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The variation of export prices across and within firms*

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Abstract

This paper uses transaction-level trade data to analyze the differences in export prices across and within Spanish manufacturing firms in the year 2014. The transactional nature of the database uncovers sizable differences in the price that an exporter charges for the same product and destination. To explain this new margin in the variation of export prices, we extend the Baldwin and Harrigan (2011) model, allowing more productive firms to manufacture a wider quality-range of varieties. For a representative sample of multi-transaction and multi-destination exporting firms, regression analyses confirm that more productive firms set higher average export prices and offer a wider quality-range of varieties within a destination.

JEL: F1, F10, F23

Keywords: export prices, firm-level transaction data, heterogeneous firms, quality.

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1 Introduction

The literature has shown that there are large differences across exporting firms (Bernard et al., 2007, 2012). On the extensive margin, there is ample variation regarding the number of exported products, the portfolio of destinations and the frequency of transactions across firms. On the intensive margin, a series of papers have identified notable differences in the export price for the same product across firms (Bastos and Silva, 2010; Görg et al., 2010; Manova and Zhang, 2012; Martin, 2012; Harrigan et al., 2015).[1] Moreover, these studies show that there are also differences in the price that a firm charges for the same product across destinations. More specifically, firms set a higher price for the same product in more distant and richer markets.

This paper uses transaction-level trade data to analyze the variation of export prices across and within Spanish firms. As previous studies, we find large differences in prices across firms, and across destinations within firms. However, the transactional nature of our database also uncovers very important differences in the export price that a firm charges for the same product in the same destination. For a representative sample of multi-transaction and multi-destination manufacturing exporters, we find that this new margin explains 45% of the overall variation in export prices.

We extend the Baldwin and Harrigan (2011) model to generate differences in export prices across firms, within firms and across destinations, and within firms and destinations. As in this model, we consider that more productive firms produce higher quality goods, which are costly to produce. However, in our extension firms do not only supply one quality variety, the highest they can achieve, but a range of quality varieties. The model predicts that more productive firms export a larger quality-range of varieties, and with a higher average quality, than less productive firms.

We derive testable predictions for each price-variation component. First, the model establishes that more productive firms export higher quality goods, explaining the differences in export prices across firms. Second, the model implies that destination characteristics alter the quality-range of the varieties exported by firms, explaining the differences in prices within firms and across destinations. In particular, the model predicts that high-quality varieties are exported to more distant markets. Finally, the model indicates that more productive firms export a larger quality-range of varieties, explaining the differences in export prices within a firm and a destination. Using a new dataset of multi-transaction and multi-destination manufacturing Spanish exporters in year 2014, we confirm the validity of the three key predictions of our model.

[1] Previous studies such as Schott (2004), Hummels and Klenow (2005), Hallak (2006), Khandelwal (2010) and Baldwin and Harrigan (2011) analyzed the variation in export prices using at the country-product level.

This paper contributes to the literature showing that there are sizable differences in the export price that firms charge for one product in the same destination. This new margin, which is uncovered by the transactional nature of our data, contributes substantially to the overall differences in export prices across and within firms. We explain this new margin arguing that more productive firms not only produce a higher quality good, but also a wider range of varieties that differ in quality.

This paper is related with different strands of the literature. First, it is related to previous papers, such as Bastos and Silva (2010), Görg et al. (2010), Manova and Zhang (2012), Martin (2012) and Harrigan et al. (2015) that use firm-level data to explain the differences in export prices across and within exporters. We confirm previous findings for the case of Spain. We add to this literature showing that differences in prices within a firm and a destination is an important source of variation in export prices.

The paper is also related to theoretical and empirical papers which argue that firms compete not only in prices, but also in quality (Verhoogen, 2008; Baldwin and Harrigan, 2011; Crozet et al., 2012; Johnson, 2012; Kugler and Verhoogen, 2012). Our paper also contends that firms compete in quality, and it adds the feature that firms might offer more than one quality variety. This characteristic relates our paper with previous studies, such as Bernard et al. (2010), Eckel and Neary (2010) and Nocke and Yeaple (2014), which argue that more productive firms export a larger range of products. In this paper, more productive firms do not produce a large range of products, but a wider quality-range of varieties of the same product.

The paper is organized as follows. The next section describes how we combine different datasets to build our sample. We pay special attention to the description of the export transactions' dataset, which is key to uncover the important contribution of the differences in prices within firms and destinations. Section 3 performs the price decomposition and highlights the important contribution of the variation in prices within a firm and a destination to the overall variation in prices. Section 4 extends the Baldwin and Harrigan (2011) model to generate variation of prices across firms, within firms and across destinations, and within firms and destinations. Section 5 tests the predictions of the model regarding each price-variation component. Section 6 introduces a measure of quality and repeats previous analyses as a robustness check. The final section concludes.

2 Data

This paper uses a new and unique firm-level export transactions dataset for Spain in 2014. The database is the result of combining three different sources. The first one is the universe of export transactions database, which is elaborated by the Customs and Excise Department of the Spanish Tax Agency. The second source is Bureau Van Dick SABI database, which provides detailed financial and accounting records of Spanish firms that deposited their accounts in the Business Register in 2013. Unfortunately, it is not possible to combine directly Customs and SABI because of the lack of a common firm identifier. This handicap is solved by using a third source, the Directory of Spanish Exporting and Importing firms (Directorio), which is elaborated by the Chamber of Commerce of Spain. The Directorio contains both the custom and the fiscal identifier for a sample of 5,000 regular exporters over the period 2002-2014. Those firms accounted for about 30% of total Spanish merchandise exports in 2014.[2]

From the Customs database we get the universe of Spanish merchandise transactions in 2014. For each transaction we know the firm's custom identification code, the product at the 8-digit Combined Nomenclature (CN) classification[3], the destination of the export transaction, the free-on-board (FOB) value in euros of the transaction and the exported quantity (in weight metric and/or units). We take several steps to clean this database. First, we remove transactions with value below 1,500 euros.[4] Second, we eliminate the transactions recorded as complete industrial plants (CN code 98) and the special CN code (CN code 99). Third, due to their particular status relative to Spain, we remove the export transactions with Andorra and Gibraltar. Fourth, we also remove the transactions with countries for which we cannot obtain some of the data needed in the econometric analyses.[5] Finally, due to their special geographical situation and fiscal status in Spain, we remove all export transactions from the Canary Islands, Ceuta and Melilla.

As shown in Table 1, after the cleaning steps, we end-up with 5,214,112 export transactions. These transactions are carried out by 71,221 firms, which export 8,471 different products to 182 different countries.[6] In our database we distinguish between all transactions (All), and transactions carried out by multi-transaction and multi-destination firms (MM). A firm should fulfill two requirements to be considered as a MM firm: (1) it should carry out, at least, two transactions per destination-product combination (multi-transaction firms); (2) it should serve, at least, two destinations per product (multi-destination firms).[7] When we focus on MM firms, the number of exporters drops to

[2]The largest effort to include firms in the Directorio took place during the years 2003 and 2004. In that time, almost 30,000 exporters were approached by mail by the Spanish Tax Revenue Agency and the Trade Chamber of Spain asking them permission to include their trade data in the Directorio. About 10,500 firms were included in the Directorio in 2004; ten years later, only 5,164 firms remain exporting.

[3]An example of an 8-digit product is CN 87120030 Bicycles with ball bearings.

[4]Firms with monthly exports to EU countries below this threshold for a given product are not obliged to report their transactions to the Spanish Tax Revenue Agency.

[5]The required country level data are real GDP, population and bilateral distance between countries. For example, we remove all export transactions with Syria, because we cannot obtain GDP data for this country in the year 2014.

[6]In 2014 Spanish merchandise exports reached 240,035 million Euros. After cleaning, our database accounts for 92% of total merchandise exports

[7]We include another condition which is related to the number of firms that export a product. In particular, we only include products that are exported by, at least, two firms. We include this latter condition to ensure that we can calculate the variation of export price for a product across firms.

Table 1: Description of the database

Database	Goods	Type of firms	Number of transactions	Number of firms	Number of products	Number of countries	Exports (mill. euros)
Customs	All	All	5,214,112	71,221	8,471	182	221,073
Customs	All	MM	4,107,448	19,053	4,868	177	177,914
Customs	Manufactures	All	4,608,040	61,815	7,540	181	184,243
Customs	Manufactures	MM	3,678,302	15,437	4,289	177	151,564
Customs+Directorio	Manufactures	All	1,605,436	4,115	5,898	180	61,798
Customs+Directorio	Manufactures	MM	1,349,141	2,411	1,928	170	50,872
Customs+Directorio+SABI	Manufactures	All	920,971	2,334	4,907	175	47,947
Customs+Directorio+SABI	Manufactures	MM	704,471	1,586	1,261	166	38,868

19,053. However, the relative reduction in the number of transactions is much lower (from 5.2 to 4.1 million). Note that MM firms still carry out 80% of all exports.

