (18). If this

[6]A detailed description of the estimation of markups is beyond the scope of this paper, but can be obtained upon request.

correlation were driven by the firm-level markup, its inclusion in the regression should dampen the estimated correlations, and its coefficient should be significant. We show the results of this exercise on columns 1-3 of Table 13, which correspond exactly to columns 1-3 of Table 8, except for the inclusion of the firm-level markups as controls. As shown, the inclusion of markups has virtually no effect on the estimated correlation of prices and export destinations. In addition, the coefficient of the markups is insignificant.

Second, we investigate directly whether there is any correlation of markups and export destination. To do so, we estimated a regression of markups on the *high income* country dummy and controls, similar to our firm-level equation (16):

$$\hat{mu}_{it} = \beta_0 + \beta_1 HI_{it} + \boldsymbol{\beta_2}\mathbf{x'_{it}} + \boldsymbol{\theta_{1i}} + \boldsymbol{\theta_{2t}} : \boldsymbol{\theta_{3i}} + \varepsilon_{it} \tag{19}$$

where $\hat{mu}_{it}$ is the estimated markup of firm i at time t, and the remaining variables are the same firm level variables as in (16), including the *high income* HI dummy. We show the results of this estimation in columns 4-6 of Table 13. The results show that the coefficient of the high income dummy is non-significant across all specifications. Therefore, the data do not support the notion that firm-level markups and the income of destination countries are correlated. This is consistent with our hypothesis that quality is the driving force behind the correlation of value per unit of weight and country income.

5 Conclusions

In this paper we studied the relationship of input and product quality with income in the export markets, for a large panel of Colombian manufacturing firms. Since there is no available direct measure of quality, we use price measures as proxy for input and output quality. We find compelling evidence of a positive correlation between these measures of quality and the income levels in export destination countries. The results are consistent with a model in which taste for quality grows with consumer income, and the technology for producing quality requires relatively high quantities of higher quality inputs.

Our results are consistent with evidence found in other countries. Compared with the existing literature, our analysis of *input* quality shows that the correlation of wages and export markets' income also extends to imported inputs. We also show that the positive correlation between *product* quality and export markets' income decreases as we condition on increasingly similar products. Moreover, we can reject the hypothesis that standard measures of markups are driving these results. All these pieces of evidence strongly support the notion that quality is the main connection between prices per unit of input/output and the income of export destinations.

Our results imply that the type of export markets has a significant effect on the type of products that are exported. And the quality of products, in turn, has an effect on the quality of inputs, including labor. As pointed out by Balat et al. (2016), the systematic differences in trade patterns, product quality and input quality are a reflection of underlying technological differences across firms. This deep connection between technology and export behavior is therefore crucial for understanding the growth and development of the manufacturing sectors in Colombia and elsewhere.

References

Balat, J., Brambilla, I. and Sasaki, Y. (2016). Heterogeneous firms: Skilled-labor productivity and the destination of exports, *Working paper* .

Baldwin, R. and Harrigan, J. (2011). Zeros, quality, and space: Trade theory and trade evidence, *American Economic Journal: Microeconomics* **3**(2): 60–88.

Bastos, P. and Silva, J. (2010). The quality of a firm's exports: where you export to matters, *Journal of International Economics* **82**(2): 99–111.

Bastos, P., Silva, J. and Verhoogen, E. (2016). Export destinations and input prices, *American Economic Review* .

Brambilla, I., Lederman, D. and Porto, G. (2012). Exports, export destinations, and skills, *The American Economic Review* **102**(7): 3406–3438.

Brambilla, I. and Porto, G. (2016). High-income export destinations, quality and wages, *Journal of International Economics* **98**: 21–35.

Casas, C. and Gonzalez, A. (2016). Productivity measures for the colombian manufacturing industry, *Borradores de Econmía* (947).

De Loecker, J. and Warzynski, F. (2012). Markups and firm-level export status, *American Economic Review* **102**(6): 2437–71.

