Markups, Quality, and Transport Costs☆

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Abstract

This paper provides new evidence on trade prices based on firm-level data from France. It shows that firms charge higher free-on-board (net of transportation costs, hereafter noted as fob) unit values on exports to more distant countries. This finding holds within firms and products, and across destinations. The price premium paid by distant consumers is due to firms charging higher fob prices, and to higher transportation costs. A simple decomposition of the elasticity of import prices to distance shows that, after trade facilitation, almost 80% of the decline in import prices enjoyed by consumers is due to firms charging lower fob prices. This newly established fact suggests a new channel through which changes in transport costs may affect welfare.

Keywords: Firm-Level Data, Per Unit Transport Costs, Welfare
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1. Introduction

In workhorse models of international trade, exporters either charge the same free-on-board (fob) price to all destination countries (Krugman, 1980; Eaton and Kortum, 2002; Melitz, 2003), or reduce it for more distant countries (Brander and Krugman, 1983; Ottaviano et al., 2002; Melitz and Ottaviano, 2008).[1] In contrast, the present paper finds that firms charge higher fob unit values on exports to more remote countries. I establish this fact using detailed firm-level data describing bilateral trade of French exporters disaggregated at the (8-digit) product level. This finding is robust to the inclusion of other determinants of export prices such as the wealth, size, level of competition, and level of trade barriers of the destination country.

Results indicate that, as distance doubles, the fob unit value charged by an exporter increases by 3.5%. The estimates imply that more distant consumers pay a price premium not only because distance increases transport costs, but also because firms charge higher prices *net of transportation costs*.

The elasticity of import (cif) prices with respect to distance (ϵ_{dist}^{cif}) may be written as a weighted average of the elasticity of fob prices to distance (ϵ_{dist}^{fob}) and the elasticity of transportation costs to distance (ϵ_{T}^{cif}):

$$\epsilon_{dist}^{cif} = \left(1 - \frac{T}{p_{cif}}\right) \epsilon_{dist}^{fob} + \frac{T}{p_{cif}} \epsilon_{dist}^{T}$$

My estimate of the elasticity of fob prices to distance (ϵ_{dist}^{fob}) is 0.05, Hummels and Skiba (2004) estimate an elasticity of transport costs to distance (ϵ_{T}^{fob}) of 0.26, and Hummels (2001) estimates that the share of transportation costs in import price (ϵ_{T}^{cif}) is 0.038. As a result, the elasticity of import prices with respect to distance is 0.06.[2] This simple decomposition shows

[1]The free-on-board price is the price set by a firm, net of freight and insurance costs.

[2]Using an alternative decomposition and information on the elasticity of cif/fob ratios to distance leads to an identical elasticity of 0.06. I further show that the elasticity of import prices to transport costs is 0.23.

that, following a trade facilitation, almost 80% of the price decline on imports enjoyed by consumers is due to firms charging lower fob prices, the rest being attributable to the drop in transport costs. The small sensitivity of import prices to direct changes in transport costs is due to the tiny share of transport costs included in import prices (only 3.8% in Hummels 2001).

This suggests a new and important channel - firms charging lower fob unit values - through which changes in transport costs may affect welfare. This channel adds up to the mechanisms identified in the literature, namely the direct effect of a drop in transport costs on consumer prices, the pro-competitive effect, and the love-for-variety effect.[3]

Different mechanisms can explain why firms charge higher unit values on export to more distant countries.[4] They may charge higher markups, sell (more expensive) higher quality goods, or use more expensive packaging for more distant shipments. In particular, the positive impact of distance on unit values is consistent with the Alchian and Allen (1964) conjecture stating that the demand for more expensive/ higher quality products should increase with transport costs. While this mechanism relies on the presence of per unit transport costs, it is worth noting that alternative explanatory mechanisms such as selection effects can be obtained with iceberg transport costs.

Interestingly, the positive impact of distance on fob unit values at the firm level is not limited to French data. In parallel works, Bastos and Silva (2010), Manova and Zhang (2011) and Gorg et al. (2010) find a similar pattern using bilateral firm level data on Portuguese, Chinese and Hungarian exports

[3]Arkolakis et al. (2011) show that recent trade models developed to explain the behavior of firm-level trade flows have the same implications in terms of the gains from trade as old theories assuming homogenous or representative firms. By contrast, models with non constant fob prices can provide new gains as shown by Irarrazabal et al. (2010).

[4]Models with exogenous (Baldwin and Harrigan, 2011; Hummels and Skiba, 2004) or endogenous (Verhoogen, 2008; Hallak and Sivadasan, 2009) quality heterogeneity explain price differential among firms and the impact of distance on average prices but they do not explain why prices, within firms, increase with distance.

respectively. Here, I find a similar pattern using French data, and further discuss the economic significance of this fact. In a related paper, Irarrazabal et al. (2010) sketch and estimate a Melitz type model with additive transport costs. In their model, fob prices increase with per unit costs at the firm level. Our estimates are consistent with theirs.

In addition to the literature cited above, our work is related to empirical studies showing that average prices are higher in more remote countries.[5] In particular, Hummels and Skiba (2004) and Baldwin and Harrigan (2011) show that product level unit values increase with distance, and they propose two distinct models explaining this feature of the data. But, in both papers, fob prices are not observed at the firm level and are assumed identical within firms, and across destinations. Complementary to the literature, this paper focuses on the impact of distance on the dispersion of prices within firms and products across destinations, i.e. on *individual* rather than *average* prices. More generally, the present paper connects to the recent literature describing exporting firms' behavior. Most studies provide evidence on firms' export status and size (Bernard et al., 2007), the number of products they sell (Bernard et al., 2010) or the number of destinations they serve (Eaton et al., 2004). The present paper focuses on unit values charged by those exporting firms.

The rest of the paper is organized as follows. Section 2 describes the data and the econometric strategy. Section 3 presents some stylized facts and the results. Section 4 provides insights concerning the economic significance of the estimates and the underlying theoretical mechanisms. Last, Section 5 concludes.

[5]See Schott (2004), Hummels and Klenow (2005), Mayer and Ottaviano (2007), Baldwin and Harrigan (2011), Hummels and Skiba (2004), or Fontagné et al. (2008).

2. Data and strategy

2.1. Data

The empirical analysis in this paper is based on a French customs database.[6] The database covers yearly bilateral shipments of firms located in France in 2003. Data are disaggregated by firm and product at the 8-digit level of the Combined Nomenclature (CN8). The raw data cover 96,467 firms and 10,050 products for a total exported value of 3.5 hundred billions euro. Since this paper focuses on the dispersion of prices within firms and products, only products sold by a firm on at least two markets are considered. This restriction reduces the number of observations. Actually, only 46 % of firms export toward several destinations. However, these multi-destination exporters realize more than 74% of French exports (in value). For each flow, the fob value and the shipped quantity (in kg) are reported. A flow is described by a firm number, a product category (CN8), and a destination country. Unit values are computed as the ratio of the value over the quantity of the flow. The unit value set by firm f for product k exported toward country j is:$P_{fjk} = \frac{V_{fjk}}{Q_{fjk}}$ where V_{fjk} and Q_{fjk} are the value and quantity of good k exported by firm f to country j.