Next, we narrow down the sample to manufactures. In the final sample we only include manufacturing firms exporting manufactured products. We take this decision because our firm-level data is more reliable for firms whose main activity is manufacturing. Manufactures represent 83% of all exports.[8] MM firms exporting manufactures represent 81% of all MM firms, and they carry out 82% of all manufacturing exports. The Directorio database provides us the link between Customs data and SABI data. The number of MM manufacturing firms included in the Directorio is 2,411, and they carry out 34% of MM firms manufacturing exports. Finally, we link Directorio with SABI, which provides the financial and accounting data and the main activity of the firm. We select firms whose main activity is manufacturing, reducing the sample to 1,586 MM manufacturing firms, which represent 10% of MM firms exporting manufactures. These firms export 1,261 different products to 166 different countries, and account for 26% of all manufacturing exports carried out by MM firms. This is the sample we use for the baseline econometric estimations in Section 5.

Export prices (or unit values) are calculated as the ratio of value over quantity. All transactions report the value in euros and quantity in a weight metric. A third of transactions also provide the number of physical units as an additional measure of quantity. The fact that some products report units suggests that export prices can be better expressed in terms of euros per physical units (i.e. pairs of shoes, number of aircrafts, ...) rather than euros per kilogram (or equivalent). In those cases we use units instead of kilograms to calculate unit values. The use of transaction data brings us closer to the actual export price charged by the firm to a customer in a given destination and for a given product. However, the use of high frequency data also introduces some problems. In particular, as explained by Manova and Zhang (2012), when high-frequency data for export prices is combined with yearly data on destinations, standard errors can be biased downwards. Nevertheless, collapsing the transaction data at annual frequency avoids that problem at the cost of eliminating the richness of price variation within any product-destination for multi-transaction firms.

Table 2 provides some summary statistics of the 1,586 MM firms included in the Customs-Directorio-SABI sample (CDS sample). Panel A presents trade data and Panel B other firm characteristics. A MM manufacturing firm exports, on average, 25 million euros per year, 3 different products, serves 14 countries and carries out 444 transactions in total. If transactions are defined at the product-destination level, an average exporter carries out 45 transactions. The table shows that there is a wide dispersion among MM

[8]Due to their special characteristics, we have excluded transactions of petroleum, tobacco and printing products from the database.

Table 2: Summary statistics of the MM firms included in the Customs-Directorio-SABI sample (N=1586)

Variable	Average	Standard deviation	Minimum	Maximum
Panel A. Trade data in 2014				
Exports (thousand euros)	24,507	224,045	11	5,534,533
Products	3	5	1	87
Countries	14	15	2	116
Number of transactions	444	3,259	4	109,412
Number of transactions of the same product and destination	45	263	2	7,739
Panel B. Firm characteristics in 2013				
Sales (mill. euros)	60.5	336	0.1	6,473
Employees	157	649	2	11,491
Assets (mill. euros)	53	227	0.2	4,060
Value added per employee (thousand euros)	100	82	4	1,267

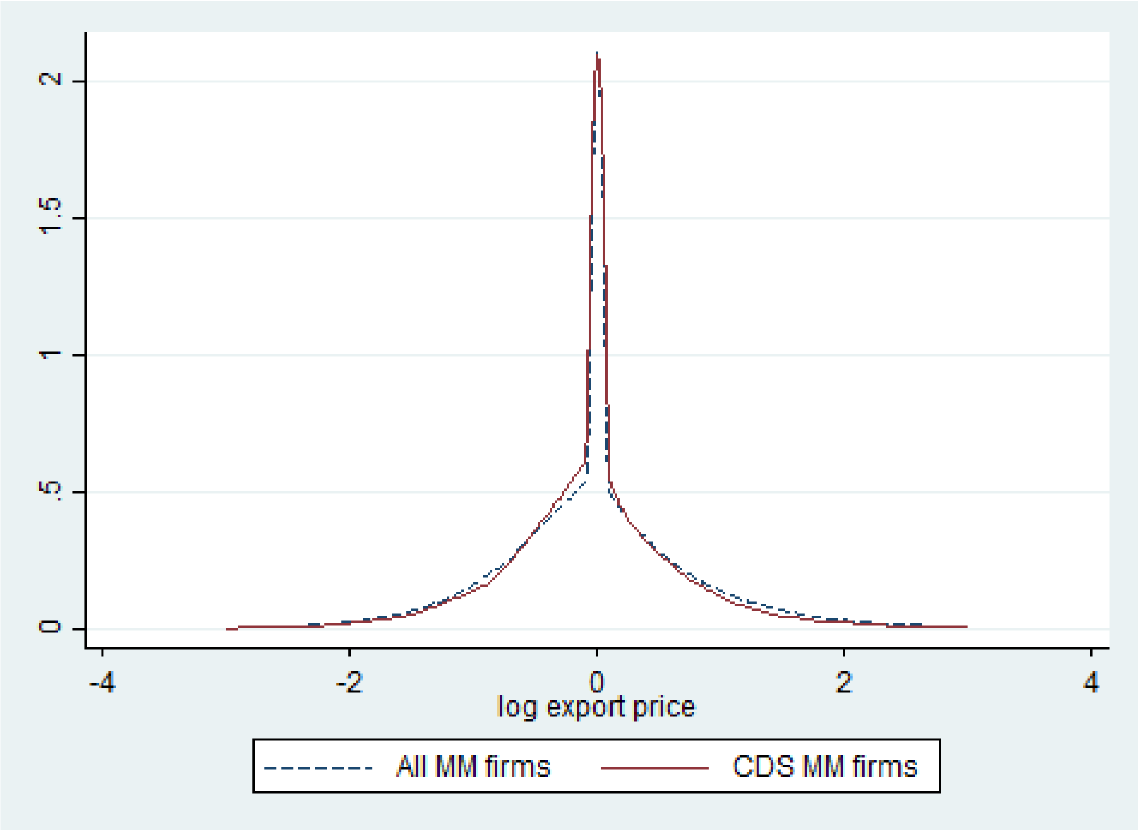
manufacturing firms. For example, there is a 5 billion euros difference in exports between the MM firm with maximum exports and the MM firm with minimum exports. Differences are also staggering regarding the number of products, countries, and transactions. Panel B indicates that the average MM firms sells 60,5 million euros, has 157 employees, 53 million euros in total assets and generates 0.1 million euros of value added per employee. As in trade variables, we observe a large dispersion in this second set of variables.

Figure 1 compares the distribution of (log) export prices in all MM firms and in CDS firms. To draw the figure, we normalize export prices taking the difference between the (log) unit value and the average (log) unit value, where the average (log) unit value is calculated for each product and destination. As shown in the figure, both distributions are very similar. This result suggests that CDS firms are a representative sample of all MM firms.

3 The decomposition of export price differences

This section shows that differences in prices for a given product within a firm and a destination contribute substantially to the overall differences in prices among MM firms. To measure the contribution of this margin, we decompose the variance in prices of a product in three components: differences across firms, differences across destinations within firms, and differences across transactions within firm and destination. Algebraically:

Figure 1: Distribution of exports prices: All MM firms vs. CDS firms



$$\sum_{fdt}(p_{fdt}-\bar{p})^2 = \sum_{fdt}(\bar{p_f}-\bar{p})^2 + \sum_{fdt}(\bar{p_{fd}}-\bar{p_f})^2 + \sum_{fdt}(p_{fdt}-\bar{p_{fd}})^2$$
$$+\,2\sum_{fdt}(\bar{p_f}-\bar{p})(\bar{p_{fd}}-\bar{p_f}) + 2\sum_{fdt}(\bar{p_f}-\bar{p})(p_{fdt}-\bar{p_{fd}}) + 2\sum_{fdt}(\bar{p_{fd}}-\bar{p_f})(p_{fdt}-\bar{p_{fd}}) \quad (1)$$

where p_{fdt} is the unit value of firm f at destination d in transaction t, $\bar{p}$ is the average price of all transactions, $\bar{p_f}$ is the average price of all transactions by firm f, and $\bar{p_{fd}}$ is the average price of all transactions by firm f at destination d. The first term on the right-hand side captures the variance across firms, the second term the variance across destinations within firms, and the third term the variance across transactions within firms and destinations. The remaining three components are interaction, or covariance, terms. We calculate equation 1 for each CN8 product. To determine the contribution of each component, we divide each right-hand side term by the left-hand side term.