Flam, H. and Helpman, E. (1987). Vertical product differentiation and north-south trade, *The American Economic Review* pp. 810–822.

Gabszewicz, J. J., Shaked, A., Sutton, J. and Thisse, J.-F. (1981). International trade in differentiated products, *International Economic Review* pp. 527–534.

Görg, H., Halpern, L. and Murakozy, B. (2010). Why do within firm-product export prices differ across markets?, *Kiel Institute for the World Economy working paper no. 1596.* .

Hallak, J. C. (2006). Product quality and the direction of trade, *Journal of international Economics* **68**(1): 238–265.

Linder, S. B. (1961). *An Essay on Trade and Transformation*, Wiley & Sons, New York NY.

Manova, K. and Zhang, Z. (2012). Export prices across firms and destinations, *Q. J. Econ.* (127): 379–436.

Markusen, J. (1986). Explaining the volume of trade: An eclectic approach, *American Economic Review* (76(5)): 1002–1011.

Martin, J. (2012). Markups, quality and transport costs, *European Economic Review* (56(4)): 777–791.

Shaked, A. and Sutton, J. (1982). Relaxing price competition through product differentiation, *Review of Economic Studies* (49): 3–13.

6 Appendix

6.1 Tables

Table 1: Firms exporting to high income countries

	DANE/DIAN					Supersociedades				
	Number of firms			Average Exports (Dollars)		Number of firms			Average Exports (Dollars)	
Year	**HI=1[a]**	**Total**	**(%)**	**HI=1[a]**	**HI=0**	**HI=1[a]**	**Total**	**(%)**	**HI=1[a]**	**HI=0**
1995	6311	9727	64.9	147823	19178					
1996	5856	8503	68.9	144997	17294					
1997	5732	8219	69.7	170359	19305					
1998	4901	6304	77.7	162684	28501					
1999	4684	5736	81.7	179824	16923					
2000	5334	6628	80.5	147522	24087					
2001	6111	7630	80.1	116003	14221					
2002	6163	7840	78.6	95872	13077					
2003	6766	8747	77.4	88432	21400					
2004	7196	9273	77.6	115345	26081					
2005	7170	8663	82.8	119193	31449	1128	1462	77.2	2375700	183759.6
2006	7130	8587	83.0	113305	29539	1237	1626	76.1	2598915	149149.9
2007	7353	8830	83.3	194050	37233	1110	1458	76.1	3657233	191898.7
2008	7318	8675	84.4	316128	73157	1092	1433	76.2	3462729	211380.5
2009	7014	8370	83.8	251354	67341	1058	1438	73.6	2627733	182687.4
2010	5935	7327	81.0	250912	62076	954	1394	68.4	2855733	165455.4
2011	5930	7418	79.9	313768	81685	918	1366	67.2	3318588	235839.8
2012	5959	7552	78.9	254113	67239	898	1328	67.6	3456668	287151.1
2013	6003	7713	77.8	262882	69774	827	1272	65.0	4002868	293472.4
2014	5910	7703	76.7	219393	77012					
2015	5932	7958	74.5	233955	57970					
Average	6224	7972	78.2	185187	38530	1025	1420	71.9	3112222	213841

a. HI is a dummy variable that takes the value of 1 if the firm exports to high income countries in any year and zero otherwise.

Table 2: PRODUCTS THAT WERE EXPORTED TO HIGH INCOME COUNTRIES

	Never High Income		High Income	
	Freq.	**Percentage**	**Freq.**	**Percentage**
nan2[a]	0	0.00	94	100.00
nan4[a]	19	1.70	1101	98.30
nan6[a]	306	5.97	4818	94.03
nan8[a]	624	8.25	6943	91.75
nan10[a]	791	9.56	7482	90.44

a. nan*k* is a dummy variable that takes the value of 1 if the product classified to *k*-digits Nandina was exported to high income countries in any year and zero otherwise.

