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Abstract

This paper uses transaction-level trade data to analyse 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. These differences are related to the number of goods covered within each product category, volume discounts and vertically differentiated varieties. Export prices are positively correlated with firms' productivity, destination markets' GDP per capita and distance to Spain. These latter results suggest that Spanish exporters compete in quality.

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

JEL classification: F1, F10, F23.

Resumen

Este trabajo utiliza datos individuales de transacciones comerciales para analizar las diferencias en los precios de exportación entre empresas y dentro de cada empresa con una muestra de compañías manufactureras españolas para el año 2014. La naturaleza transaccional de la base de datos revela importantes diferencias en el precio que el exportador carga a un mismo producto y destino. Estas diferencias están relacionadas con el número de bienes comerciados dentro de cada categoría de producto, los descuentos por volumen, y el grado de diferenciación vertical de las variedades de producto. Por su parte, los precios de las exportaciones están positivamente correlacionados con la productividad de las empresas, el PIB per cápita de los mercados de destino y su distancia a España. Estos últimos resultados sugieren que los exportadores españoles compiten en calidad.

Palabras clave: precios de exportación, datos de transacciones a nivel de empresa, heterogeneidad empresarial, calidad, España.

Códigos JEL: F1, F10, F23.

1 Introduction

The literature has documented large differences across exporters (Bernard et al., 2007, 2012). On the extensive margin, there is ample variation in the number of exported products, the portfolio of destinations and the frequency of transactions across firms. On the intensive margin, there are sizable differences in the export price of a product across firms, and within firms and across destinations (Bastos and Silva, 2010; Görg et al., 2010; Manova and Zhang, 2012; Martin, 2012; Harrigan et al., 2015).[1] In particular, exporters set higher prices 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 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 exporters, we find that this new margin explains 19% of the overall variation in export prices.

We test three hypotheses that might explain this new component of the variation in export prices. First, even in a highly detailed 8-digit product classification, some categories might cover different goods. We show that within a firm and a destination, product categories that cover more goods have a higher dispersion of prices. Second, firms might charge lower prices for customers that place larger orders. Our empirical analysis confirms this hypothesis, documenting a negative correlation between export prices and quantities for the same firm, product and destination. Finally, as suggested by Bastos and Silva (2010), firms might offer vertically-differentiated varieties of a product. Following Eckel and Neary (2010) flexible manufacturing model, we argue that firms have a core quality variety, and can produce other quality varieties with higher marginal costs. In this framework, we would expect the range of quality varieties, and export prices, to be lower in more distant markets. Since these markets have larger entry costs, firms will only find profitable to export the varieties that command higher profits, reducing the range of products, and export prices. Our empirical analysis confirms this negative relationship, providing an indirect evidence that vertically-differentiated varieties may also explain the differences in prices within a firm, destination and product.

We also investigate the variation in prices across firms, and within firms and across destinations. As previous studies, we find that more productive firms set higher export prices; and exporters charge higher prices in richer and more distant markets. These results confirm the predictions of models which stress that firms compete in quality and firms offer vertically-differentiated varieties of a product.

[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 country-product-level data.

This paper contributes to the literature showing that there are sizable differences in the export price that firms charge for the same product and destination. This new margin, which is uncovered by the transactional nature of our data, contributes substantially to the overall differences in export prices. We show that this new component of the variation of prices is related to the number of goods that are covered within each product category, pricing to customer strategies and vertically-differentiated varieties. The paper also adds to the literature investigating the variation of export prices across firms, and within firms and across destinations, in Spain, a major exporter in the world.

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 in quality (Verhoogen, 2008; Baldwin and Harrigan, 2011; Crozet et al., 2012; Johnson, 2012; Kugler and Verhoogen, 2012). Our empirical estimations regarding the differences in prices across firms confirm the predictions of these papers. Finally, our paper is related to previous studies, such as Bernard et al. (2010), Eckel and Neary (2010) and Nocke and Yeaple (2014), which analyze multiple-product firms. In this paper, we show, indirectly, that firms, may also export vertically-differentiated varieties of a product.