We present the results of the price decomposition for the three MM firm categories identified in Table 1: all MM firms (*MM all*), MM firms exporting manufactures (*MM manufactures*), and MM manufacturing firms, exporting manufactures and with firm-level data (*MM CDS*). This latter category forms the sample used in the baseline regression

Table 3: Decomposition of the variance in prices

Component	Percentiles				
	P5	P25	P50	P75	P95
MM All					
Across firms	0.008	0.085	0.276	0.573	0.889
Across destinations (within firms)	0.012	0.073	0.162	0.287	0.560
Across transactions (within firms + within destinations)	0.037	0.201	0.436	0.679	0.917
MM Manufactures					
Across firms	0.007	0.081	0.265	0.553	0.872
Across destinations (within firms)	0.013	0.077	0.168	0.294	0.561
Across transactions (within firms + within destinations)	0.039	0.205	0.444	0.681	0.919
MM CDS					
Across firms	0.002	0.037	0.179	0.490	0.857
Across destinations (within firms)	0.017	0.096	0.215	0.381	0.664
Across transactions (within firms + within destinations)	0.037	0.201	0.449	0.689	0.934

analyses. As in Martin (2012) and Harrigan et al. (2015), Table 3 presents the contribution of the three variance components for products located in a specific percentile of the distribution. Taking the median product as a reference, we can see that differences in prices within firms and destination is the most important source of variation in prices in all MM categories. In particular around 44% of the differences in prices are explained by this component. This result highlights that there are large differences in the prices that firms charge for the same product in one destination. These differences suggest that firms offer a wide range of quality varieties of a product in foreign markets. This important source of the variation of prices was hidden in previous analyses, and it is uncovered due to the transactional nature of our database.

The relative share of the other two components varies across MM categories. For *MM all* differences in prices across firms explain 28% of the overall variation in prices. The share of this component is similar for *MM manufactures* (27%), and falls to 18% for *MM CDS*. Differences in prices within firms and across destinations contribute by 16% to the variation in prices in *MM all*, by 17% in *MM manufactures* and 22% for *MM CDS* firms.

Table 3 shows that export prices vary across firms, within firms across destinations and within firms and destinations. Moreover, it shows that among MM firms, differences within firms and destinations is the most important contributor to the variation of prices. In the next section, we extend the Baldwin and Harrigan (2011) model to generate these three sources of variation in prices.

4 A simple model of heterogeneous quality and quality-ranges

We extend the Baldwin and Harrigan (2011) model to generate the three sources of variation in prices identified in the previous section. In our extension firms might produce more than one quality variety of a product.

We start defining the consumption side of the economy, whose key characteristic is that consumers value quality. For a given product i, the preferences of a representative consumer are given by a constant elasticity of substitution (CES) utility function

$$U = \left(\int_{j \varepsilon \Omega_i} (c_j q_j)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}, \sigma > 1 \tag{2}$$

where j is a variety that belongs to the set of varieties of product i (Ω_i), c_j is the quantity consumed of variety j, q_j is the quality of variety j, and σ is the elasticity of substitution across varieties.

In a CES utility framework, expenditure on a variety is determined by the following expression

$$p_j c_j = E P^{\sigma-1} \left(\frac{p_j}{q_j} \right)^{1-\sigma} \tag{3}$$

where E is the expenditure that consumers devote to product i; the ratio $\frac{p_j}{q_j}$ is the quality-adjusted price, and P the quality-adjusted price index of product i, which is exogenous to individual firms.

Following Baldwin and Harrigan (2011), we assume that the production of higher quality goods demand more labor inputs.[9] Analytically,

$$q_j = a_j^{1+\theta}, \theta > -1 \tag{4}$$

where a_j is the amount of labor needed to produce one unit of j. The term $1 + \theta$ measures the elasticity of quality relative to the amount of labor inputs.[10] To keep the model as simple as possible, we do not consider that higher-quality products might also demand more expensive intermediate products, as shown by Kugler and Verhoogen (2012).

As in Baldwin and Harrigan (2011), we assume that firms, after paying a sunk cost, draw a labor coefficient, a, from a cumulative distribution function, which is assumed to be Pareto. The labor coefficient determines the maximum quality a firm is able to obtain.

$$G[a] = 1 - \left(\frac{a_{min}}{a} \right)^{\kappa}, a_{min} \leq a, \kappa > 1 \tag{5}$$

where κ is the shape parameter and a_{min} is the minimum labor coefficient a firm can

[9] Using the words of Crozet et al. (2012), higher quality goods might demand a "low yield" or an artisan way of production.

[10] For example, if θ was -1, more labor inputs would not yield higher quality.

draw. The labor coefficient draw is equivalent to a productivity draw in a Melitz-type model (Melitz, 2003).

To produce any quality variety the firm should pay a fixed cost, f_v, that we assume to be the same for all varieties.[11]

In a monopolistic competition model firms maximize profits setting a constant mark-up over marginal costs. Hence, prices can be expressed as:

$$p_j = \left(\frac{\sigma}{\sigma - 1}\right) w a_j, \tag{6}$$

Based on equation 6, operating profits are given by the following expression:

$$\left(\frac{a^{-\theta} w}{1 - 1/\sigma}\right)^{1-\sigma} \frac{E P^{\sigma-1}}{\sigma} \tag{7}$$

It is important to note that according to equation 7 profits depend on the term $a^{-\theta}$. If $\theta > 0$ higher quality varieties (those that demand a higher a), get larger profits. This happens because a marginal increase in the labor coefficient leads to a higher increase in quality, and in prices, than in costs. We will assume that $\theta > 0$.

The fixed cost to develop a variety, f_v, determines the cut-off quality, where profits are zero:

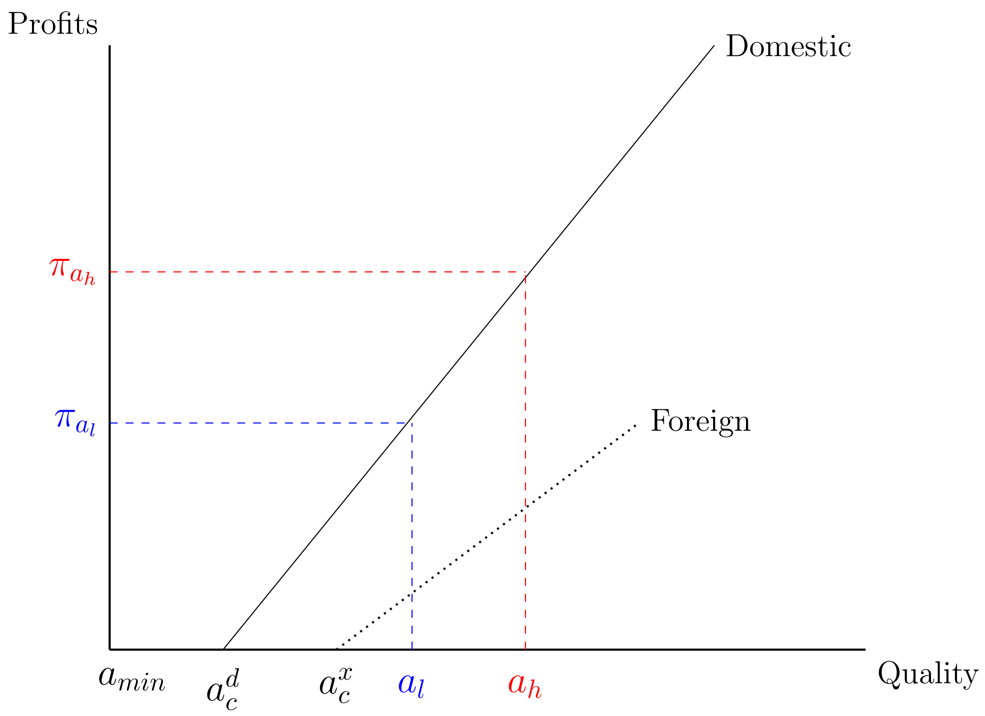
$$\left(\frac{a^{-\theta} w}{1 - 1/\sigma}\right)^{1-\sigma} \frac{E P^{\sigma-1}}{\sigma} = f_v \tag{8}$$

If a firm draws a labor coefficient above the cut-off quality (a_c^d), it will produce the variety with the level of quality that corresponds to the draw. However, the firm will also produce all the quality varieties between its draw a and the cut-off quality for the domestic market a_c^d. This is shown in Figure 2. If a firm draws a labor coefficient a_h, it will produce all the quality varieties between a_c^d and a_h. However, if a firm draws a lower labor productivity, a_l, it will produce a narrower quality-range, $[a_c^d - a_l]$. According to our model, more productive firms, understood as those that can produce higher quality varieties, offer a larger range of quality varieties than less productive firms. Figure 2 also shows that profits are positively related to the quality of the variety ($\pi_{a_h} > \pi_{a_l}$).

A firm faces two additional costs if it wants to sell its varieties in a foreign market. First, they have to pay a variable, iceberg-type, trade cost: τ_x, where $\tau_x > 1$ and x stands for foreign market. Second, firms have to pay a fixed cost to enter a foreign market, (f_x). As in Melitz (2003), we assume that the variable trade costs and fixed export costs are higher than the fixed costs of producing each quality variety ($\tau_x^{1-\sigma} f_x > f_v$). Exports'

[11] To simplify the model we do not consider that a firm should pay higher marginal cost to produce varieties different to its core (quality) variety, as in Eckel and Neary (2010).