Unit values are known to be a noisy measure of prices. The main criticism was formulated by Kravis and Lipsey (1974) and more recently Silver (2007). The authors state that unit values do not take into account quality differences among products. The high level of disaggregation of the data and their firm dimension limits the main drawback of unit values and more particularly the mixed-quality effect. Actually with more than 10,000 products, the possibility of having goods with highly different characteristics within these unit values is limited.[7]

[6] Berthou and Fontagné (2008), Méjean and Schwellnus (2009), Crozet et al. (2009) or Berman et al. (2009) use the same source.

[7] For instance, product CN8 52081296 has this description: *Woven fabrics of cotton, containing 85 % or more by weight of cotton, unbleached, Plain weave, weighing more than*

There are some errors in declarations or in reporting. To deal with outliers, we follow Méjean and Schwellnus (2009) and drop observations for which the unit value is 10 times larger or lower than the median unit value set by the firm on its different markets. This procedure retains 73% of total exports.

Like most of the papers in the literature, distance is used as a proxy transport costs. I also use GDP and GDP per capita as a control for the size and wealth of the destination country. Another control used in the empirical analysis is the average multilateral import unit value of destination countries to control for the level of competition on each market.[8] To investigate the impact of product differentiation on the link between unit values and distance, I use the elasticity of substitution computed at the product level by Broda and Weinstein (2006). Last, as an additional control, the tariff faced by French exporters is introduced in some regressions. All these variables are described in the appendix.

2.2. Econometric strategy

First, we estimated the following equation:

$$log(P_{fkj}) = \alpha log(dist_j) + \beta controls_j + FE_{fk} + \epsilon_{fkj} \tag{1}$$

100 g/m2 but not more than 130 g/m2 and of a width not exceeding 165 cm . For a deeper discussion on the use of this database's unit values as a proxy for prices, see Méjean and Schwellnus (2009).

[8]Because international trade data are harmonized at the HS6 level, the multilateral unit values are measured at the 6-digit level while the firm-level export unit values are measured at the 8-digit level. For EU countries, the COMEXT nomenclature allows us to build multilateral unit values at the 8-digit level. As a robustness, 8-digit COMEXT multilateral unit values are compared with 6-digit BACI ones. The correlation is very high: 0.79. Furthermore, I obtain very similar results in regressions on the EU sample using the 6- or 8- digit multilateral unit values. In regression including COMEXT data, the impact of distance on prices is even stronger. Results are available upon request.

where P_{fkj} is the unit value computed at the firm and product level, $dist_j$ is the distance between France and country j, FE_{fk} is a firm and product fixed effect, $controls_{kj}$ is a vector of control variables, and ϵ is the error term. Three different samples of countries are used to test the robustness of the results: all the countries, the OECD countries, and the euro members. The OECD sample allows comparison of prices toward countries with similar levels of development. Focusing on euro members is a way to get rid of the firm price discrimination due to (i) incomplete exchange rate pass-through and (ii) country specific tariffs.

The impact of distance on prices can be non-linear. Non-parametric regressions of the logarithm of prices on dummies for different intervals of distance are run to tackle this problem. With firm$\times$product fixed effects, interval coefficients yield average prices set by each firm in each distance interval.[9]

Part of the trade literature emphasizes the impact of the size and the wealth of countries on bilateral unit values. GDP and GDP per capita are used to control for these effects.[10] The expected signs are as follows. In large countries, competition is tougher, which should reduce prices. By contrast, wealthy countries are expected to have a higher willingness to pay, which should contribute to higher prices.[11]

Models with quadratic utility functions suggest that prices depend on the average price on the market. Those average prices reflect not only the level of competition in the destination country but also its relative remoteness.

[9]This method is used at lower levels of disaggregation by Baldwin and Harrigan (2011) or Eaton and Kortum (2002) among others.

[10]Using manufacturing output instead of GDP leads to similar results.

[11]Baldwin and Harrigan (2011) use these controls and Hummels and Lugovskyy (2009) bring theoretical foundations to these explanatory variables in a generalized model of ideal variety. One can also interpret the GDP per capita coefficient with respect to trade costs. If the cost of selling a good abroad includes a distribution cost, then trade costs are expected to increase with the wealth of the destination country, because wages are higher there for instance (Corsetti and Dedola, 2005; Berman et al., 2009, see).

Hence, they depend on the number of firms serving the market, the fob price of those firms, but also the average transport cost paid by firms exporting to this country. Multilateral average unit values of imported products for the different countries are introduced in regressions to control for this. They are computed as the value-weighted average of import prices in the destination countries.

Most models of international trade predict that the elasticity of price to distance is nil.[12] Therefore, the statistical significance of estimated coefficients is important. In the regressions, standard errors can be biased by the correlation within groups of observations. To deal with this bias, estimated standard errors are clustered in the country dimension. However this clustering procedure assumes a large number of clusters whereas in our dataset the number of clusters (number of countries) is rather small compared to the number of observations (Harrigan, 2005; Wooldridge, 2005, see). Results with clustered standard errors are in the main text. In Appendix, we describe the methodology proposed by Harrigan (2005) to tackle this issue and the results it yields.

3. Results

This section presents empirical findings concerning the relationship between prices and distance at the firm level. The first section provides graphical evidence on the link between prices charged by exporters and distance. The following section reports the results of our estimations. The results unambiguously suggest that firms charges higher *free-on-board* prices on exports to more distant countries.

[12]This is true for all the CES models with monopolistic competition and iceberg transport costs like Krugman (1980) or Melitz (2003).

3.1. Stylized facts

Before investigating the impact of distance on individual prices, the variance decomposition of individual prices is investigates. Most of the literature has focused on the dispersion of unit values, within product across destinations (Baldwin and Harrigan, 2011; Hummels and Skiba, 2004). The analysis focuses on the dispersion of unit values within firms and products across destinations. Thus, the variance of individual prices for each product category is decomposed as the sum of the variance of individual prices within firms across destinations, and the variance of firms' average prices across destinations, plus a covariance term. Namely, the following decomposition is made:

$$\sum_{f,j} (p_{fj} - p)^2 = \sum_{f,j} (p_{fj} - p_f)^2 + \sum_{f,j} (p_f - p)^2 + 2\sum_{f,j} (p_{fj} - p_f)(p_f - p) \tag{2}$$

Where p_{fj} is the price charged by firm f on exports to country j, p is the average price, and p_f is the average price charged by firm f. The first term on the right hand side gives the within-firm price dispersion, the second term gives the between-firms price dispersion, and the last term gives the covariance between the previous two sources of variation. We compute those terms for each CN8 product. Then, the RHS terms are divided by the left hand side term. This provides us with a measure of the contribution of the within and between terms to individual price dispersion. Table 1 gives the different percentiles of the within and between contributions by products. On average, about half of the dispersion in individual prices is explained by within firm price dispersion.