Table 3: Salary per worker and Export Intensity

	Average Salary		Exports Intensity	
Year	**HI=1**[a]	**HI=0**	**HI=1**[a]	**HI=0**
2005	21470.9	16034.6	22.7	8.0
2006	22329.2	17641.4	22.7	8.1
2007	22990.2	20599.2	22.8	6.7
2008	47582.0	26533.1	23.2	7.4
2009	28293.2	22472.8	23.1	6.3
2010	28271.0	27446.0	20.3	5.5
2011	33902.6	30471.8	19.7	6.7
2012	31150.9	26166.7	20.5	6.7
2013	40040.2	28023.1	19.9	7.1
Total	30192.3	24305.4	21.8	6.9

a - Firms that exported at least one high-income country.

Table 4: Quality of Products and Inputs

Year	Products Quality				Inputs Quality			
	FOB Value per Unit Weighted by:				CIF Value per Unit Weighted by:			
	FOB Value		Volumen		CIF Value		Volumen	
	High Income[a]	**Low Income**	**High Income**[a]	**Low Income**	**High Income**[a]	**Low Income**	**High Income**[a]	**Low Income**
1995	45848.760	629.815	1.079	0.603	371.463	126.471	1.505	0.601
1996	34110.280	73.435	0.849	0.527	376.822	63.773	1.316	0.504
1997	16237.900	88.102	1.140	0.492	278.514	74.915	1.197	0.711
1998	18304.290	253.787	0.880	0.541	343.008	111.710	1.120	0.934
1999	12174.280	881.720	0.645	0.489	282.851	116.160	1.021	0.661
2000	4190.666	124.890	0.677	0.614	237.442	64.179	1.007	0.973
2001	18673.120	431.911	0.594	0.817	239.905	82.410	0.980	0.932
2002	7332.368	1003.532	0.548	0.709	278.585	131.217	1.007	1.020
2003	7853.178	309.383	0.590	0.648	267.901	64.093	1.104	0.982
2004	16546.610	5663.646	0.709	0.700	488.511	53.373	1.317	0.912
2005	13101.190	1137.155	0.899	0.870	217.958	259.226	1.452	0.564
2006	18174.590	1018.169	1.016	1.145	213.867	77.288	1.523	0.618
2007	16995.470	2380.951	1.350	1.289	377.190	35.554	1.585	0.775
2008	24320.480	2986.043	1.439	1.423	153.394	305.777	1.980	0.938
2009	17310.770	1783.995	1.526	1.177	874.249	75.569	1.651	0.671
2010	41426.450	2302.210	1.602	1.246	213.278	670.784	1.962	0.689
2011	75400.760	4980.621	1.847	1.483	466.527	62.781	2.447	0.897
2012	56018.540	10723.330	1.848	1.509	554.680	280.623	2.273	0.947
2013	37529.050	4393.625	1.601	1.493	1649.837	629.068	2.357	0.817
2014	51747.540	5965.039	1.659	1.388	2452.179	4714.629	2.107	1.391
2015	91974.700	4217.762	1.295	1.426	1244.585	357.591	1.877	0.996
Total	34407.090	3612.925	1.130	1.050	746.807	574.076	1.672	0.820

a - Indicator that takes the value of 1 for the firms that exported to at least one country defined under the category of high income according to the classification of the World Bank.

Table 5: WAGES

Dependent Variable: w	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HI	6,488**	9,136**	4,150***	-1,643			
	(3,068.000)	(3,639.000)	(1,268.000)	(2,138.000)			
VFOB_HI					4.467		
					(17.270)		
income_avg						0.00479	
						(0.031)	
income_weight							0.0188
							(0.060)
Control Variables	-	-	Yes	Yes	Yes	Yes	Yes
FE year-ISIC	-	Yes	Yes	Yes	Yes	Yes	Yes
FE firm	-	-	-	Yes	-	-	-
Observations	12,840	12,840	11,899	12,840	11,899	11,064	11,899
R-squared	0	0.01	0.044	0.029	0.043	0.043	0.043
Number of nit				2,678			