Figure 2: Profits, maximum quality and quality range



fixed and variable costs are the same for all varieties, and each variety should pay its fixed export cost.

Export costs raise the cut-off quality to earn profits in a foreign market.

$$\left(\frac{a^{-\theta} w \tau_x}{1 - 1/\sigma}\right)^{1-\sigma} \frac{E_x P_x^{\sigma-1}}{\sigma} = f_x \tag{9}$$

where E_x is the share that the foreign country spends in industry i and P_x is industry i's price index in the foreign country.

As shown in Figure 2, for foreign markets the cut-off quality level rises to a_c^x. In addition to that, the additional variable costs lower the slope of the profits-quality line (Foreign dotted line). More productive firms export a larger range of quality varieties $[a_h - a_c^x]$ than less productive firms $[a_l - a_c^x]$. The quality-range of exported varieties $[a_h - a_c^x]$ is narrower than the quality-range of varieties sold in the domestic market $[a_h - a_c^d]$. However, the average quality of the exported varieties is higher.

Equation 9 and Figure 2 also guide us on the relationship between the range of qualities that a firm offers in a foreign market and some destination characteristics. For example, if variable trade costs are positively related to distance, firms will export a narrower range of varieties to countries that are far from Spain; moreover, the exported varieties will have a higher quality level. An increase in the size of the foreign market (an increase in E_x in equation 9), reduces the cutoff quality, leading firms to widen their range of varieties from the low-end. This will also be the case if there is an increase in average prices in the foreign market, as lower-quality varieties would earn larger profits, reducing the cut-off quality.

Our simple extension of the Baldwin and Harrigan (2011) model generates the three components of the variation of prices identified in the previous section. First, more productive firms produce, on average, higher quality goods than less productive firms. This generates the differences in prices across firms. As firms produce more than one quality variety, destination characteristics determine the range of varieties sold in each foreign market. This explains the variation in prices within firms and across destinations. Finally, the fact that firms produce a range of quality varieties of the same product explains why we find differences in prices within firms and destinations. The next section empirically tests these predictions.

5 Explaining the differences in prices across and within Spanish firms

This section aims to test empirically the predictions of our model regarding each price variation component. We divide the section into three parts. First, we test the predictions regarding the differences in prices across firms. Second, we test the predictions regarding the differences in prices within firms and across destinations. Finally, we test the predictions regarding the differences in prices within firms and destinations.

5.1 Differences in prices across firms

Our model predicts that more productive firms export, on average, higher-quality goods than less productive firms. If quality is reflected in higher prices, more productive firms should charge, on average, higher prices than less productive firms. This would explain the variation in prices across firms. To get average prices, we collapse the transaction data at the firm, product and destination level, and calculate an average unit value for each firm-product-destination triad. Next, we estimate the following equation:

$$\ln p_{kfd} = \alpha + \beta \ln(TFP) + \gamma \ln(C') + \mu_{kd} + \epsilon_{kfd} \tag{10}$$

where p_{kfd} is the average unit value of product k exported by firm f to destination d. TFP is total factor productivity, which is estimated using the Levinsohn and Petrin (2003) methodology.[12] C' is a vector of other firm characteristics. The equation includes

[12] We estimate a separate production function for each 4-digit NACE rev 2 industry using all firms with complete information about output, materials, tangible assets and employment over the period 2008-

product-destination fixed effects. Hence, it analyzes how average unit values differ across firms for the same product and destination. ϵ_{kfd} is the independent disturbance term. We cluster errors at the firm level.

Table 4: Differences in export prices across firms

	(1)	(2)	(3)	(4)	(5)	(6)
log TFP	0.347***	0.364***	0.298***	0.375***	0.613***	0.356***
	(0.044)	(0.044)	(0.048)	(0.051)	(0.072)	(0.042)
log total employees		0.044***	0.040***	0.044***	0.063***	0.091***
		(0.007)	(0.008)	(0.009)	(0.011)	(0.007)
log wage per worker			0.192***	0.165***	0.214***	0.181***
			(0.041)	(0.047)	(0.055)	(0.035)
log capital per worker			-0.029***	-0.021*	-0.037**	-0.016*
			(0.010)	(0.011)	(0.015)	(0.009)
intermediate import share			0.452***	0.681***	0.831***	0.620***
			(0.133)	(0.140)	(0.392)	(0.106)
correction term						-0.246***
						(0.005)
Sample	CDS	CDS	CDS	CDS domestic	CDS >= 50 empl	CDS
Frequency	Annual	Annual	Annual	Annual	Annual	Annual
Estimation	OLS	OLS	OLS	OLS	OLS	Selection control
Cluster	firm	firm	firm	firm	firm	firm
N.observ	38711	38711	38711	32199	28887	38711
Fixed effects	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1399	756	1586
Products	1261	1261	1261	1224	1178	1261
Countries	166	166	166	163	165	166
R squared	0.840	0.841	0.841	0.806	0.870	0.879

Note: Standard errors clustered at the firm level in parentheses. ***, **, * statistically significant at 1%. 5% and 10% respectively.

Table 4 presents the regression results. First, we estimate equation 10 using TFP, along with the product-destination fixed effects, as the only independent variable. The TFP coefficient is positive and statistically significant, confirming that more productive firms charge, on average, higher export prices. In particular, a 100% increase in TFP leads to a 35% rise in unit value. This result is in line with the findings in Görg et al. (2010), Bastos and Silva (2010) and Harrigan et al. (2015) for Hungary, Portugal and the US, respectively.

In column 2 we add the log number of employees, to control that TFP is not capturing the positive effect of firm size on unit values. We can see that the size of the firm is positively correlated with unit value, but the TFP coefficient remains positive and

2013. Output is deflated using 4-digit NACE rev 2 industrial prices. Materials and tangible assets are deflated using 2-digit NACE rev 2 input and capital prices, respectively. We use the Stata routine *levpet* to estimate the production coefficients using intermediate inputs (materials) as control for unobservable productivity shocks.

statistically significant. In column 3 we control for other firm characteristics, such as the wage per employee, capital per employee and intermediate import share. We find that firms with a higher skill intensity, proxied by wages per employee, charge higher unit values. In contrast, more capital-intensive firms set lower unit values. Results also indicate that a higher share of intermediate inputs are positively related with export prices.[13] We observe that the TFP coefficient remains positive and statistically significant once we control for these additional firm characteristics.

As robustness checks, in column 4 we run the regression for a sample of domestically-owned firms, and in column 5 for a sample of firms with 50 or more employees. The main change is the much higher TFP coefficient for firms with 50 or more employees. The remaining coefficients keep their sign and remain statistically significant.

As explained by Harrigan et al. (2015), firms' pricing decisions are only observed when they decide to export. If the variables determining export prices also influence the value of exports, the coefficients in equation 10 might capture not only the effect of firms' characteristics on prices, but also on trade volumes. Econometrically, the errors of the price equation might be correlated with the errors of the export volume equation, biasing the coefficients. To remove this bias, Harrigan et al. (2015) estimate an export-volume equation and calculate the residuals. Then, they add the residuals as an additional regressor in the price equation.[14] Column 6 presents the results of estimating equation 10 with the selection control methodology. Comparing column 6 with column 3, we observe that the TFP coefficient, the total employees coefficients and the intermediate import share coefficient are larger. The capital per worker and the wages per employee coefficients are smaller in absolute terms. In any case, all coefficients keep their sign and remain statistically significant.

5.2 Differences in exports prices within firms and across destinations

The second component of the variation in prices is differences within a firm and across destinations. Our model predicts that firms should export, on average, higher quality varieties to more distant countries, and lower quality varieties to countries with a large GDP and a high price index. Other models, such as Fajgelbaum et al. (2011), also predict a positive relationship between GDP per capita in the destination market and export

[13] We control for this variable due to its positive relationship with productivity (Halpern et al., 2015), and quality (Manova and Zhang, 2012; Fan et al., 2015).

[14] In fact, before estimating the export volume equation, Harrigan et al. (2015) estimate, for each product, a Probit model to analyze firms' entry decision in a given market. They save the inverse Mills ratio yielded by this estimation, and introduce it as an additional regressor in the export volume equation. This procedure ensures that the coefficients in the export volume equation capture the effect of the independent variables on the intensive margin and not on the extensive margin of exports.

prices. To test these predictions, as in the previous analysis, we collapse the transaction data at the firm-product-destination triad, and estimate the following regression equation,

$$\ln p_{kfd} = \alpha \ln(dist_d) + \beta \ln(GDP_d) + \sigma \ln(GDPpc_d) + \theta \ln(REM_d) + \mu_{kf} + \epsilon_{kfd} \quad (11)$$

where $dist_d$ is the distance between Spain and destination d, GDP_d is the GDP of destination d, $GDPpc_d$ is the GDP per capita of destination d and REM_d is the remoteness of destination d. This variable aims to capture the price index in the destination country.[15] Models assume that the price index will be larger the lower the number of varieties available in the destination; this number will be negatively correlated with distance to large suppliers. Based on these assumptions remoteness is calculated as follows:

$$REM_d = [\sum_s Y_s/d_{sd}]^{-1} \quad (12)$$

where Y_s is the GDP of supplier country, d_{sd} is the distance between the supplier and the destination country. According to equation 12, a country will be more economically remote the larger the weighted distance to its partners, using GDP as weight.