The previous variance decomposition shows that a large part of price dispersion occurs within firms and products across destinations. I now investigate whether this price dispersion is related to the distance to the destination country. As preliminary evidence, Figure 1 plots the logarithm of individual prices against the logarithm of distance. To focus on within firms and products patterns, the firm and product mean are removed from the two variables.

I keep firm-product pairs present in at least 5 markets. Since the figure is unreadable with too many observation, 5% of observations are randomly drawn from the sample. The figure shows a positive relationship between prices and distance. However, the correlation is not systematic. The slope is 0.04, and we observe an important dispersion of prices, which is is not explained by distance. Distance is destination-specific whereas unit values have the three dimensions: firm, product and destination. Thus, destination-specific variables cannot explain the whole price dispersion. Next, I investigate the importance of distance among destination-specific determinants in explaining individual price dispersion.

Figure 2 presents another piece of evidence supporting distance as an important determinant of individual prices. To build the figure, country fixed effects are estimated by regressing the logarithm of prices on country fixed effects and firm-product fixed effects. A large country fixed effect means that on average, a firm charges a higher price to this country than to the other destinations it exports to. Then, those country fixed effects are regressed on the logarithm of distance. The figure also indicates the country names and their GDP per capita. We can see a clear positive relationship between estimated fixed effects and distance. This suggests that firms, on average, charge higher fob prices toward the more distant markets. Furthermore, distance alone explains one half of the dispersion of country fixed effects. Thus it appears as one of the main country-specific determinants of prices.[13] There are however some outliers. The most visible is Switzerland. French exporters seem to charge relatively high prices to this neighbor country. This may be explained by the high GDP per capita of Switzerland.

3.2. Regressions results

We now turn to the regression analysis investigating the determinants of export prices. Results confirm the previous stylized facts: firms charge

[13]Adding GDP per capita or average unit value increases the R^2 to 0.62 only.

higher unit values on exports to more distant countries.

Table 2 presents regressions of the logarithm of the price on the logarithm of distance. In all the regressions, the estimated elasticity of prices to distance is positive and almost always significant. In column (1), the sample contains all destination markets of French exporters. The estimated elasticity is 0.042. If the distance doubles, the average exporter increases its fob price by 3% ($2^{0.042}-1$). Focusing on the OECD sample (column 2), one observes that the elasticity is larger. The estimated elasticity reaches 0.45. Column (3) focuses on the euro sample. This sample is interesting because the pricing to market in the euro area cannot be due to incomplete exchange rate pass-through, and there are no country specific tariffs for French goods. The elasticity is much lower and weakly significant but still positive (0.011).

In columns (4-6) regressions control for market characteristics by introducing the size (GDP) and the wealth (GDP per capita) of the destination country. One can see that the size of the country has no significant impact on prices whereas wealth has a positive impact. The distance coefficient remains positive, significant, and even higher than without controls. This is particularly true for the Eurozone, where the distance elasticity is greater and more significant (column 3 vs column 6). Within the Eurozone, the countries closest to France are also the countries with the highest GDP per capita, which has a positive impact on fob prices.

The average unit value takes into account the competition on the market. Columns (7) to (9) present the results once the average unit value is introduced. As expected, the mean unit value coefficient is positive (even though it is not significant for Eurozone sample regressions). Actually, in highly competitive markets (where the multilateral unit value is low), firms set relatively lower prices. However, even with this control, the distance coefficient remains positive and significant. Namely, the regression including all the control variables indicates that doubling the distance implies a 3.5% increase of the fob price charged by firms (Table 2, column 7: $2^{0.05} - 1 = 0.035$).[14]

Table 3 presents the non-parametric version of the previous regressions. The logarithm of unit values are regressed on distance interval dummies. Since the dummies are collinear with the constant and the fixed effects, the first interval is dropped. For the reasons mentioned previously, firm$\times$product specific fixed effects are added. To obtain a sufficient number of observations in each interval, regressions are run on the entire sample of countries.

Overall, the regressions suggest that prices increase with distance. The only noteworthy point is that this increase is not always significant toward countries lying at a distance of between 1,500 and 3,000 kilometers. Exporting to closer countries (less than 3,000 km) increases prices by 2 log points, while exporting to remoter countries (more than 12,000 km) increases prices by 14 log points. In the three regressions, an F-test allows rejection of the equality of distance intervals' coefficients.[15]

The previous regressions are run on the pooled sample. To gauge how systematic is the impact of distance on prices, similar regressions are run for every CN8 product. Then, the sample is split into several bins grouping firms according to their size (measured by total exports) or the substitution of products (measured by the elasticity of substitution provided by Broda and Weinstein (2006)). Actually, most models predict that the reaction of markups or quality as well as the strength of composition effects are stronger in more differentiated industries.[16] Furthermore, the recent trade literature emphasizes the importance of firm heterogeneity, which suggests that the

[14]Table C.1 in Appendix presents the results obtained when applying the two-step methodology developed by Harrigan (2005). With this methodology, estimated coefficients are still positive and significant and of even higher magnitude.

[15]In Appendix, Table C.2 presents the results when introducing country random effects instead of clustering at the country level. Coefficients are still significant and increasing with distance which reinforces the previous results. Even close intervals become statistically significant.

[16]Even if it is not emphasized, this prediction is in models by Baldwin and Harrigan (2011), Ottaviano et al. (2002) or Hummels and Skiba (2004).

reaction to distance may differ across firms.

For each product category, the logarithm of unit values is explained by the logarithm of distance, GDP, GDP per capita, multilateral unit value, and firm fixed effects. For 81% of product categories, there is a sufficient number of observations to run those regressions. Table 4 synthesizes the coefficients on distance obtained from doing so. Namely, coefficients are sorted in 4 bins depending on their sign and statistical significance. First, 62.3% of coefficients are positive. They account for 70% of total exports, in value. The large number of non-significant results (55%) is partly explained by the low number of observations for some product categories. Only 9% of the coefficients are negative and significant, and they account for 9% of exports in value. By contrast, 23.8 percent are positive and significant, and they account for 34.5% of exports. Among significant coefficients, 72% are positive, and they account for 78% of the value of exports. These figures show that while verified for the majority of product categories, the positive impact of distance on prices does not apply for every product category.

Table 6 investigates whether the heterogeneity in distance coefficients obtained in by-product regressions is related to the degree of differentiation of those products. It appears that within more differentiated industries (industries with a low elasticity of substitution), unit values are more responsive to changes in distance. This result is confirmed by the negative and significant coefficient that shows up when interacting the logarithm of distance with the elasticity of substitution of the good sold by the firm. In more differentiated sectors, firms have more room to adjust their markups or the quality they sell across destination countries.

Table 5 presents a similar exercise in which regressions are run on different samples of firm sizes. The total value of exports is used as a proxy for firm sizes or performances. There is no significant difference between estimated coefficients for the different samples of firm sizes. The interaction between the log of distance and the log of firms' size is not significant either. This suggests that firms of different size react in the same fashion to changes in distance.

4. Discussion

This section discusses the previous findings in light of the extant empirical and theoretical literature. First, it compares the estimates to results obtained in other papers. Second, it examines the economic significance of these estimates. Last, it reviews the different theoretical explanations consistent with the empirical finding.