The paper is organized as follows. The next section describes how we combine three different datasets to build our estimation samples. 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 proposes three hypotheses to explain the new price variation component and tests their empirical validity. Section 5 investigates the differences in export prices across firms, and within firms and across destinations. This section calculates a quality measure to test the robustness of our results for these additional price variation components. The final section concludes.

2 Data

This paper uses a new and unique firm-level manufacturing export transactions dataset for Spain in 2014. The database is the result of combining three different sources. The first 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 53% of total Spanish merchandise exports in 2014.[2]

From the Customs database we get the universe of Spanish manufactures export transactions in 2014. Each export transaction captures an invoice-based exchange between an exporter and importer. If the invoice includes more than a product, it is disaggregated into product-specific transactions. Hence, the Customs database does not capture shipments, but transactions. 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 transaction, the free-on-board (FOB) value in euros of the transaction and the exported quantity (in weight metric and/or units).

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, which constitutes the main analysis of this investigation.

Unit value data are prone to outliers, which might bias the empirical analyses. Since outliers are more likely to arise in small transactions, we remove all transactions with

[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.

a value below 1,500 euros.[4] Next, following Méjean and Schwellnus (2009) and Martin (2012), we drop observations for which the unit value is 5 times higher or lower than the product and firm-specific median unit value in all destinations.

We take additional steps to clean the database. Due to the large heterogeneity of products included in chapters 98 (complete industrial plants) and 99 (special codes), we remove all transactions belonging to these chapters. Due to their special characteristics, we also exclude transactions of petroleum, tobacco and printing products from the database. Since they have a particular status relative to Spain, we remove export transactions with Andorra and Gibraltar. We also drop transactions with countries for which we cannot obtain some of the data demanded by 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.

Table 1: Description of the database

Dabatabase	Customs	Customs	Customs+Directorio+SABI
Type of transacation	All	Multi	Multi
Number of transactions	4,484,187	4,148,858	1,228,006
Number of firms	61,815	32,127	3,008
Number of products	7,539	6,976	4,755
Number of countries	181	178	169
Exports (mill. euros)	177,245	168,073	66,499

As shown in Table 1, after the cleaning steps, we end-up with 4,484,187 export transactions with a total value of 177 billion euros. These transactions are carried out by 61,815 firms, which export 7,539 products to 181 countries. We calculate the number of transactions for each firm-product-destination. We consider that a transaction belongs to the multi-transaction set if it is related to a firm-product-destination that has, at least, two transactions. This set will allow us to measure the price variation within a firm, product and destination. When we move from the all transactions set (All) to the multi-transaction set (Multi), the number of exporters drops to 32,127. However, the relative reduction in the number of transactions is much lower (from 4.5 to 4.1 million). Note that Multi still represents 95% of all manufacturing exports. This is our main estimation sample.

We link the Customs-Multi sample with SABI, using Directorio as link. The sample is reduced to 3,008 firms, which represent 9% of firms included in Multi. These firms export 4,755 different products to 169 different countries, and account for 40% of all

[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.

manufacturing exports in Multi. We use this sample for estimations incorporating firm-level characteristics.

Table 2: Summary statistics for the median firm

Panel A. Trade data in 2014	Multi	CDS	All
Exports (thousand euros)	318	1,940	44
Product	2	3	2
Countries	2	8	1
Number of transactions	15	83	3
Number of transactions of the same product and destination	5	5	2
Panel B. Firm characteristics in 2013	CDS		All manufacturing
Sales (thousand euros)		7,967	6,614
Employees		42	37
Wages per employee (thousand euros)		36	35
Tangible assets (thousand euros)		42	37
Value added per employee (thousand euros)		78	76

Table 2 provides some summary statistics of the two estimating samples and the Customs database, which includes all manufacturing exporters. Panel A presents summary statistics on exports data. The median firm in our main estimating sample, Multi, exports 318,000 euros, two products and serves two destinations. The median firm performs 15 transactions per year, and five of them belong to the same product and destination. The median firm in Multi exports more, sells the same amount of goods abroad, serves more countries and performs more transactions than the median exporter in the Customs database. These differences are widened when we compare the CDS sample with the Customs database.

Panel B presents the characteristics of the median firm in the CDS sample, and compares it with the median manufacturing firm included in SABI. The median firm in CDS has higher sales, more employees, pays higher wages, generates more value added and owns more tangible assets that the median manufacturing firm.