Equation 11 also includes a product-firm fixed effect, μ_{kf}, and an exogenous disturbance, ϵ_{kfd}. Hence, coefficients capture how destination characteristics might alter the pricing decision of a firm for a given product.

Table 5-column 1 estimates equation 11 with our baseline sample (MM CDS). The GDP per capita coefficient is positive and statistically significant, suggesting that firms set a higher price in richer countries. The GDP coefficient is negative, but statistically not significant. The remoteness coefficient is negative and statistically significant, confirming that firms set a lower export price when they trade with remote countries. Finally, the distance coefficient is positive and statistically significant, showing that firms sell at higher unit values in more distant destinations. In particular, the doubling of distance leads to a 4.9% increase in unit values.

These results confirm the predictions of our model regarding price index and distance. As for this latter variable, in our model firms only earn profits in foreign markets with higher quality varieties; hence, we predict a positive relationship between export prices and distance. However, this positive relationship could also stem if transport costs were unitary. This is known as the Alchian-Allen conjecture, which predicts a larger

[15] In bilateral trade gravity models remoteness is denoted as the multilateral index (Anderson and van Wincoop, 2003), and is proxy by a destination fixed effect. We cannot follow this procedure because it would preclude the estimation of other destination-specific variables, such as distance, GDP or GDP per capita.

Table 5: Variation of export prices within firm-product and across destinations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log GDPpc	0.025***	0.029***	0.024***	0.036***	0.037***	0.039***	0.037***	0.045***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
log GDP	-0.001	-0.002	-0.002	0.024***	-0.014***	-0.014***	-0.014***	0.009***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
log remoteness	-0.057***	-0.040***	-0.060***	-0.025**	-0.026***	-0.015***	-0.028***	-0.003
	(0.011)	(0.013)	(0.011)	(0.012)	(0.005)	(0.006)	(0.005)	(0.006)
log distance (kms)	0.049***		0.052***		0.057***		0.057***	
	(0.006)		(0.006)		(0.002)		(0.002)	
$500 < kms <= 2500$		0.042***		0.000		0.053***		0.008
		(0.015)		(0.014)		(0.006)		(0.006)
$2500 < kms <= 6000$		0.076***		0.010		0.120***		0.057***
		(0.017)		(0.016)		(0.006)		(0.007)
$6000 < kms <= 11000$		0.115***		0.041**		0.132***		0.074***
		(0.017)		(0.017)		(0.007)		(0.008)
$> 11000 kms$		0.123***		0.048**		0.197***		0.099***
		(0.024)		(0.023)		(0.011)		(0.011)
correction term			-0.005***	-0.071***			-0.004***	-0.073***
			(0.000)	(0.003)			(0.000)	(0.002)
Sample	CDS	CDS	CDS	CDS	Customs	Customs	Customs	Customs
Frequency	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual
Method	OLS	OLS	Selection Control	Selection Control	OLS	OLS	Selection Control	Selection Control
N.observ	38711	38711	38711	38711	271285	271285	271285	271285
Fixed effects	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod
Clusters	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1586	15437	15437	15437	15437
Products	1261	1261	1261	1261	4289	4289	4289	4289
Countries	166	166	166	166	177	177	177	177
R squared	0.928	0.927	0.928	0.932	0.934	0.934	0.934	0.938

Note: Standard errors clustered at product-destination level in parentheses. All regressions include firm-product fixed effects. ***, **, * statistically significant at 1%. 5% and 10% respectively.

relative demand for high-quality goods in more distant markets.[16] An alternative explanation is that firms might be able to set higher mark-ups in more distant destinations. However, this explanation has two drawbacks. First, extant models predict that firms' mark-ups should be lower in more distant markets, because they have to absorb some of the additional trade costs to remain competitive (Melitz and Ottaviano, 2008). Second, differences in demand elasticities across countries for the same product have to be unreasonable large to generate the differences in the observed unit values across destinations (Harrigan et al., 2015).

Our model also predicts a negative relationship between GDP and quality. However, the estimated coefficient, although negative, is not statistically significant. Manova and Zhang (2012) argues that higher-quality varieties might entail higher fixed costs in production and delivery. In this case, firms would be willing to face these higher costs if they expect to earn profits in the foreign market. This would generate a positive relationship between market size and average export prices. The existence of opposing forces might explain why the literature, as explained below, does not find a clear-cut relationship between quality and market size.

To keep it simple, our model assumes homothetic preferences. However, as explained by Verhoogen (2008) and Fajgelbaum et al. (2011), consumers might raise their expenditure in higher-quality goods when they become richer. The non-homothetic preferences would explain the positive GDP per capita coefficient reported in column 1.

In column 1 we assume a log-linear relationship between unit values and distance. While a constant elasticity of distance is the standard assumption underlying gravity equations, there is little a priori reason to expect this relationship to carry over to prices. Therefore, in column 2 we divide distance in five steps. The first step, distance$<$ 500 km., only includes Portugal, the closest country to Spain. The second step, 500 $<$distance$\leq$ 2500, includes most of European countries; the third step, 2500 $<$distance$\leq$ 6000, includes the north of Africa, the Middle East and Central Asia; the fourth step, 6000 $<$distance$\leq$ 11000 includes all American countries and South-East Asia; the final step distance$>$ 11000 includes Oceania and some Asian countries that are far from Spain. The first step is the excluded category in the regression. We can see that Spanish firms increase prices by 4.2% when they sell in European countries. Export prices rise by 7.6% when exports are sold in the North of Africa and the Middle-East, and between 11-12% when products are sold in the American continent, most of Asia and Oceania. These results point out that, except for the last distance step, the assumption about a constant distance elasticity is reasonably valid. GDP and GDP per capita coefficients are similar to those reported in column 1, and there is a drop in the value of the remoteness coefficient. Columns 3 and 4 estimate the model using the selection correction method suggested by Harrigan

[16] This prediction has been validated empirically by Hummels and Skiba (2004).

et al. (2015). Column 3 reports very similar results to column 1. Column 4 reports lower coefficients for the distance steps.

Equation 11 does not include any firm characteristic variable. Hence, we can also estimate the equation using the whole sample of MM firms. This raises the number of firms from 1,546 to 15,437. As shown in column 5, the GDP per capita and distance coefficients remain positive and statistically significant. The remoteness variable remains negative and statistically significant, although its absolute value is lower than in column 1. The main change is related to the GDP coefficient, which now, as predicted by our model, is negative and statistically significant. In column 6, we estimate equation 11 with distance steps. As shown in the table, now the last distance step coefficient, $> 11,000$, is much higher than the previous step, $6000 < distance \leq 11000$. Finally, in columns 7 and 8 we estimate the equation with the selection control methodology. As before, the main changes are related with the distance step coefficients, which are lower when the selection control is applied. In the last column, the GDP coefficient shifts to positive and the remoteness coefficient becomes statistically not significant.

We can use the estimates reported in column 5 to compare our results with the existing literature. To the best of our knowledge, there are five papers that have analyzed the relationship between export prices and destination characteristics using firm-level data: Görg et al. (2010) use data on Hungarian firms for the year 2003, Bastos and Silva (2010) use data on Portuguese firms for the year 2005, Martin (2012) uses data on French firms for the year 2003, Manova and Zhang (2012) use data on Chinese firms for the year 2005, and Harrigan et al. (2015) use data on US firms for the year 2002.[17] All studies find that within a product and a firm unit values rise with distance. Our point estimate, 0.057, is very similar to the one reported by Bastos and Silva (2010). Manova and Zhang (2012) and Martin (2012) find a positive and statistically significant effect for GDP per capita; Görg et al. (2010) also find a positive coefficient, although statistically not significant. Bastos and Silva (2010) and Harrigan et al. (2015) use GDP per worker instead of GDP per capita. The former reports a positive and statistically significant effect and the latter a negative, but statistically not significant effect. Our point estimate, 0.037 is substantially higher than those reported by Manova and Zhang (2012) and smaller than the one reported by Bastos and Silva (2010). The literature reports the whole range of possible estimates for GDP. Manova and Zhang (2012) report a positive and statistically significant effect, Bastos and Silva (2010) report a positive but statistically not significant effect, Görg et al. (2010) and Harrigan et al. (2015) report a negative and statistically significant coefficient, and Martin (2012) reports a negative but statistically not significant coefficient. Our point estimate, -0.014, has a lower (absolute) value than those reported

[17] For comparisons we use Table 4-column 1 for Görg et al. (2010), Table 6-column 11 for Bastos and Silva (2010), Table 2-column 4 for Martin (2012), Table 7-column 5 for Manova and Zhang (2012) and Table 3-column 2 for Harrigan et al. (2015).

by Görg et al. (2010) and Harrigan et al. (2015). Finally, Manova and Zhang (2012) and Harrigan et al. (2015) also estimate remoteness. In both cases, the coefficient is negative and statistically significant. Our point estimates, -0.026, has a lower (absolute) value than the coefficients reported by these authors.