4.1. Comparison with the literature

Three papers are highly comparable in terms of methodology. Bastos and Silva (2010), Manova and Zhang (2011) and Gorg et al. (2010) also explore the determinants of individual fob unit values. In doing so, they use bilateral firm level data on Portuguese, Chinese and Hungarian exports respectively. The most comparable estimates are those for the manufacturing sample in 2005 for China and Portugal, and 2003 for Hungary. The estimated elasticity of fob prices to distance is 0.052 for Portugal (Table 6, column 11 in Bastos & Silva), 0.056 for Hungary (Table 2, column 5 in Gorg et al.), and 0.014 for China (Table 8, column 1 in Manova & Zang). Those estimates - in particular for Hungary and Portugal - are very close to the elasticity of 0.050 estimated in the previous section (Table 2, columns 7-8).

Another paper addressing similar issues is Irarrazabal et al. (2010). The authors study the importance of the form of transport costs in a Melitz type model. In particular, they develop a model combining per unit and iceberg trade costs, and then bring it to the data to estimate the prevalence of per unit costs. They use Norwegian firm-level data and structurally estimate their model using a minimum distance estimator. They find per unit trade costs account on average for 35% of consumer prices. However, the main results emerging from their empirical exercise are not directly comparable with the estimates obtained in the previous section. To obtain a comparison, the elasticity of fob prices to distance implied by their estimates is derived.

In their model, the elasticity of fob prices to distance is firm specific. Therefore, it is necessary to write down the average elasticity, and then compute it using their estimates. Computations are described in Appendix D. Their estimates yield an elasticity of fob prices to transport costs of 0.23. The implied elasticity of fob price to distance is the product of this elasticity and the elasticity of transport costs to distance. They estimate an elasticity of transport costs to distance of 0.07. This implies an elasticity of fob price to distance of 0.016 (0.23×0.07). The elasticity is a bit smaller to what is find this paper (and what is found in the literature) but has the same order of magnitude.[17]

Overall, those results suggest that the elasticity of fob prices to distance is positive and around 0.05. This seems quite robust to the sample, and the method used to compute it.

4.2. Economic significance

This section discusses the economic significance of the estimates. We have measured an elasticity of fob prices to distance of 0.05. What does this mean for consumers? To better interpret our estimates, the elasticity of import (cif) prices with respect to distance and transport costs are computed.[18] Two alternative formulas are used to compute the elasticity of import prices to changes in distance.

[17]Another prediction from Irarrazabal et al. (2010) is that the dispersion of quantities within products, should decrease in more distant countries. Measuring dispersion by the P90/P10 ratio of quantities, I regressed the dispersion measured for every product and country on distance, GDP, GDP per capita, and product fixed effects. Consistent with the prediction, distance is found to have a negative and significant impact on dispersion. Results are available upon request.

[18]For simplicity, we refer to cost, insurance and freight (cif) prices as import prices. The consumer price is composed of the import price and the local costs. Conclusions for consumer prices would be similar to the ones for import prices if local costs such as VAT or distribution margins affect import prices in a multiplicative way.

First, the logarithm of the cif price is decomposed in two parts: the logarithm of the fob prices and the logarithm of cif/fob margins. Using this decomposition yields the following formula for the elasticity of import prices to distance:

$$\frac{\delta log(p_{cif})}{\delta log(dist)} = \frac{\delta log(p_{fob})}{\delta log(dist)} + \frac{\delta log(p_{cif}/p_{fob})}{\delta log(dist)} \tag{3}$$

The first term on the right hand side of the equality is the elasticity of fob prices to distance, the second term is the elasticity of the cif/fob margins to distance. From the previous section, the elasticity of fob prices to distance is 0.05, and Hummels and Lugovskyy (2006) estimate an elasticity of the cif/fob margins of 0.01 (table 6, national data, US imports). Therefore, the implied elasticity of firm-level cif prices to distance is 0.06 $(0.05 + 0.01)$.[19]

The second formula build from the definition of import prices. The import price (p_{cif}) is the sum of the fob price (p_{fob}) and freight costs (T):

$$p_{cif} = p_{fob} + T \tag{4}$$

Taking the first derivative of this expression with respect to distance, multiplying by distance, dividing by the price, and rearranging yield:

$$\frac{\partial p_{cif}}{\partial dist} \times \frac{dist}{p_{cif}} = \left(\frac{\partial p_{fob}}{\partial dist} \times \frac{dist}{p_{fob}}\right) \times \frac{p_{fob}}{p_{cif}} + \left(\frac{\partial T}{\partial dist} \times \frac{dist}{T}\right) \times \frac{T}{p_{cif}} \tag{5}$$

In words, the elasticity of import prices to distance is a weighted average of the elasticity of fob prices to distance and the elasticity of transport costs to distance. Each elasticity is weighted respectively by the share of the fob price and the freight costs in the import price. The intuition for this formula is

[19] The elasticity of the cif/fob margins for all countries is estimated to be 0.045 (Hummels and Lugovskyy, 2006, table 6). This yields to an elasticity of import prices to distance of almost 0.10. The elasticity of cif/fob margins is considered for the US because the second formula uses information for the US only. Furthermore US cif/fob ratios are based on DOTS, which are of better quality than the IMF-COMTRADE cif/fob ratios (Hummels and Lugovskyy, 2006).

straightforward. The sensitivity of import prices to distance not only depends on the elasticity of its components but also on the relative importance of those components in the final price. Hummels and Skiba (2004) estimate an elasticity of transport costs to distance of 0.26.[20] Furthermore, Hummels (2001) shows that for in the US, the share of freight costs in import prices is 3.8%. Using this information and the elasticity of fob prices to distance give an elasticity of cif prices to distance of: 0.06 ($0.038 \times 0.26 + 0.962 \times 0.005 = 0.058$). This means that more than 80% of the change in import prices is due to the indirect effect of distance on fob prices ($0.05 \times 0.962/0.06$).[21]

Using the elasticity of import prices to distance and the elasticity of transport costs to distance, it is easy to compute the elasticity of import prices to transport costs. It is equal to 0.23 ($0.06/0.26 = 0.23$). This means that about one fourth of the changes in transport costs are passed on import prices.

Welfare gains from trade liberalization emphasized by the literature are mainly due to two effects: an increase in the number of varieties available to consumers and a decrease in the prices paid by consumers. Traditionally, two mechanisms explain the drop in prices. First, the direct effect linked with the drop in transport costs. Since part of the import price paid by consumers includes the cost of shipment, reducing this cost mechanically reduces the consumer price. Second, there is an indirect "pro-competitive" effect. Actually, in models with variable markups, the decline in transport costs increases competition and the pressure on firms' markups. The present results suggest that a third mechanism explains the fall in consumer prices

[20] Hummels (2001) estimates an elasticity of 0.27. However, freight costs are measured as the ratio between freight expenditure and the value of imports. Hummels and Skiba' s estimation relies on the ratio of freight expenditure over quantities. This is exactly T.