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 export prices. 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 firms and destinations. Algebraically:

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

where p_{fdr} is the price of firm f at destination d in transaction r, $\bar{p}$ 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. We perform the price decomposition without weighting and weighting transactions by quantity. To determine the contribution of each component, we divide each right-hand side term by the left-hand side term.

Table 3: Decomposition of the variance in prices. Results for the median product (%)

	Multi		CDS		Customs	
	Unweighted	Weighted Quantity	Unweighted	Weighted Quantity	Unweighted	Weighted Quantity
Across firms	66.1	70.1	25.8	29.2	85.2	82.0
Across destinations	2.0	3.4	4.9	6.7	2.0	4.2
Across transactions	24.0	19.0	40.0	34.0	6.1	9.3

We present the contribution of each variance component for the median product. First, we perform the analysis for our main estimation sample: Multi. In the unweighted calculation, the across firms component is the main contributor to the differences in export prices: 66%. The second contributor is the across transactions component, explaining 24% of the overall differences in export prices. This result points out that the new component uncovered by the transactional nature of our database contributes notably to the overall differences in prices. The across destinations component only explains 2% of the differences in prices. In the next column, we calculate the contribution of each component weighting transactions by quantity. The across transaction component is reduced from 24% to 19%. Nevertheless, it still contributes substantially to the overall differences in export prices.

In the CDS sample, our second estimation sample, the across transaction component becomes the most important contributor to the overall differences in prices. In the quantity-weighted calculation, differences in export prices within firms, products and destinations explain around one-third of the overall differences in prices.

Our estimation samples only includes firm+product+destination combinations that have, at least, two transactions. This selection leads to a positive bias in the contribution of the across transactions component. To measure this bias, in the last two columns of Table 3 we perform the decomposition of export prices for all firms included in the Customs database. In this sample, as shown in Table 1, almost half of firms only perform one transaction per product and destination, so their across transactions component is zero. The across firms component becomes the most important contributor to the variation of export prices, explaining 82% of the quantity-weighted variation. The across destinations component explains 4% of the differences, and the across transactions component 9% of the differences. Although the contribution of the across transaction component is lower than in the estimation samples, it is still remarkable, given that half of firms only perform one transaction per product and destination.

Figure 1: Distribution of the percentage deviations of export unit values from firm-product-destination means