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: Robust standard errors in parentheses. Only includes exporting firms. The dependent variable is *salary*, the average wage per worker at the firm level. *HI* is a variable that takes the value of 1 if the firm exports at least one high-income country in a given year and zero otherwise. *VFOB_HI* represents the share of the total FOB value of the exports of the firm in a year to high-income countries in relation to the total FOB value. *income_avg* is the average per capita income of countries that are the destination of a firm's exports in a given year. *income_weight* is the average per capita income of countries that are export destinations weighted by export share for a firm in a given year. The control variables are employ, expo, revenues and interm_consm. *employ* is the number of employees per firm in a given year. *expo* is the value of a firm's total exports in a year. *revenues* is the value of a firm's total revenue in a year. *interm_consm* is the total value of the intermediate consumption of a firm in a year.

Table 6: WAGES: DIFFERENCES 2013-2005

Dependent Variable: Δw	(1)	(2)	(3)	(4)
ΔHI	5,243*		4,936*	
	(2,884.000)		(2,792.000)	
ΔVFOB_HI		22.24		29.05
		(50.730)		(49.550)
Control variables in differences	Yes	Yes	Yes	Yes
Control variables in levels	-	-	Yes	Yes
FE sector	Yes	Yes	Yes	Yes
Observations	1,316	1,316	1,316	1,316
R-squared	0.043	0.042	0.046	0.046

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: Robust standard errors in parentheses. Only includes exporting firms in 2005 and 2013. The dependent variable is Δw_e, is the difference between the average wage per worker for a firm between 2013 and 2005. *HI_13_05* is a variable that represents the change in the export status of the firm. *HI_13_05* this takes the value 1 if the firm does not export to at least one high income country in 2005 but did it in 2013. *HI_13_05* takes a value of zero if there was no change in the export status of the firm, whether exporting or not exporting to high-income countries. *HI_13_05* takes the value of -1 if the firm exported at least one high-income country in 2005 but did not do so in 2013. $\Delta VFOB\_HI$ represents the difference between the years 2013 and 2005 of the share of the total FOB value of the firm's exports to high-income countries in relation to the total FOB value. The control variables at 2005 levels are employ, expo, revenues and interm_consm. *employ* is the number of employees per firm in a given year. *expo* is the value of a firm's total exports in a year. *revenues* is the value of a firm's total revenue in a year. *interm_consm* is the total value of the intermediate consumption of a firm in a year. The control variables in differences are $\Delta employ$, $\Delta expo$, $\Delta revenues$ and $\Delta interm\_consm$. $\Delta employ$ is the difference between the number of employees at the firm level between 2013 and 2005. $\Delta expo$ is the difference between the value of a firm's total exports between 2013 and 2005. $\Delta revenues$ is the difference between the value of a firm's total revenues between 2013 and 2005. $\Delta interm\_consm$ is the difference between the total value of the intermediate consumptions of a firm between 2013 and 2005.

Table 7: Price of Imported Inputs

Dependent Variable: Price of Inputs	No fixed effects	Fixed effects Nandina2	Fixed effects Nandina4	Fixed effects Nandina6	Fixed effects Nandina8	Fixed effects Nandina10
Panel A: Full Data.						
HI	284.8***	293.9***	259.9***	250.5***	245.0**	244.5**
	(69.760)	(79.330)	(84.760)	(89.350)	(106.200)	(106.200)
N	1,616,665	1,616,665	1,616,665	1,616,665	1,616,665	1,616,665
R-squared	0.000	0.002	0.009	0.016	0.022	0.022
Panel B: Only data between 2005 and 2013.						
HI	208.8***	213.6***	192.5***	188.0**	198.4**	198.3**
	(59.070)	(67.660)	(71.570)	(79.420)	(98.600)	(98.630)
N	849,409	849,409	849,409	849,409	849,409	849,409
R-squared	0.000	0.002	0.01	0.017	0.02	0.02
Panel C: Data between 2005 and 2013, including controls.						
HI	3.988	32.65	77.02	108.8**	98.88*	98.91*
	(58.960)	(55.630)	(49.390)	(54.210)	(50.830)	(50.880)
N	246,925	246,925	246,925	246,925	246,925	246,925
R-squared	0.000	0.003	0.041	0.201	0.292	0.292