As an additional analysis on the relationship between export prices and destination characteristics, we divide the CDS sample in low-TFP firms and high-TFP firms. We estimate a regression similar to equation 11, but interacting each independent variable with a dummy variable that takes the value of one if the firm is a high-TFP firm and zero otherwise. Our model predicts that more productive firms export a larger range of quality-varieties than less productive firms. Hence, we expect the (average) unit values of high-TFP firms to be more sensible to destination characteristics than the (average) unit values of low-TFP firms. Table 6 presents the estimations. They show that even the low-TFP firms adjust their (average) prices to the characteristics of the destination as predicted by theory. However, contrary to our expectations, we do not observe that destination characteristics become more sensible for high-TFP firms. Bastos and Silva (2010) and Harrigan et al. (2015) neither find significant differences in destination coefficients across firms with different TFP levels.

5.3 Explaining the differences in prices within firms and destinations

Finally, we analyze the factors that might explain the differences in prices within a firm and a destination. According to our model more productive firms export a wider quality-range of varieties than less productive firms. Hence, we should expect a positive relationship between range of quality-varieties and productivity. Our database does not provide information on the range of varieties offered by firms in a given product. We use two variables to proxy the number of varieties. First, we proxy it with the standard deviation of (log) prices. Our claim is that a wider quality-range of varieties should reflect in a broader menu of prices. Second, we count the number of transactions within a firm-production-destination triad that have different prices.[18]

To test the validity of this argument we estimate the following equation:

$$qrv_{kfd} = \beta \ln(TFP_f) + \mu_{dk} + \epsilon_{kfd} \tag{13}$$

where qrv_{fdk}, is the proxy for quality-range of varieties: the variance of (log) unit values, or the number of transactions with different unit values, of firm f, in destination

[18] We establish a 1% difference threshold to consider that two transactions have different unit values. Results are not altered if we use a 5% threshold.

Table 6: Variation of export prices within firm-product and across destinations. Low-TFP vs. High-TFP firms

	(1)	(2)	(3)	(4)
log GDPpc	0.023***	0.028***	0.023***	0.038***
	(0.006)	(0.007)	(0.006)	(0.006)
log GDPpc*highTFP	0.004	0.002	0.003	-0.003
	(0.009)	(0.009)	(0.009)	(0.009)
log GDP	-0.001	-0.001	-0.001	0.024***
	(0.003)	(0.004)	(0.003)	(0.004)
log GDP*highTFP	-0.001	-0.002	-0.002	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)
log remoteness	-0.060***	-0.042**	-0.064***	-0.016
	(0.015)	(0.017)	(0.015)	(0.017)
log remote*highTFP	0.005	0.002	0.006	0.003
	(0.021)	(0.024)	(0.021)	(0.024)
log distance	0.043***		0.043***	
	(0.007)		(0.007)	
log distance*highTFP	0.011		0.017	
	(0.011)		(0.011)	
$500 < kms <= 2500$		0.059***		0.014
		(0.021)		(0.020)
kms[500, 2500]*highTFP		-0.031		-0.025
		(0.028)		(0.027)
$2500 < kms <= 6000$		0.102***		0.031
		(0.023)		(0.022)
kms[2500, 6000]*highTFP		-0.047		-0.037
		(0.031)		(0.030)
$6000 < kms <= 11000$		0.116***		0.047**
		(0.024)		(0.023)
kms[6000, 11000]*highTFP		-0.003		-0.011
		(0.032)		(0.031)
$> 11000 kms$		0.126***		0.067**
		(0.030)		(0.030)
kms[> 11000]*highTFP		-0.008		-0.008
		(0.044)		(0.043)
correction term			-0.005***	-0.071***
			(0.000)	(0.003)
Sample	CDS	CDS	CDS	CDS
Frequency	Annual	Annual	Annual	Annual
Method	OLS	OLS	Selection control	Selection Control
N.observ	38711	38711	38711	38711
Fixed effects	firm*prod	firm*prod	firm*prod	firm*prod
Cluster	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1586
Products	1261	1261	1261	1261
Countries	166	166	166	166
R squared	0.928	0.928	0.928	0.932

Note: Standard errors clustered at the firm level in parentheses. ***, **, * statistically significant at 1%. 5% and 10% respectively.

d, and in product k.

Table 7 reports the regression results. Columns 1 to 4 estimate the regression using the log dispersion of prices as the dependent variable, and columns 5 to 8 the number of transactions with different prices as the dependent variable. As expected, the TFP coefficient in column 1 is positive and statistically significant. This result confirms that more productive firms have a larger dispersion of prices for the same product in the same destination, which proxies for a larger quality-range of varieties. A 100% increase in TFP leads to a 4.7% increase in price dispersion. In column (2) we control for other firm level characteristics. We find that the dispersion of prices is positively correlated with the size of the firm and the wages per employee, and negatively with capital per employee. The share of intermediate inputs has no effect on dispersion. In columns 3 and 4 we show that main results are robust to the size of firms and selection control. In columns 5 to 8 we use the (log) number of transactions with different prices as dependent variable. As expected, for all estimations the TFP coefficient is positive and statistically significant. In particular, according to the coefficient reported in column (5), a 100% increase in TFP leads to 18.4% increase in the number of transactions with different prices. In column 6 we observe that the number of transactions is positively correlated with the size of the firm and the share of intermediate inputs, but negatively correlated with capital per employee. The TFP coefficient is also robust to changes in the size of the firm and selection control.

Next, we analyze whether destination characteristics influence the quality-range of varieties offered by exporters. We estimate an equation similar to 11, but substituting the dependent variable with the proxies for quality-range of varieties. According to our model, firms should export a larger quality-range of varieties to countries with a larger GDP and a higher price index, and a smaller quality-range of varieties to more distant countries.[19]

Table 8, column 1, reports the estimation when log dispersion of prices is the dependent variable. As predicted, we find a positive and statistically significant effect for GDP and remoteness, and a negative and statistically significant effect for distance. We also get a non-significant effect for GDP per capita. In column 5 we use the number of transactions as the dependent variable. We still find a positive coefficient for GDP and remoteness, and a negative coefficient for distance; however, now we obtain a positive and statistically significant coefficient for GDP per capita. These results are robust to using a selection control model.

In columns 2 and 6, we interact the country destination characteristics with a dummy for high-TFP firms. As productive firms can offer a wider quality-range of varieties, we

[19] This outcome is similar to that predicted by Bernard et al. (2010) for multi-product firms, where only the most profitable, or core, products are exported to distant markets.

Table 7: Variation of export prices within product, firm and destination. Firm characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log TFP	0.047***	0.033*	0.065**	0.033*	0.184***	0.230***	0.244***	0.177***
	(0.016)	(0.018)	(0.027)	(0.018)	(0.033)	(0.035)	(0.052)	(0.029)
log total employees		0.009***	0.016***	0.009***		0.112***	0.128***	0.067***
		(0.003)	(0.005)	(0.003)		(0.006)	(0.009)	(0.005)
log wage per worker		0.039**	0.031	0.039**		0.021	-0.033	0.031
		(0.016)	(0.022)	(0.016)		(0.031)	(0.045)	(0.026)
log capital per worker		-0.009**	-0.028***	-0.009**		-0.016**	-0.041***	-0.027***
		(0.004)	(0.007)	(0.004)		(0.007)	(0.012)	(0.006)
intermed. import share		-0.058	-0.189	-0.057		0.484***	1.251***	0.334***
		(0.042)	(0.188)	(0.042)		(0.097)	(0.425)	(0.087)
correction term				-0.001				0.218***
				(0.002)				(0.003)
Dep.var.	sd(price)	sd(price)	sd(price)	sd(price)	n. trans.	n. trans.	n. trans.	n. trans.
Sample	CDS	CDS	CDS >= 50 empl	CDS	CDS	CDS		CDS
Frequency	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	CDS >= 50 empl	Selection control
Method	OLS	OLS	OLS	Selection control	OLS	OLS	OLS	OLS
N.observ	38711	38711	28887	38711	38711	38711	28887	38711
Fixed effects	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Cluster	firm	firm	firm	firm	firm	firm	firm	firm
Firms	1586	1586	756	1586	1586	1586	756	1586
Products	1261	1261	1178	1261	1261	1261	1178	1261
Countries	166	166	165	166	166	166	165	166
R squared	0.469	0.470	0.461	0.470	0.431	0.448	0.462	0.613

Note: Standard errors clustered at the firm level in parentheses. ***, **, * statistically significant at 1%. 5% and 10% respectively.