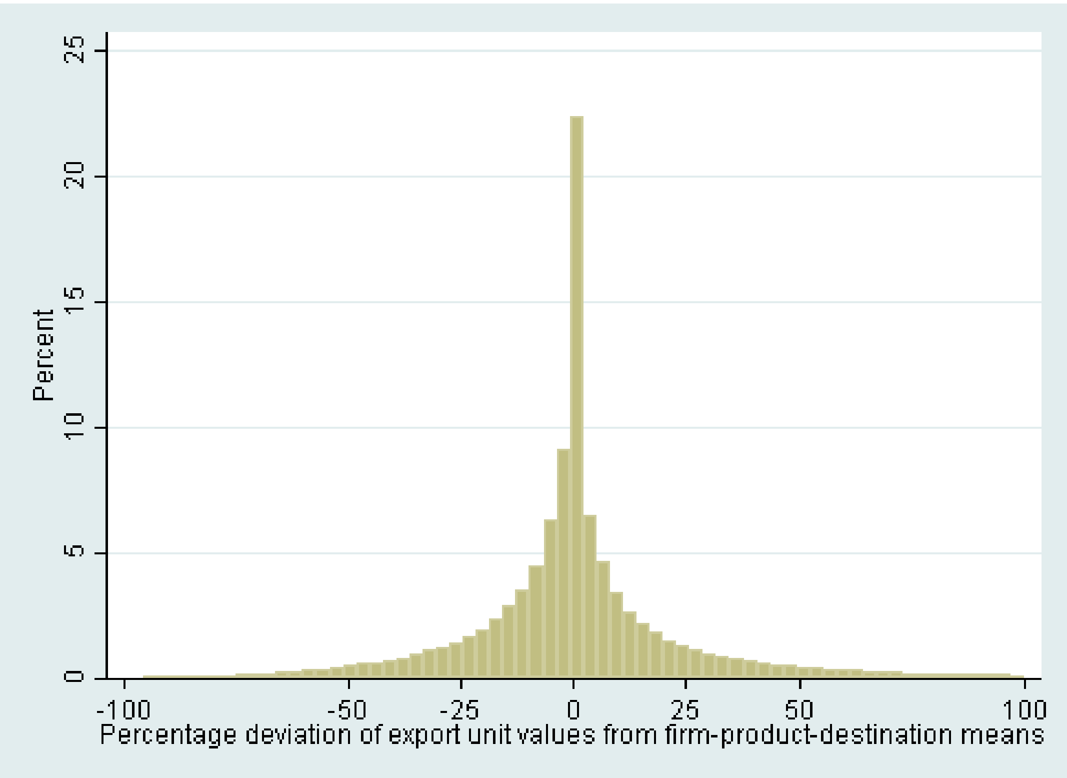

Figure 1 shows the distribution of the percentage deviations of export unit values from firm-product-destination averages. The figure shows that around 22% of transactions have a deviation close to zero. In particular, 54% of transactions lie in the [-10%, 10%] range; this figure rises to 76% when we widen the margin to [-25%,25%]; and it rises further to 90% and 97% when the range is enlarged to [-50%,50%] and [-100%,100%] respectively.

To sum up, the transactional nature of our database uncovers a new source of price variation, which contributes substantially to the overall difference in export prices, and was hidden in previous analyses. The next section analyzes the reasons that might explain this new price variation component.

4 Explaining the variation in prices within firms, products and destinations

The previous section uncovered that around 19% of the variation in prices happens within the same firm, product and destination for the sample of multi-transaction firms. How can we explain this new price-variation component? This section explores three reasons: 1) 8-digit Combined Nomenclature products still cover different goods; 2) Firms charge different prices to different customers; and, 3) Vertically-differentiated varieties.

The first explanation for the variation in prices within firms, products and destinations is that CN 8-digit product categories might still cover different types of goods. If these products have different prices, the new price variation component will capture the mix of products that are sold within each CN 8-digit category. For example, the CN8 code 95051090, Articles for Christmas festivities, not of glass, covers different products, such as artificial Christmas trees, wood ornaments or nativity scenes and figures, that probably command different unitary prices.

To proxy the number of products that might be included within each CN product category, we compare European Union's CN classification and the US Harmonized Tariff System (HTS) classification. The root of both classifications is the Harmonized System 6-digit classification established by the World Customs Organization. As explained by Pierce and Schott (2009), countries adopting this system can further disaggregate the HS 6-digit classification. For each 6-digit category, the element common to the European Union and the US classifications, we count the number of product lines in the HTS classification and in the CN classification. Then, we calculate the ratio of HST product lines to CN product lines for each 6-digit category.

Based on this variable we run the following regression:

$$\ln cvp_{fdk} = \beta \ln ratio_k + \gamma_{fd} + \epsilon_{fdk} \tag{2}$$

where cvp_{fdp} is the coefficient of variation of prices of firm f in destination d and product k. The coefficient of variation is the normalized standard deviation of prices within a firm, destination and product. $ratio_k$ is the ratio of HTS to CN8 product lines in product k, $\gamma_{f,d}$ is a firm-destination fixed effect, and ϵ_{fdk} the independent disturbance term.[6] Hence, the regression equation analyzes the differences in the coefficient of varia-

[6] All CN8 codes belonging to the same HS 6-digit root have the same ratio.

tion in prices across products for the same firm and destination. Therefore, the equation is estimated with a sample of firms that export, at least, two products per destination. We expect a positive correlation between prices' coefficient of variation and the ratio of product lines. Errors are clustered at the product level.

Table 4, column 1 presents the results of the estimation. The ratio of product lines coefficient is positive and statistically significant. In particular, a 100% increase in the ratio of product lines leads to a 6.6% rise in the coefficient of variation. This result confirms that product categories covering a larger range of goods have a higher dispersion of prices.