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: Standard errors corrected by *cluster* at the firm level in parentheses. Only includes exporting firms. All regressions include fixed effects by year. The dependent variable is the CIF value per unit of imported inputs. *HI* is a variable that takes the value of 1 if the firm exports at least one high-income country in a given year and zero otherwise. The control variables are employ, expo, revenues and interm_consm. *employ* is the number of employees per firm in a given year. *expo* is the value of a firm's total exports in a year. *revenues* is the value of a firm's total revenue in a year. *interm_consm* is the total value of the intermediate consumption of a firm in a year.

Table 8: Manufactured Products and ISIC

Dependent	Supersociedades			DANE/DIAN			
Variable: UV	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HI	28.34**	-0.677	38.72**	14,022***	2,406**	14,200***	2,361**
	(11.630)	(4.925)	(15.520)	(2,454.000)	(1,092.000)	(2,517.000)	(1,121.000)
FE Year-ISIC	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	-	-	Yes	-	-	-	-
FE Firm	-	Yes	-	-	Yes	-	Yes
Observations	12,777	11,844	12,777	166,348	166,342	161,411	161,405
R-squared	0.009	0.01	0.01	0.014	0.006	0.014	0.006
Number of nit			2,667		57,577		56,365

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: Robust standard errors in parentheses. All regressions include fixed effects by year, FE ISIC are fixed effects by double digit ISIC, FE firm are fixed effects by firm. The dependent variable is the FOB value per product unit. *high_income* is a dummy that takes the value of 1 if the country is classified as high income according to the World Bank classification for 2013 and zero otherwise. *HI* is a variable that takes the value of 1 if the firm exports at least one high-income country in a given year and zero otherwise. This distinction between the two variables is due to the fact that in the first two columns the aggregate data are used at the firm-year level, and in columns 3 to 6 the most disaggregated data at the firm-year-country-product level are used. The regressions in columns 3 and 4 include ISIC divisions 23 and 27 while columns 5 and 6 exclude data associated with these divisions. The control variables included are the export value in colombia pesos, the constant income, the intermediate consumption and the Total Factor Productivity.

Table 9: MANUFACTURED PRODUCTS AND NANDINA

Dependent Variable: UV	No fixed effects	Fixed effects Nandina2	Fixed effects Nandina4	Fixed effects Nandina6	Fixed effects Nandina8	Fixed effects Nandina10
Panel A: All firms						
HI	51.789**	34.315**	26.392*	21.752	21.399	21.399
	(20.368)	(17.325)	(15.602)	(15.109)	(15.132)	(15.132)
N	1551058	1551058	1551058	1551058	1551058	1551058
R-squared	0.000	0.013	0.032	0.048	0.048	0.048
Panel B: Firms exporting both destinations.						
HI	46.453**	30.894*	24.438	18.155	17.987	17.987
	(19.060)	(17.157)	(15.510)	(15.294)	(15.308)	(15.308)
N	1346902	1346902	1346902	1346902	1346902	1346902
R-squared	0.000	0.005	0.016	0.038	0.037	0.037

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: Standard errors corrected by *cluster* at the firm level in parentheses. All regressions include fixed effects by year. The dependent variable is the FOB value per product unit. The *high_income* variable is a dummy that takes the value of 1 if the country is classified as high income according to the World Bank classification for 2013 and zero otherwise. The firms that exported to both destinations are those that exported to both high and low income countries for any year in the sample. The column name indicates the fixed effects that are included in that regression.