[21] We can see how important is the share of freight costs in import prices. For instance, if it was a bit higher, say 10%, the elasticity of import prices to distance would be 0.07 ($0.9 \times 0.05 + 0.1 \times 0.26$), and changes in freight costs would contribute to 1/3 of the change ($0.1 \times 0.26/0.07$).

following a trade facilitation. Following a decline in transport costs, firms react by charging a lower price net of transportation costs. Moreover, it appears this channel is far from negligible: after a drop in transport costs, 80% of the import price decline enjoyed by consumers is due to firms charging lower prices. The rest is attributable to the direct effect of transport costs on import prices.[22]

The direct effect of transport costs is very small since those costs account for a tiny share of final prices. By contrast, the indirect effect of a change in transport costs through fob prices is small, but changes in fob prices are almost entirely transmitted to import prices (96% of the change is passed on). Therefore in economies in which transport costs account for a tiny share of import prices, most of the action comes from changes in fob unit values. The next section discusses through which theoretical mechanisms distance and transport costs may affect those unit values.

4.3. Theoretical mechanisms

In most models of international trade, firms are expected to charge the same fob price to all countries or to reduce their markups to more distant ones.[23] This section reviews the different theoretical mechanisms that may explain the positive impact of distance on prices found in the data.

First, firms may simply charge higher markups to more distant countries. This arises naturally if the elasticity of demand is increasing with distance, like in a CES model with additive transport costs.[24]

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[22]The effect of a drop in transport costs on prices through a change in competition is not considered in the estimation.

[23]Some papers focus on dumping strategies: firms reduce their markup when exporting toward more distant countries to remain competitive (Brander, 1981; Brander and Krugman, 1983; Ottaviano et al., 2002; Melitz and Ottaviano, 2008). But most of the international trade literature gets rid of price discrimination in the interest of tractability. In models à la Krugman (1980) or Melitz (2003), firms charge the same markup across countries.

[24]See Greenhut et al. (1985), and Hoover (1937).

Second, firms may choose to sell upgraded versions of their product to more distant countries. Such quality upgrading is consistent with a CES model with additive transport costs where firms endogenously choose a destination-specific quality for their goods.

Third, if firms are multi-products within CN8 categories, the positive impact of distance on fob unit values may reflect the fact that the share of more expensive, higher quality varieties within firms and 8 digit level categories increases with distance. Such an explanation is consistent with both a composition effect due to additive transport costs as in Alchian and Allen (1964) and a selection of higher quality varieties (within firms) to more difficult markets. The selection effect may be driven by the presence of fixed costs, paid by multi-product firms, for each of their products. The mechanism is similar to Baldwin and Harrigan (2011), but the selection occurs within firms among products rather than among firms. Since only high qualities are sold in more difficult markets, the average price is higher in those markets.

Last, higher unit values in more distant markets may simply reflect some additional costs of shipping such as packaging costs included in the free-on-board prices.

It is worth emphasizing that most of these mechanisms are connected to the Alchian-Allen conjecture: the relative demand for more expensive/higher quality goods increases with transport costs. Interestingly, this demand-driven mechanism builds on the hypothesis of non-multiplicative transport costs. This hypothesis may explain the first two mechanisms. Actually, both the markup and the quality upgrading mechanisms can easily be sketched in a monopolistic competition CES model with per unit transport costs (rather than (multiplicative) iceberg ones).[25] The composition mechanism is even more closely related to Alchian-Allen's original statement. If firms are multi-product within CN8 categories, in the presence of per unit transport costs,

[25]See Martin (2010).

the relative demand for higher quality varieties is expected to increase with distance. By contrast, the selection mechanism is a supply mechanism that does not require per unit transport costs.[26]

5. Conclusion

Using highly detailed data on bilateral trade of French exporters, this paper finds that firms charge higher free on board unit values on exports to more distant countries. This result is robust to the inclusion of other determinants of export prices such as the wealth, the size, the level of competition, and the tariffs faced by French exporters in the destination country.

The positive impact of distance on free-on-board unit values is far from negligible. After a drop in transport costs, about 80% of the import price decline enjoyed by consumers is due to firms charging lower prices net of transport costs. The rest is attributable to the direct effect of a drop in transport cost on consumer prices. This suggests a potential new channel through which changes in transport costs may affect welfare.

However, several mechanisms may explain the positive impact of distance on fob unit values: higher markups, higher quality, composition effects, selection effects, or costs of packaging. Understanding the contribution of these mechanisms is the next step before we can evaluate precisely the gains from trade linked with this feature of the data.

[26] An interesting way to discriminate between models with and without per unit costs, would be to compare the impact on prices of (multiplicative) tariffs. In Alchian-Allen like models, multiplicative costs are expected to reduce unit values. By contrast, in model with selection effects, tariffs are expected to affect prices in the same direction as distance. Unfortunately, the data set used in this paper is not appropriate to run the test. Actually, almost 70% of French exports are directed to European countries, that do not charge any tariffs on French exports. Furthermore, because of the EU, tariffs are strongly correlated with distance. This leads to inconclusive results, highly sensitive to the inclusion of EU countries. It is worth noting that the coefficients on distance are not affected by the inclusion of tariffs variables. The method and regressions are presented in Appendix E.