Table 4: Explaining the variation of export prices within product, firm and destination

	(1)	(2)	(3)
log ratio of product lines	0.066***		
	(0.010)		
log(volume)		-0.132***	
		(0.000)	
log distance			-0.065***
			(0.006)
log GDPpc			0.027***
			(0.005)
log GDP			0.108***
			(0.003)
log remoteness			0.219***
			(0.012)
Dep.var.	cv(price)	log(price)	sd(price)
Method	OLS	OLS	OLS
N.observ	236742	4148858	267641
Fixed effects	firm*cou	firm*prod*cou	firm*prod
Cluster	product		prod*cou
Adj. R squared	0.270	0.982	0.732

Note: ***, **, * statistically significant at 1%. 5% and 10% respectively.

The second explanation of the variation in prices within a firm, destination and product, is that exporters might charge different prices to different customers. There could be different explanations. Firms might offer discounts to customers that place large orders. It is also possible that exporters offer discounts to new customers in order to attract them, or to old customers to reward fidelity. Finally, firms might also charge a lower price if they are selling the product to a subsidiary in the foreign market.[7]

Our database does not identify the importing firm, so we cannot test most of the hypotheses mentioned above. We can only perform a test for the first explanation, which predicts a negative relationship between unit prices and transaction volumes. To test the validity of this prediction, we estimate the following regression:

$$\ln p_{fdkr} = \beta \ln q_{fdkr} + \gamma_{pdk} + \epsilon_{fdkr} \tag{3}$$

where p_{fdkr} is the export price of firm f, in destination d, product k and transaction r, and q_{fdkr} is the quantity of the export transaction. Equation (3) includes a product, destination and firm fixed effect. Hence, the regression analyzes whether larger volume transactions within a firm, product and destination have a lower export price. We expect a negative value for the β coefficient.

Table 4, column 2, presents the results of the estimation. As expected, the coefficient for export volume is negative and statistically significant. In particular, a 100% increase in the volume of a transaction leads to a 13.2% reduction in the export price. This result suggests that firms might offer price discounts to customers that place larger orders. Hence, pricing to customers might also contribute to explain the differences in prices we observe within firms, destinations and products.

Finally, the new price component can also be explained because firms offer vertically-differentiated varieties of a product (Bastos and Silva, 2010). In this case the variation in prices will be capturing the differences in unit values across vertically-differentiated varieties. Since we cannot observe vertically-differentiated varieties, we analyze whether exporters behave in a way consistent with the vertically-differentiated varieties hypothesis. We build on Eckel and Neary (2010) flexible manufacturing model, and argue that firms produce a core quality, but can offer other vertically-differentiated varieties with rising quality-adjusted marginal costs. In this scenario, destination characteristics determine the range of vertically-differentiated varieties exported by a firm. In particular, since distant markets have larger entry costs, firms would only sell the high-profit, core quality, variety in those markets. Hence, we would expect a negative relationship between distance and the range of vertically-differentiated varieties. If the range of quality varieties can be proxy by the dispersion of prices, we would expect a negative correlation between the dispersion of prices and distance. To test this hypothesis, we estimate the following regression equation:

[7] Since we are analyzing differences in prices within the same firm, product and destination, we do not consider market characteristics, such as distance or size, that might determine pricing-to-market strategies as in Melitz and Ottaviano (2008) or Martin (2012).

$$\ln sdp_{fdk} = \alpha dist_d + \beta' X_d + \gamma_{fp} + \epsilon_{fdk} \quad (4)$$

where sdp_{fdk} is the standard deviation of prices in firm f, destination d and product k; $dist_d$ is the distance between Spain and the foreign market and X_d is a vector of other destination characteristics. The regression equation includes firm+product fixed effects, so it measures how the dispersion of export prices for a firm and product varies when the characteristics of the destination are altered.

Table 4, column 3, presents the results of the estimation. As expected, the coefficient for distance is negative and statistically significant, confirming that the dispersion of export prices is lower in more distant destinations. In particular a 100% increase in distance leads to a 6.5% reduction in the dispersion of prices. This result provides an indirect evidence that firms produce vertically-differentiated varieties of a product; these varieties, in turn, might explain the differences in prices within a firm, product and destination.