Table 8: Variation within product, firm and destination. Destination and firm characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log GDPpc	0.003	0.001	0.003	0.001	0.031***	0.025***	0.032***	0.025***
	(0.003)	(0.005)	(0.003)	(0.005)	(0.006)	(0.008)	(0.006)	(0.008)
log GDP	0.017***	0.015***	0.017***	0.015***	0.141***	0.128***	0.143***	0.128***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.004)	(0.005)	(0.004)	(0.005)
log remote	0.028***	0.015	0.029***	0.015	0.197***	0.142***	0.202***	0.148***
	(0.007)	(0.011)	(0.007)	(0.011)	(0.014)	(0.021)	(0.014)	(0.020)
log distance	-0.010***	0.001	-0.010***	0.001	-0.228***	-0.192***	-0.233***	-0.193***
	(0.003)	(0.005)	(0.003)	(0.005)	(0.008)	(0.010)	(0.008)	(0.010)
log GDPpc*highTFP		0.003		0.003		0.010		0.012
		(0.006)		(0.006)		(0.010)		(0.010)
log GDP*highTFP		0.003		0.003		0.023***		0.025***
		(0.003)		(0.003)		(0.006)		(0.006)
log remote*highTFP		0.025*		0.025*		0.101***		0.099***
		(0.014)		(0.014)		(0.025)		(0.025)
log distance*highTFP		-0.020***		-0.020***		-0.065***		-0.074***
		(0.007)		(0.007)		(0.013)		(0.013)
correction term			0.000	0.000*			0.009***	0.009***
			(0.000)	(0.000)			(0.001)	(0.001)
Dep.Var.	sd(price)	sd(price)	sd(price)	sd(price)	n. transac	n. transac	n. transac	n. transac
Sample	CDS	CDS	CDS	CDS	CDS	CDS	CDS	CDS
Frequency	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.
Method	OLS	OLS	Selection control	Selection control	OLS	OLS	Selection control	Selection control
N.observ	38711	38711	38711	38711	38711	38711	38711	38711
Fixed effects	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod
Cluster	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1586	1586	1586	1586	1586
Products	1261	1261	1261	1261	1261	1261	1261	1261
Countries	166	166	166	166	166	166	166	166
R squared	0.403	0.404	0.403	0.404	0.375	0.376	0.382	0.383

Note: Standard errors clustered at the firm level in parentheses. ***, **, * statistically significant at 1%. 5% and 10% respectively.

expect high-TFP firms to be more sensible to differences in GDP, remoteness and distance among destinations. When the dependent variable is the standard deviation in log prices, column 2, we find, as expected, a positive interaction coefficient for remoteness and a negative interaction coefficient for distance; the GDP interaction coefficient, as predicted, is positive, but statistically not significant. When we use the (log) number of transactions with different prices (column 6), the GDP interaction coefficient becomes statistically significant. Results are not altered when we use the selection control estimation method.

Table A1 in the Appendix reports the results when we use distance steps instead of a (log) linear distance. Regarding country characteristics (columns 1 and 4), we still find a positive effect of GDP and remoteness, although this latter coefficient is not statistically significant in column 4. In column 1, as expected, the effect of distance on the quality-range of varieties becomes more negative as we move to more distant steps; however, this relationship is not clear in column 4. Regarding interaction coefficients, as expected, more distant steps have a larger negative effect on high-TFP firms. The interaction coefficients for GDP and remoteness are positive, but they are only statistically significant when quality-range is proxy by the (log) number of transactions with different prices.

6 Robustness. Effective quality

In the previous section we have used unit values as our dependent variable to analyze how firm- and destination-specific characteristics affect the level and dispersion of export prices. Our results confirm that the behavior of unit values is consistent with the fact that more productive firms produce higher quality goods and a wider range of qualities of the same product in the same destination. Since unit values are, at best, a noisy proxy for quality, some effort has been made recently in estimating export quality. [20]

To measure directly quality, we adopt the easy-to-implement approach proposed recently by Khandelwal et al. (2013) based on the following intuition: "conditional of price, a variety with a higher quantity is assigned a higher quality". It derives that, if two products are offered at the same price but one sells a higher quantity than the other, the reason is that the first product has higher quality. In order to infer the quality of the varieties sold by a firm in a given destination, only data on the value and quantity of exports are needed. Indeed, the quality of an exported variety sold by a firm in a particular destination is obtained directly from the residual of the following OLS regression:

[20] The use of unit values as a proxy of quality has some shortcomings. First, unit values can also reflect production costs or pricing strategies. Second, if the composition of goods within a product category varies across exporters, then cross-country differences in unit values may reflect differences in composition, rather than in quality. Third, changes over time may reflect changes in quality-adjusted prices rather than quality.

Table 9: Effective quality. Differences across firms

	(1)	(2)	(3)	(4)	(5)	(6)
log TFP	1.855***	2.019***	1.728***	2.031***	3.002***	1.782***
	(0.195)	(0.193)	(0.210)	(0.229)	(0.310)	(0.209)
log total employees		0.429***	0.407***	0.492***	0.495***	0.454***
		(0.030)	(0.033)	(0.039)	(0.047)	(0.034)
log wage per worker			0.914***	0.770***	0.970***	0.904***
			(0.176)	(0.204)	(0.234)	(0.174)
log capital per worker			-0.093**	-0.032	-0.147**	-0.081*
			(0.047)	(0.052)	(0.064)	(0.046)
intermediate import share			2.944***	3.684***	3.622***	3.100***
			(0.539)	(0.567)	(0.626)	(0.529)
correction term						-0.228***
						(0.027)
Sample	CDS	CDS	CDS	CDS domestic	CDS >= 50 empl	CDS
Frequency	Annual	Annual	Annual	Annual	Annual	Annual
Estimation	OLS	OLS	OLS	OLS	OLS	Selection control
Cluster	firm	firm	firm	firm	firm	firm
N.observ	38711	38711	38711	32199	28887	38711
Fixed effects	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1399	756	1586
Products	1261	1261	1261	1224	1178	1261
Countries	166	166	166	163	165	166
R squared	0.349	0.359	0.361	0.367	0.403	0.368

Note: Standard errors clustered at the firm level in parentheses. ***, **, * statistically significant at 1%. 5% and 10% respectively.

$$\ln q_{kfd} + \sigma * lnp_{kfd} = \alpha_k + \alpha_d + \epsilon_{kfd} \tag{14}$$

where q_{kfd} and p_{kfd} are, respectively, the quantity and the price (unit value) of product k, exported by firm f to country d. α_k and α_d account for product and country specific fixed effects, respectively. The extra piece of information to estimate quality is the elasticity of substitution (σ). We follow Fan et al. (2015) and assume that σ is constant and equal to 5. Then, the residuals from the regression provide a measure of "effective quality", that is, quality obtained from the consumer's utility.[21] We use export data defined at firm-product-destination level to calculate the average quality of each product sold by one firm across different markets. In order to calculate the degree of dispersion in quality within a product exported by a firm to a particular destination, we use the transaction-level trade data.

With our measure of quality replacing export prices as the dependent variable, we test again the three main hypotheses derived from the theoretical model. First, we examine

[21] Hallak (2006), Khandelwal (2010) and Schott (2004) propose alternative approaches to estimate effective quality.

the correlation between quality of exports and productivity across firms. Our measure of quality allows us to test directly whether more productive firms sell abroad higher quality varieties compared to less productive firms selling the same product. The results displayed in Table 9 are very similar to those found in Table 4. Without controlling for other observable firm characteristics, more productive firms export products, on average, with higher quality. The result holds after controlling for firm size only (column 2) or total sales, wage per employee, physical capital per employee and the share of imported inputs in variable costs (column 3). The positive correlation is also found for two subsamples of firms: domestic firms only (column 4), and firms with more than 50 employees (column 5). Finally, the results are not affected by changing the estimation technique from OLS to 3-stage selection model (column 6).

Next, we test our second hypothesis: firms tend to sell higher quality varieties of the same product in richer and more distant markets. The results are presented in Table 10. Overall the findings are similar to those displayed in Table 5, in which we used export prices as a proxy for quality. We use two different samples of firms: the sample of firms with observable firm characteristics (CDS sample) and the whole population of multi-transaction and multi-destination firms. After controlling for firm-product fixed effects, the positive coefficient of GDPpc confirms that richer countries demand higher quality of the same product sold by the same firm across destinations. The negative coefficient of remoteness confirms that isolated markets tend to exhibit higher prices so quality is less important. And, the positive coefficient on distance shows again that firms tend to sell their varieties of higher quality in more distant markets. However, there are two main differences with respect to the results from Table 5. First, the coefficient of economic size (GDP) is positive and statistically significant in all estimations except for selection control. Second, when we estimate the impact of distance on quality using a semiparametric specification (i.e. odd columns), the positive and increasing coefficients only emerge for very distant destinations. Surprisingly, within Europe, the highest quality is found in Portugal, after controlling for economic size and level of development.