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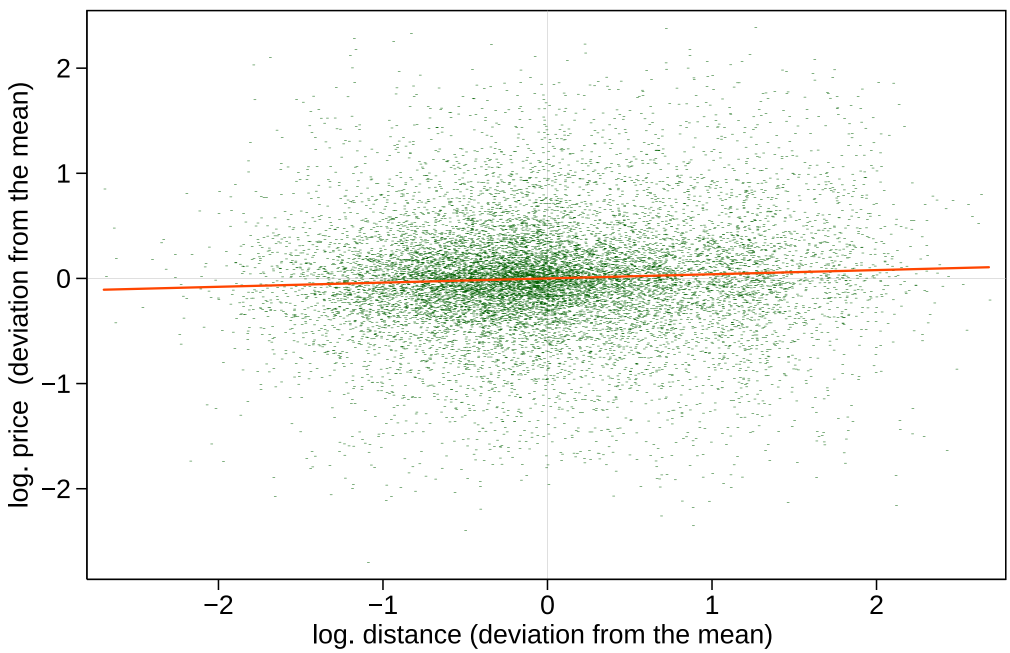
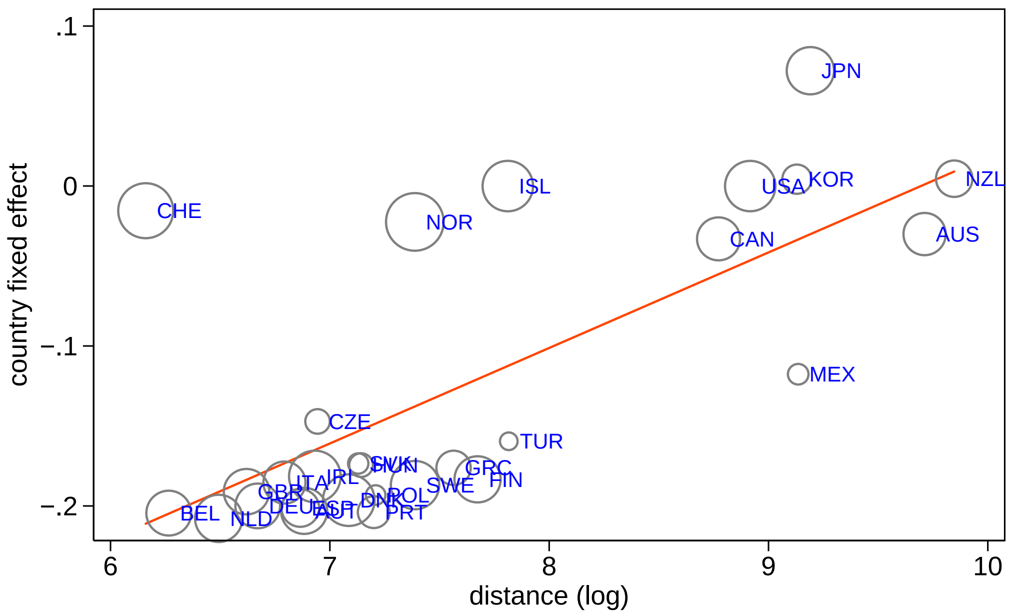
Figure 1: Price and distance at the firm level, random sample, 2003



The graphs plots the logarithm of prices at the firm and product level against the logarithm of distance. Both variables are purged of firm×product fixed effects. The slope of the linear fit line is 0.039 and the standard deviation is 0.006. The exercise is done on a sample of 14,387 observations based on 1,195 couples of firms and products (5%) randomly drawn from the initial sample.

Figure 2: Country fixed effects, distance, and GDP per capita. OECD countries. 2003



The graph plots estimated country fixed effects for OECD countries against distance. Circles are proportional to countries' GDP per capita. Country fixed effects are estimated from a regression of the log of prices (at the firm-product level) on country fixed effects and firm×product fixed effects. the correlation between distance and country fixed effects is 0.7. A regression of country fixed effects on the logarithm of distance yields an R^2 of 0.5.

Table 1: Within and between components of price dispersion

	Percentiles	P5	P25	P50	P75	P95
Contribution	Within	0.03	0.26	0.48	0.72	1
	Between	0	0.20	0.48	0.77	1.05

This table reports the contribution of the within and between firms component of price dispersion for each CN8 product category. Namely for each product the following equation is estimated: $\sum_{f,j}(p_{fj}-p)^2 = \sum_{f,j}(p_{fj}-p_f)^2 + \sum_{f,j}(p_f-p)^2 + 2\sum_{f,j}(p_{fj}-p_f)(p_f-p)$ where p_{fj} is the price set by firm f on exports to country j, p_f is the average price set by firm f, and p is the average price across firms and destinations. The within and between contribution are computed for each CN8 category. PX is the contribution for the X^{th} percentile. For instance, 48% of the dispersion for the median product is due to within firm price dispersion. The other 48% percent is due to between firm price dispersion. The last two percent is attributable to covariance effects.

Table 2: Price and distance, 2003

Dependent variable:					Price (log)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance (log)	0.042^a	0.045^b	0.011^c	0.050^a	0.051^a	0.019^b	0.050^a	0.051^a	0.019^b
	(0.012)	(0.017)	(0.005)	(0.010)	(0.013)	(0.007)	(0.010)	(0.013)	(0.007)
GDP (log)				-0.004	0.000	0.003	-0.004	0.000	0.003
				(0.004)	(0.006)	(0.002)	(0.004)	(0.006)	(0.002)
GDP per capita (log)				0.020^a	0.047^b	0.014	0.018^a	0.046^b	0.014
				(0.006)	(0.020)	(0.010)	(0.006)	(0.020)	(0.010)
Mean UV (log)							0.018^a	0.010^c	0.003
							(0.005)	(0.005)	(0.002)
Fixed effects					Firm × Product				
Sample:	All	OECD	Eurozone	All	OECD	Eurozone	All	OECD	Eurozone
Observations	1,199,711	910,108	591,733	1,199,711	910,108	591,733	1,198,282	909,398	591,268
R^2	0.003	0.004	0.000	0.004	0.005	0.000	0.005	0.005	0.000
rho	0.911	0.923	0.933	0.911	0.923	0.933	0.910	0.922	0.933

This table investigates the impact of distance on firm's export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, and the level of competition in the destination country measured by the average unit value of imports in this country. In columns 1, 4, 7 all destinations are considered. In columns 2, 5, 8 only exports toward OECD countries are considered. In columns 3, 6, 9, only exports toward euro countries are considered. Reported standard errors are clustered by country. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

A. Appendix. Data.

Distances are from the dataset developed by Mayer and Zignago (2006). [27]

Real GDP and GDP per capita in PPP, from the IFS database, are used as control variables. We also use average imported unit values by country. These unit values are computed from BACI, the database of international trade at the product level developed by Gaulier and Zignago (2008).[28]

For each hs6 product and country, average unit value weighted by the quantities are computed. For product k in country j :$UV(kj) = \sum w_{ijk}UV_{ijk}$. Where UV_{ijk} is the unit value of the good k imported from country i to country j. And w_{ijk} is the weight of good k exports from country i. Then these hs6 unit values are merged with customs data. Thus for each product exported from a French firm in 2003, we have the corresponding average unit value in each potential destination market.

In our empirical analysis we also investigate the interplay between distance and product differentiation. Product differentiation is measured by the elasticity of substitution between products within narrowly defined sectors. Information on this comes from Broda and Weinstein (2006).

Last, we look at the impact of tariffs on trade prices. Tariffs collected by UNCTAD-TRAINS are used. We use average and weighted average tariffs computed at the 3digit level of the ISIC nomenclature.

B. Appendix. Methodology.

The alternative methodology to clustering proposed by Harrigan (2005) consists in a two way error component model. The basic idea is to introduce

[27] Data are available on CEPII's website: *http : //www.cepii.fr/anglaisgraph/bdd/distances.htm*.