The estimation also introduces three additional destination characteristics. We observe that GDP per capita of the destination is positively correlated with the dispersion of prices. This positive coefficients could be explained if higher GDP per capita countries are more unequal, or their preferences are more diverse. We also find a positive and statistically significant coefficient for GDP, suggesting that firms offer a wider range of vertically-differentiated varieties in larger markets. The intuition for this result is that larger markets ensure a minimum of sales, so even the less efficient vertically-differentiated varieties can bear the entry costs and make profits. Our result is the opposite to that predicted by Melitz and Ottaviano (2008), who expect a higher level of competition in larger markets and lower mark-ups. In this scenario only the most efficient varieties would obtain the profits to bear the entry costs.

Finally, the estimation also includes a remoteness variable, which aims to capture the price index in the destination country.[8] 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:

$$REM_d = [\sum_s Y_s / dist_{sd}]^{-1} \quad (5)$$

where Y_s is the GDP of the supplier country s, and $dist_{sd}$ is the distance between

[8] 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.

the supplier and the destination country. According to equation (5), a country will be more economically remote the larger the weighted distance to its partners, using GDP as weight.

The remoteness coefficient is positive and statistically significant. The intuition for this result is that more remote countries have a lower level of competition and higher prices. This allows less efficient vertically-differentiated varieties to obtain enough profits to bear entry-costs. Therefore, we would expect a positive relationship between countries' remoteness and the range of vertically-differentiated varieties offered by firms.

To sum up, the empirical analyses support that differences in the number of products covered with each CN8 product category, pricing to customers and vertically-differentiated varieties might explain the differences in export prices within firms, product and destinations.

5 Explaining the differences in export prices across firms and across destinations

In Section 3 we showed that differences across firms, and differences within firms and across destinations, also explain the total variation in products' export prices. In this section we analyze the reasons that might explain these two additional price variation components. First, we analyze the differences in prices across firms. Second, we investigate differences in prices within firms and across destinations. Finally, we test the robustness of our results using effective quality, instead of export prices, as our dependent variable.

5.1 Differences in prices across firms

In this section we analyze the variables that might explain the differences in export prices across firms. Melitz (2003) predicts that more productive firms set lower export prices. However, other models argue that firms compete in quality (Verhoogen, 2008; Baldwin and Harrigan, 2011; Crozet et al., 2012; Johnson, 2012; Kugler and Verhoogen, 2012). If quality is reflected in higher prices, more productive firms should charge higher prices than less productive firms. To test these competing predictions, we estimate the following equation:

$$\ln p_{kfdr} = \beta \ln(TFP_f) + \mu' \ln(C_f) + \gamma_{kd} + \epsilon_{kfdr} \tag{6}$$

where p_{kfdr} is the price of product k exported by firm f to destination d in transaction r. TFP_f is total factor productivity, which is estimated using the Levinsohn and Petrin

(2003) methodology.[9] C_f is a vector of other firm characteristics. The equation includes product-destination fixed effects. Hence, it analyzes how export prices differ across firms for the same product and destination. ϵ_{kfdr} is the independent disturbance term. We cluster errors at the firm level. Since, equation 6 includes firm level characteristics, it is estimated using the CDS sample.

Table 5: ../../Draft/Differences in export prices across firms

	(1)	(2)	(3)
log TFP	0.468***	0.444***	0.486***
	(0.156)	(0.011)	(0.168)
log total employees		0.072***	0.086***
		(0.002)	(0.021)
log wage per worker		0.211***	0.222**
		(0.009)	(0.105)
log capital per worker		-0.056***	-0.051***
		(0.002)	(0.017)
intermediate import share		-0.069***	-0.036
		(0.009)	(0.039)
correction term			-0.057*
			(0.030)
Source	CDS	CDS	CDS
Estimation	OLS	OLS	Selection control
Cluster	firm	firm	firm
N.observ	1228006	1228006	1228006
Fixed effects	prod*cou	prod*cou	prod*cou
Adj. R squared	0.957	0.957	0.959

Note: ***, **, * statistically significant at 1%. 5% and 10% respectively.