Table 10: Two-digit ISIC Division: All firms

Dependent variable: UV	No fixed effects		Fixed effects by year		Fixed effects by year-Nandina 2		Fixed effects by year-Nandina 4	
CIIU	High Income	N	High Income	N	High Income	N	High Income	N
(15)	49.538***	90530	49.966***	90530	10.197	90530	3.051	90530
(16)	-2.207	560	-1.931	560	-1.931	560	1.512	560
(17)	3.745**	117284	5.627***	117284	3.798**	117284	4.301***	117284
(18)	-6.803	327310	2.331	327310	2.281	327310	2.902	327310
(19)	19.24	84287	18.666	84287	16.52	84287	16.151	84287
(20)	6.408**	19983	8.756***	19983	6.757***	19983	6.085***	19983
(21)	52.933	45426	52.379	45426	52.418	45426	54.687	45426
(22)	-182.845	94977	-145.322	94977	-230.818	94977	-183.599	94977
(23)	559.811***	7057	534.239***	7057	29.194	7057	31.795	7057
(24)	80.637***	181404	83.020***	181404	83.899***	181404	61.806***	181404
(25)	28.694	113808	30.484	113808	28.993	113808	25.996	113808
(26)	-3.438	50433	-2.392	50433	-2.117	50433	-0.734	50433
(27)	2327.187***	25389	2394.109***	25389	122.218	25389	31.992	25389
(28)	68.204*	92881	72.945*	92881	72.260*	92881	72.723*	92881
(29)	180.676	109260	182.028	109260	136.140*	109260	153.808*	109260
(30)	-105.68	6763	-66.073	6763	-72.338	6763	-149.047	6763
(31)	65.911***	53685	66.408***	53685	66.001***	53685	65.522***	53685
(32)	324.314***	14297	328.100***	14297	328.359***	14297	277.363***	14297
(33)	940.636**	33092	941.796**	33092	943.717**	33092	697.426***	33092
(34)	15.597	28501	18.146*	28501	17.511*	28501	18.349*	28501
(35)	-8.395	6594	35.674	6594	-515.391	6594	-447.598	6594
(36)	87132.674***	90698	94158.554***	90698	59211.223***	90698	6091.423	90698
(37)	1.239	1163	1.521	1163	1.521	1163	1.521	1163

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The dependent variable is the FOB value per unit of product. The *high_income* variable is a dummy that takes the value of 1 if the country is classified as high income according to the World Bank classification for 2013 and zero otherwise. Includes all manufacturing firms. The column name indicates the fixed effects that are included in that regression. N is the number of observations. Each row corresponds to the two-digit ISIC division for the manufacturing sector. We have regressions for each sector with different fixed effects. Standard errors are corrected by *cluster* at the firm level.

Table 11: Two-digit ISIC Division: Only firms that exported to both income categories

Dependent variable: UV	**No fixed effects**		**Fixed effects by year**		**Fixed effects by year-Nandina 2**		**Fixed effects by year-Nandina 4**	
CIIU	High Income	N	High Income	N	High Income	N	High Income	N
(15)	32.829***	74624	33.205***	74624	5.172	74624	0.357	74624
(16)	-2.894	411	-3.19	411	-3.19	411	-2.444	411
(17)	3.297*	104010	5.145***	104010	3.015*	104010	3.336**	104010
(18)	29.723	286583	31.280*	286583	31.870*	286583	30.636*	286583
(19)	24.108	66284	26.062	66284	24.133	66284	22.972	66284
(20)	9.444***	14134	11.295***	14134	8.869***	14134	7.550***	14134
(21)	60.208	41000	59.617	41000	59.901	41000	61.654	41000
(22)	-200.306	86357	-176.57	86357	-260.842	86357	-235.427	86357
(23)	125.557**	5890	117.398**	5890	-12.978	5890	-12.653	5890
(24)	50.429***	164655	53.142***	164655	54.872***	164655	39.141**	164655
(25)	30.538	101995	32.589	101995	30.988	101995	27.708	101995
(26)	-1.209	42152	-0.401	42152	-0.38	42152	1.099	42152
(27)	1900.711***	21898	1925.331***	21898	225.331*	21898	123.327	21898
(28)	87.832*	80375	92.083**	80375	91.363**	80375	91.443*	80375
(29)	208.826	92347	210.06	92347	156.396*	92347	178.294	92347
(30)	133.787	5509	156.133	5509	153.361	5509	78.833	5509
(31)	71.071***	46815	71.015***	46815	69.459***	46815	67.406***	46815
(32)	400.845***	11950	401.602***	11950	401.602***	11950	326.888***	11950
(33)	305.483*	28661	328.601**	28661	328.343**	28661	261.560**	28661
(34)	17.008	23460	20.755*	23460	20.462*	23460	20.641*	23460
(35)	-1.35	5257	14.719	5257	-667.745	5257	-595.196	5257
(36)	76498.597***	75327	81781.019***	75327	51015.388***	75327	3455.78	75327
(37)	1.457**	1045	1.712**	1045	1.712**	1045	1.712**	1045