[28] For a description of the database, see *http : //www.cepii.fr/anglaisgraph/bdd/baci.htm*.

both firm$\times$ product fixed effects and country random effects. Since one cannot run such a regression, one first removes the firm and product means from all variables and then runs the random effects regressions on the transformed variables as indicated in this paper.

C. Appendix. Empirical Results.

Table 3: Price and distance intervals

Dependent variable:	Price (log)		
	(1)	(2)	(3)
$1500 < distance < 3000$	0.024	0.026	0.026
	(0.015)	(0.017)	(0.017)
$3000 < distance < 6000$	0.085[a]	0.108[a]	0.108[a]
	(0.017)	(0.016)	(0.016)
$6000 < distance < 12000$	0.115[a]	0.136[a]	0.135[a]
	(0.021)	(0.017)	(0.017)
$12000 < distance$	0.145[a]	0.141[a]	0.140[a]
	(0.020)	(0.020)	(0.020)
GDP (log)		-0.006	-0.006
		(0.004)	(0.004)
GDP per capita (log)		0.022[a]	0.021[a]
		(0.007)	(0.006)
Mean UV (log)			0.018[a]
			(0.005)
Fixed effects	Firm × Product		
Sample:	All	All	All
Observations	1,199,711	1,199,711	1,198,282
R^2	0.004	0.005	0.006
rho	0.911	0.911	0.910

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, and the level of competition in the destination country measured by the average unit value of imports to this country. Distance is measured using distance interval. Dummy is equal to 1 if the destination country belongs to the interval and 0 elseotherwise. Reported standard errors are clustered by country. [c], [b], [a] indicate significance at the 10%, 5% and 1% level.

Table 4: Distance coefficents, regressions by CN8 product categories

	positive	negative	*sum*
non significant	2,298	1,696	3,994
significant	1,402	545	1,947
sum	2,241	3,700	5,941

This table reports the number of coefficient positive, negative, significant and non-significant coefficients on distance. Coefficients are estimated for each CN8 product category, for OECD countries, by regressing the log of prices at the firm and CN8 level on the log of GDP, GDP per capita, multilateral unit value and firm fixed effects. Regressions are run for product categories with more than 10 observations ie 5,941 over 7,294. The significativity threshold is 10%.

Table 5: Price, distance, and firms' size

Dependent variable:	Price (log)				
	(1)	(2)	(3)	(4)	(5)
Firms' size:	Small	Small-Medium	Medium-Large	Large	All
Sales $\times 100,000$ (euros)	$[0, 9]$	$[9, 56]$	$[56, 315]$	> 315	
Distance (log)	0.076[a]	0.052[a]	0.039[a]	0.042[a]	0.074[b]
	(0.018)	(0.011)	(0.008)	(0.008)	(0.037)
GDP (log)	-0.002	-0.003	-0.007[b]	-0.006	-0.004
	(0.007)	(0.004)	(0.003)	(0.004)	(0.004)
GDP per capita (log)	0.039[a]	0.027[a]	0.012[b]	0.010[c]	0.018[a]
	(0.012)	(0.008)	(0.005)	(0.005)	(0.006)
Mean UV (log)	0.012[b]	0.014[a]	0.021[a]	0.026[a]	0.018[a]
	(0.006)	(0.005)	(0.004)	(0.004)	(0.005)
Distance (log) $\times$ Size (log)					-0.002
					(0.002)
Fixed effects	Firm $\times$ Product				
Sample:	Q1	Q2	Q3	Q4	All
Observations	299,532	299,631	299,544	299,575	1,198,282
R^2	0.010	0.005	0.004	0.004	0.005
rho	0.922	0.905	0.908	0.906	0.910

This table investigates the impact of distance on firm's export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, the level of competition in the destination country measured by the average unit value of imports in this country, and firms' total sales. The first four columns present the regressions run on subsamples of the data. Subsamples group firms belonging to the same quartile range in terms of total export sales. Q1 is for the small, Q2 for the small-medium, Q3 for the medium-large, and Q4 for the large firms. In the last column, we interact the log of distance with the log of firms' size measured as total sales. Reported standard errors are clustered by country. [c], [b], [a] indicate significance at the 10%, 5% and 1% level.

Table 6: Price, distance, and elasticity of substitution

Dependent variable:	Price (log)				
	(1)	(2)	(3)	(4)	(5)
Elasticity:	Small	Small-Medium	Medium-Large	Large	All
	$[1, 4.3]$	$[4.3, 5.1]$	$[5.1, 5.8]$	$[5.8, 27]$	
Distance (log)	0.073[a]	0.045[a]	0.042[a]	0.037[a]	0.066[a]
	(0.015)	(0.010)	(0.008)	(0.008)	(0.014)
GDP (log)	-0.001	-0.012[a]	-0.010[a]	0.004	-0.004
	(0.006)	(0.004)	(0.003)	(0.004)	(0.004)
GDP per capita (log)	0.027[a]	0.019[a]	0.006	0.025[a]	0.018[a]
	(0.010)	(0.005)	(0.006)	(0.007)	(0.006)
Mean UV (log)	0.012	0.025[a]	0.016[a]	0.022[a]	0.018[a]
	(0.009)	(0.004)	(0.003)	(0.006)	(0.005)
Dist. (log) × Elasticity (log)					-0.003[a]
					(0.001)
Fixed effects	Firm × Product				
Sample:	Q1	Q2	Q3	Q4	All
Observations	320,882	308,396	258,696	293,680	1,181,654
R^2	0.010	0.005	0.004	0.004	0.005
rho	0.880	0.883	0.914	0.908	0.907

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by GDP per capita, the size of the destination country measured by GDP, the level of competition in the destination country measured by the average unit value of imports in this country, and product level elasticity of substitution. The elasticity of substitution is computed at the HS6 product level by Broda & Weinstein (2004). The first four columns present the regressions run on subsamples of the data. Subsamples group products belonging to the same quartile range in terms of elasticity of substitution. Q1 is for products with a small elasticity, Q2 for the small-medium, Q3 for the medium-large, and Q4 for the large. In the last column, we interact the log of distance with the log of the elasticity of substitution. Reported standard errors are clustered by country. [c], [b], [a] indicate significance at the 10%, 5% and 1% level.

Table C.1: Price and distance, mixed effects, 2003

Dependent variable:					Price (log)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance (log)	0.057^a	0.059^a	0.055^a	0.068^a	0.081^a	0.092^a	0.068^a	0.081^a	0.093^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
GDP (log)				-0.006^a	-0.002	0.017^a	-0.006^a	-0.002	0.017^a
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita (log)				0.022^a	0.036^a	0.030^a	0.021^a	0.036^a	0.030^a
				(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Mean UV (log)							0.016^a	0.010^a	0.007^a
							(0.001)	(0.001)	(0.001)
Fixed effects					Firm × Product				
Random effects					Country				
Sample:	All	OECD	Eurozone	All	OECD	Eurozone	All	OECD	Eurozone
Observations	1,199,711	910,108	591,733	1,199,711	910,108	591,733	1,198,282	909,398	591,268
rho	0.015	0.009	0.000	0.015	0.006	0.000	0.013	0.005	0.000

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, and the level of competition in the destination country measured by the average unit value of imports in this country. In columns 1, 4, 7 all destinations are considered. In columns 2, 5, 8 only exports toward OECD countries are considered. In columns 3, 6, 9, only exports toward euro countries are considered. Country random effects are added to control for unobserved heterogeneity. Robust standard errors in parenthesis. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.