Table 5 presents the regression results. First, we estimate equation (6) using TFP, along with the product-destination fixed effects, as the only independent variable. The TFP coefficient is positive and statistically significant. In particular, a 100% increase in TFP leads to a 47% rise in unit value. This result supports models arguing that firms

[9] We use total factor productivity as the index for productivity. 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 2008-2013. 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.

compete in quality. Our 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 other firm characteristics, such as the log number of employees, wage per employee, capital per employee and intermediate import share. Firms with more employees and a higher skill intensity, proxy by wages per employee, charge higher unit values. In contrast, more capital-intensive firms and a higher share of intermediate inputs set lower export prices. We observe that the TFP coefficient remains positive and 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 (6) 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.[10] Column 6 presents the results of estimating equation (6) with the selection control methodology. Comparing column 3 with column 2, we observe that the TFP, total employees and wage per employee coefficients are slightly larger. The capital per worker and the intermediate import share 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 remaining component of the variation in prices is differences within a firm and across destinations. In line with the analyses we carried out in the previous section, we analyze how destination characteristics, such as GDP per capita, GDP, distance to Spain and remoteness might affect export prices. We estimate the following regression equation:

$$\ln p_{kfdr} = \alpha \ln(dist_d) + \beta \ln(GDP_d) + \sigma \ln(GDPpc_d) + \theta \ln(REM_d) + \gamma_{kf} + \epsilon_{kfdr} \quad (7)$$

Equation (7) includes a product-firm fixed effect (γ_{kf}). Hence, coefficients capture how destination characteristics might alter the pricing decision of a firm for a given product. Errors are clustered at the product-destination level.

[10] 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.

Table 6: Variation of export prices within firm-product and across destinations

	(1)	(2)
log GDPpc	0.053***	0.053***
	(0.003)	(0.003)
log GDP	-0.022***	-0.022***
	(0.002)	(0.002)
log remoteness	0.011	0.011
	(0.007)	(0.007)
log distance (kms)	0.031***	0.030***
	(0.003)	(0.003)
correction term		-0.000
		(0.000)
Method	OLS	Selection Control
N.observ	3608798	3608798
Fixed effects	firm*prod	firm*prod
Clusters	prod*cou	prod*cou
Adj. R squared	0.972	0.972

Note: ***, **, * statistically significant at 1%. 5% and 10% respectively.

Table 6-column 1 presents the results of the estimation. The GDP per capita coefficient is positive and statistically significant, indicating that firms set a higher price in richer countries. The GDP coefficient is negative, and statistically significant, pointing out that firms set lower prices in larger markets. The remoteness coefficient is positive but statistically not significant. Finally, the distance coefficient is positive and statistically significant, showing that firms set higher prices in more distant destinations. In particular, the doubling of distance leads to a 3.1% increase in unit values. Column 2 estimates the model using the selection correction method suggested by Harrigan et al. (2015). Results are very similar to those presented in Column 1.

To explain these results, as in the previous section, we assume, following Bastos and Silva (2010), that firms export vertically-differentiated varieties of a product. Since richer countries demand higher-quality goods, firms sell higher quality varieties to richer markets (Verhoogen, 2008). However, higher prices could also be explained by higher mark-ups in richer markets (Simonovska, 2015). Regarding GDP, a larger market size allows lower-quality, and less efficient varieties, to bear the fixed costs of entering a foreign market. This leads to a negative correlation between export prices and destination market GDP. This results is also in line with Melitz and Ottaviano (2008), which predict lower mark-ups, and prices, in larger markets. However, Manova and Zhang (2012) argue 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 export prices. The existence of opposing forces might explain why the empirical literature does not find a clear-cut relationship between export prices and market size.[11]

Since competition is lower in remote markets, as explained in the previous section, firms can also sell lower quality varieties in these markets, leading to a negative relationship between prices and remoteness. Contrary to this prediction, we do not find any statistically significant relationship between export prices and remoteness. Finally, since high-quality varieties command higher profits, they can bear the higher entry-costs of more distant countries. However, the positive relationship between distance and export prices could also stem if transport costs were unitary. This is known as the Alchian-Allen conjecture, which predicts a larger relative demand for high-quality varieties in more distant markets.[12] 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).

To sum up, the empirical analyses carried out in this section confirm that destination characteristics influence how firm set export prices. Most of results are in line with models that predict that firms export vertically-differentiated varieties of a product.

5.3 Robustness. Effective quality

In the previous subsections we have used unit values as our dependent variable to analyze how firm and destination characteristics affect export prices. Our results are in line with models arguing that firms compete in quality and offer vertically-differentiated varieties of a product.