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: The dependent variable is the FOB value per unit of product. The *high_income* variable is a dummy that takes the value of 1 if the country is classified as high income according to the World Bank classification for 2013 and zero otherwise. Includes all manufacturing firms. The column name indicates the fixed effects that are included in that regression. N is the number of observations. Each row corresponds to the two-digit ISIC division for the manufacturing sector. We have regressions for each sector with different fixed effects. Standard errors are corrected by *cluster* at the firm level.

Table 12: Robustness analysis

Dependent Variable: UV	No Fixed effects	Fixed effects Nandina2	Nandina4	Nandina6	Nandina8	Nandina10
Panel A						
HI	71.578***	60.218**	38.647*	30.202	22.216	22.064
	(26.203)	(24.724)	(21.655)	(19.173)	(18.544)	(18.570)
N	1352354	1352354	1352354	1352354	1352354	1352354
r2_a	0.000	0.001	0.014	0.031	0.047	0.047
Panel B						
Log(Income)	0.125***	0.096***	0.064***	0.048***	0.044***	0.044***
	(0.016)	(0.010)	(0.008)	(0.008)	(0.008)	(0.007)
N	1203182	1203182	1203182	1203182	1203182	1203182
r2_a	0.018	0.381	0.475	0.512	0.524	0.525

* p < 0.10, ** p < 0.05, *** p < 0.01.
Note: Standard errors corrected by *cluster* at the firm level in parentheses. All regressions include fixed effects by year. In Panel A, the dependent variable is the FOB value per unit of product and *HI* is a dummy variable that takes the value of 1 if the country is classified as high income according to the World Bank classification for 2013 and zero otherwise. The dependent variable in Panel B is the logarithm of FOB value per unit of product and the variable *log(Income)* is the logarithm of gross national income per capita according to the World Bank for 2013. The column name indicates the fixed effects that are included in that regression. Includes all firms.

Table 13: Markups

	Dependent variable: UV			Dependent variable: Markup		
	(1)	(2)	(3)	(4)	(5)	(6)
HI	28.34**	-0.673	38.89**	-0.00547	0.0115	0.0325
	(11.630)	(4.925)	(15.620)	(0.070)	(0.091)	(0.074)
Markup	0.0642	-0.057	-0.849			
	(0.467)	(0.609)	(0.712)			
FE Year-ISIC	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	-	-	Yes	-	-	Yes
FE Firm	-	Yes	-	-	Yes	-
Observations	12,777	12,777	11,844	12,319	12,319	11,426
R-squared	0.009	0.01	0.01	0.013	0.753	0.018

* p < 0.10, ** p < 0.05, *** p < 0.01.
Note: Robust standard errors in parentheses. All regressions include fixed effects by year. *HI* is a dummy variable that takes the value of 1 if the country is classified as high income according to the World Bank classification for 2013 and zero otherwise.


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