In our last robustness check, we test whether more productive firms tend to sell a wider range of qualities of the same product in one particular destination. The results are presented in Table 11. We confirm that more productive firms offer a larger quality-range of varieties, both when we use the dispersion in prices and the number of transactions with different price as the dependent variable.

7 Conclusion

This paper shows that there are sizable differences in the prices that a firm charges for the same product and destination. To explain this new margin in the variation of export

Table 10: Effective quality. Variation within firm-product and across destinations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log GDPpc	0.067**	0.041	0.075***	-0.044	0.262***	0.233***	0.259***	0.168***
	(0.029)	(0.030)	(0.029)	(0.028)	(0.013)	(0.014)	(0.013)	(0.014)
log GDP	0.149***	0.138***	0.158***	-0.174***	0.231***	0.221***	0.229***	-0.033***
	(0.016)	(0.017)	(0.016)	(0.018)	(0.007)	(0.007)	(0.007)	(0.012)
log remoteness	-0.171**	-0.396***	-0.133*	-0.581***	-0.036	-0.311***	-0.015	-0.445***
	(0.071)	(0.081)	(0.071)	(0.076)	(0.031)	(0.037)	(0.032)	(0.038)
log distance (kms)	0.068*		0.065*		0.150***		0.148***	
	(0.037)		(0.037)		(0.017)		(0.017)	
$500 < kms <= 2500$		-0.480***		0.023		-0.438***		0.085**
		(0.097)		(0.087)		(0.036)		(0.041)
$2500 < kms <= 6000$		-0.408***		0.376***		-0.223***		0.497***
		(0.107)		(0.096)		(0.042)		(0.048)
$6000 < kms <= 11000$		-0.071		0.810***		0.186***		1.078***
		(0.112)		(0.103)		(0.046)		(0.055)
$> 11000 kms$		0.005		1.190***		0.348***		1.460***
		(0.153)		(0.148)		(0.071)		(0.081)
correction term			0.063***	0.848***			0.044***	0.828***
			(0.003)	(0.022)			(0.004)	(0.027)
Sample	CDS	CDS	CDS	CDS	Customs	Customs	Customs	Customs
Frequency	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual
Method	OLS	OLS	Selection Control	Selection Control	OLS	OLS	Selection Control	Selection Control
N.observ	38711	38711	38711	38711	271285	271285	271285	271285
Fixed effects	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod
Clusters	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1586	15437	15437	15437	15437
Products	1261	1261	1261	1261	4289	4289	4289	4289
Countries	166	166	166	166	177	177	177	177
R squared	0.579	0.580	0.587	0.671	0.720	0.720	0.724	0.777

Note: Standard errors clustered at product-destination level in parentheses. All regressions include firm-product fixed effects. ***, **, * statistically significant at 1%. 5% and 10% respectively.

Table 11: Effective quality. Variation within firm-product-destination

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log TFP	0.315***	0.252**	0.458***	0.242**	0.283***	0.361***	0.484***	0.297***
	(0.094)	(0.102)	(0.154)	(0.102)	(0.039)	(0.041)	(0.062)	(0.034)
log total employees		0.069***	0.107***	0.060***		0.155***	0.178***	0.100***
		(0.020)	(0.030)	(0.020)		(0.007)	(0.011)	(0.006)
log wage per worker		0.206**	0.118	0.208**		-0.015	-0.100*	-0.003
		(0.091)	(0.128)	(0.091)		(0.037)	(0.054)	(0.031)
log capital per worker		-0.047*	-0.156***	-0.049**		-0.011	-0.047***	-0.025***
		(0.025)	(0.038)	(0.025)		(0.008)	(0.013)	(0.007)
intermed. import share		-0.172	-0.712	-0.202		0.563***	1.648***	0.379***
		(0.256)	(1.120)	(0.256)		(0.110)	(0.459)	(0.088)
correction term				0.043***				0.268***
				(0.013)				(0.004)
Dep.var.	sd(quality)	sd(quality)	sd(quality)	sd(quality)	n. trans.	n. trans.	n. trans.	n. trans.
Sample	CDS	CDS	CDS >= 50 empl	CDS	CDS	CDS	CDS >= 50 empl	CDS
Frequency	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.
Method	OLS	OLS	OLS	Selection control	OLS	OLS	OLS	Selection control
N.observ	38711	38711	28887	38711	38711	38711	28887	38711
Fixed effects	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Cluster	firm	firm	firm	firm	firm	firm	firm	firm
Firms	1586	1586	756	1586	1586	1586	756	1586
Products	1261	1261	1178	1261	1261	1261	1178	1261
Countries	166	166	165	166	166	166	165	166
R squared	0.459	0.461	0.457	0.461	0.449	0.472	0.485	0.647

Note: Standard errors clustered at firm level in parentheses. All regressions include firm-product fixed effects. ***, **, * statistically significant at 1%. 5% and 10% respectively.

prices, we extend the Baldwin and Harrigan (2011) model, where more productive firms manufacture higher quality goods, but also a wider quality-range of varieties. Using transaction data for a representative sample of Spanish multi-transaction and multi-destination manufacturing firms, we show that more productive firms export higher quality goods, and set higher prices in more distant and richer destinations. We also find that more productive firms export a larger quality-range of goods, proxy by the standard deviation of (log) prices and the number of transactions with different unit values. As expected, a firm offers a larger range of varieties in high GDP destinations and a lower range of varieties in markets that are far from Spain.

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Table A1: Low-TFP vs. High-TFP firms with distance steps

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log GDPpc	0.003	0.002	0.003	0.001	0.007	-0.003	-0.007	-0.023***
	(0.003)	(0.005)	(0.003)	(0.005)	(0.006)	(0.008)	(0.006)	(0.008)
log GDP	0.017***	0.015***	0.014***	0.013***	0.143***	0.131***	0.090***	0.079***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)
log remote	0.018**	0.009	0.017**	0.008	0.067***	-0.009	0.035**	-0.040*
	(0.008)	(0.014)	(0.008)	(0.014)	(0.017)	(0.023)	(0.016)	(0.022)
$500 < kms <= 2500$	-0.010	-0.001	-0.005	0.004	-0.368***	-0.428***	-0.283***	-0.337***
	(0.009)	(0.014)	(0.009)	(0.014)	(0.018)	(0.026)	(0.017)	(0.025)
$2500 < kms <= 6000$	0.010	0.024	0.017*	0.032**	-0.538***	-0.559***	-0.405***	-0.414***
	(0.010)	(0.016)	(0.010)	(0.016)	(0.021)	(0.029)	(0.019)	(0.027)
$6000 < kms <= 11000$	-0.013	0.008	-0.005	0.016	-0.621***	-0.597***	-0.471***	-0.457***
	(0.010)	(0.015)	(0.010)	(0.015)	(0.022)	(0.030)	(0.020)	(0.029)
$> 11000kms$	-0.036**	-0.005	-0.025	0.006	-0.716***	-0.650***	-0.515***	-0.449***
	(0.016)	(0.025)	(0.016)	(0.025)	(0.031)	(0.045)	(0.030)	(0.045)
log GDPpc*highTFP		0.003		0.003		0.017*		0.027***
		(0.006)		(0.006)		(0.010)		(0.009)
log GDP*highTFP		0.003		0.003		0.023***		0.020***
		(0.003)		(0.003)		(0.006)		(0.006)
log remote*highTFP		0.017		0.017		0.139***		0.137***
		(0.017)		(0.017)		(0.029)		(0.027)
kms$[500, 2500]$*highTFP		-0.014		-0.015		0.109***		0.098***
		(0.018)		(0.018)		(0.034)		(0.031)
kms$[2500, 6000]$*highTFP		-0.026		-0.027		0.036		0.016
		(0.020)		(0.020)		(0.037)		(0.033)
kms$[6000, 11000]$*highTFP		-0.037*		-0.036*		-0.045		-0.028
		(0.020)		(0.020)		(0.038)		(0.035)
kms$[> 11000]$*highTFP		-0.055*		-0.055*		-0.125**		-0.124**
		(0.032)		(0.032)		(0.056)		(0.054)
correction term			0.008***	0.008***			0.144***	0.144***
			(0.001)	(0.001)			(0.004)	(0.004)
Dep.Var.	sd(price)	sd(price)	sd(price)	sd(price)	n. transac	n. transac	n. transac	n. transac
Sample	CDS	CDS	CDS	CDS	CDS	CDS	CDS	CDS
Frequency	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.	Transact.
Method	OLS	OLS	Selection control	Selection control	OLS	OLS	Selection control	Selection control
N.observ	38711	38711	38711	38711	38711	38711	38711	38711
Fixed effects	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod	firm*prod
Cluster	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou	prod*cou
Firms	1586	1586	1586	1586	1586	1586	1586	1586
Products	1261	1261	1261	1261	1261	1261	1261	1261
Countries	166	166	166	166	166	166	166	166
R squared	0.404	0.404	0.405	0.405	0.371	0.372	0.490	0.491