However, unit values are, at best, a noisy proxy for quality. To measure quality directly, 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

[11]Manova and Zhang (2012) report a positive and statistically significant GDP coefficient, Bastos and Silva (2010) report a positive but statistically not significant coefficient, 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.

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

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:

$$\ln q_{kfdr} + \sigma * lnp_{kfdr} = \gamma_k + \gamma_d + \epsilon_{kfdr} \tag{8}$$

where q_{kfdr} and p_{kfdr} are, respectively, the quantity and the price (unit value) of product k, exported by firm f to country d in transaction r. γ_k and γ_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.[13] We use export data defined at firm-product-destination transaction level to calculate the average quality of each product sold by one firm across different markets.

With our measure of quality replacing export prices as the dependent variable, we test, first, 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 7 are very similar to those found in Table 5. Without controlling for other observable firm characteristics, more productive firms export higher quality products. The result holds after controlling for other firm characteristics (column 2). Finally, results are not affected by changing the estimation technique from OLS to 3-stage selection model (column 3).

Next, we test the relationship between our measure of quality and destination characteristics. The results are presented in Table 8. The positive coefficient of GDP per capita confirms that richer countries demand higher quality of the same product sold by the same firm across destinations. And, the positive coefficient on distance shows again that firms tend to sell their varieties of higher quality in more distant markets. However, now the coefficient of economic size (GDP) is positive and statistically significant in both estimations.

To sum up, the quality variable confirms the results for the differences in prices across firms, and the role of GDP per capita and distance when setting prices in foreign markets. However, we obtain a different result for the effect of GDP. As explained before, in the case of GDP, empirical papers do not obtain a robust relationship between this variable and export prices.

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

Table 7: Effective quality. Differences across firms

	(1)	(2)	(3)
log TFP	2.118***	1.976***	2.083***
	(0.656)	(0.752)	(0.744)
log total employees		0.347***	0.384***
		(0.078)	(0.077)
log wage per worker		1.090**	1.117**
		(0.477)	(0.463)
log capital per worker		-0.212***	-0.199***
		(0.072)	(0.072)
intermediate import share		0.028	0.112
		(0.153)	(0.161)
correction term			-0.145*
			(0.079)
Source	CDS	CDS	CDS
Estimation	OLS	OLS	Selection control
Cluster	firm	firm	firm
N.observ	1228006	1228006	1228006
Fixed effects	prod*cou	prod*cou	prod*cou
Adj. R squared	0.534	0.539	0.545

Note: ***, **, * statistically significant at 1%. 5% and 10% respectively.

Table 8: Effective quality. Variation within firm-product and across destinations

	(1)	(2)
log GDPpc	0.421***	0.419***
	(0.018)	(0.018)
log GDP	0.089***	0.088***
	(0.009)	(0.009)
log remoteness	0.023	0.027
	(0.043)	(0.043)
log distance (kms)	0.248***	0.251***
	(0.020)	(0.020)
correction term		0.003***
		(0.001)
Method	OLS	Selection Control
N.observ	3608798	3608798
Fixed effects	firm*prod	firm*prod
Clusters	0.725	0.725

Note: ***, **, * statistically significant at 1%. 5% and 10% respectively.

6 Conclusion

This paper shows that there are very important differences in the prices that a firm charges for the same product and destination. We propose three explanations for this new price variation component. First, we show that even highly disaggregated product categories might cover different goods. Hence, firms might charge different prices for the same product in the same destination because they are selling different goods. Second, firms might offer price discounts to customers that place large orders. We show that there is a negative correlation between export prices and quantities for the same firm, product and destination. Finally, firms may offer vertically-differentiated varieties of a product. We test this hypothesis in an indirect way. Since we cannot observe vertically-different varieties, we analyze whether exporters behave in a way consistent with producing a range of varieties. In particular, exporters should offer a lower range of varieties in more distant markets. Our empirical results confirm this prediction.

The paper also shows that more productive firms export higher-priced products, and price is positively related with GDP per capita of the destination market, and the distance between Spain and the destination market. These results support the predictions of models arguing that firms compete in quality and offer vertically-differentiated varieties of a product.

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