D. Appendix. Comparison with the literature

I build on the following equations from Irarrazabal et al. (2010). The authors define $B_n^k = t_n^k \times \left(\tau_n^k / \bar{z}_n^k\right)$, where t is the per unit transport cost, τ is an iceberg trade cost and $\bar{z}$ is the productivity of the least efficient exporter. For simplicity it is assumed $\tau = 1$. The fob price charged by a firm with productivity relative to the cutoff z is:[29]

$$p_n^k(z) = \frac{\sigma w t_n^k}{\sigma - 1} \left(\frac{1}{z B_n^k} + 1/\sigma \right)$$

where p is the fob price, w is the unit cost, σ is the elasticity of substitution among goods, and z is the productivity of the firm measured relative to the cutoff.

The elasticity of fob price to transport cost for firm with relative productivity z is simply:

$$\frac{\delta log(p_n^k(z)}{\delta log(t_n^k)} = 1/\left(1 + \sigma/(z \times B_n^k)\right) \tag{D.1}$$

The average elasticity is:

$$\frac{\delta log(p_n^k)}{\delta log(t_n^k)} = \int_1 1/\left(1 + \sigma/(z \times B_n^k)\right) dF(z) \tag{D.2}$$

where $F(z)$ is the distribution of firm productivity.

Computing it requires some values for σ, B_n^k and to know the distribution F. I follow the authors and assume an elasticity σ of 4 and a Pareto distribution with a parameter of 1.31. We derive B_n^k using their estimate of the trade cost relative to average consumer prices. Namely, they estimate:

$$\frac{w t_n^k}{\bar{p}_n^k} = \frac{\sigma - 1}{\sigma} \frac{B_n^k(\gamma + 1)}{\gamma + B_n^k(\gamma + 1)}$$

[29] Notice that the focus is on the fob price and not the cif price as in the paper.

where γ is the Pareto parameter. B is solved given the authors' assumptions $\sigma = 4$, $\gamma = 1.31$ and their estimation: $\frac{wt_n^k}{\bar{p}_n^k} = 0.35$. This gives $B = 0.496$. Then, weI solve equation D.2 numerically which yields an average elasticity of fob price to transport costs of 0.23.

E. Appendix. Impact of tariffs.

One way to discriminate between models is to look at the impact of tariffs. All else being equal, (multiplicative) tariffs should reduce (i) markups and quality in a CES model with both per unit and iceberg costs, and (ii) the average price in a quality composition model, while they should be positively related to unit values in (iii) a model with pure selection effects.[30] To discriminate between the two, in the regressions, a measure of bilateral tariff faced by French exporters at the ISIC 3 digit level are included (tariffs are from the UNCTAD-TRAINS database). Both simple and weighted average tariffs are used. Results presented in Table C.3 are inconclusive. Considering the whole sample, tariffs have a positive impact on unit values (Table C.3, columns 3 and 5), supporting the pure selection effect model. However, the regressions potentially suffer from multi-collinearity: distance and tariffs are very strongly correlated (0.67) because there is no tariffs on exports to neighbor countries (most of them belong to the European Union). When focusing on exports outside the European Union, the correlation between distance and tariffs drops to -0.23 and turns weakly significant. Results focusing on this sample excluding the EU countries yield opposite predictions: firms charge lower prices when facing higher tariffs (Table C.3, columns 3 and 5), but the positive effect of distance remains. If distance-related costs are not proportional to prices and that tariffs are, this means that additive and multiplicative costs would affect prices in opposite ways.

[30] See Martin (2010) for (i), Hummels and Skiba (2004) for (ii), and Baldwin and Harrigan (2011) for (iii).

Therefore, it appears difficult to disentangle those (possibly complementary) theoretical explanations. While beyond the scope of this paper, this goal may be achieved by using a richer set of data or estimating a structural model.

Table C.2: Price and distance intervals, mixed effects

Dependent variable:	Price (log)		
	(1)	(2)	(3)
$1500 < distance < 3000$	0.024[a]	0.026[a]	0.026[a]
	(0.002)	(0.002)	(0.002)
$3000 < distance < 6000$	0.085[a]	0.108[a]	0.108[a]
	(0.003)	(0.003)	(0.003)
$6000 < distance < 12000$	0.115[a]	0.136[a]	0.135[a]
	(0.002)	(0.002)	(0.002)
$12000 < distance$	0.145[a]	0.141[a]	0.140[a]
	(0.006)	(0.006)	(0.006)
GDP (log)		-0.006[a]	-0.006[a]
		(0.000)	(0.000)
GDP per capita (log)		0.022[a]	0.021[a]
		(0.001)	(0.001)
Mean UV (log)			0.018[a]
			(0.001)
Fixed effects	Firm × Product		
Random effects	Country		
Sample:	All	OECD	Eurozone
Observations	1,199,711	1,199,711	1,198,282
rho	0.000	0.000	0.000

This table investigates the impact of distance on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, and the level of competition in the destination country measured by the average unit value of imports in this country. Distance is measured using distance interval. Dummy is equal to 1 if the destination country belongs to the interval and 0 otherwise. Country random effects are added to control for unobserved heterogeneity. Robust standard errors in parenthesis. [c], [b], [a] indicate significance at the 10%, 5% and 1% level.

Table C.3: Price, distance, and tariffs 2003

Dependent variable:	Price (log)					
	(1)	(2)	(3)	(4)	(5)	(6)
Distance (log)	0.050^a	0.036^a	0.045^a	0.024^a	0.047^a	0.025^a
	(0.010)	(0.010)	(0.010)	(0.006)	(0.010)	(0.006)
Mean uv (log)	0.018^a	0.027^a	0.018^a	0.027^a	0.018^a	0.027^a
	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
GDP (log)	-0.004	-0.008^b	-0.003	-0.009^b	-0.003	-0.009^b
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
GDPC (log)	0.019^a	0.015^a	0.027^a	0.013^a	0.025^a	0.015^a
	(0.006)	(0.004)	(0.007)	(0.004)	(0.007)	(0.004)
Tariff (log)			0.015^a	-0.019^b		
			(0.006)	(0.008)		
Tariff - weighted (log)					0.012^b	-0.015^b
					(0.005)	(0.006)
Fixed effects	Firm × Product					
Sample:	All	Out. EU	All	Out. EU	All	Out. EU
Observations	1,158,370	319,459	1,155,993	398,556	1,155,993	398,465
R^2	0.005	0.003	0.005	0.004	0.005	0.004
rho	0.905	0.901	0.905	0.902	0.905	0.902

This table investigates the impact of distance and tariffs on firms' export prices. It uses the variance of prices across destination country within firm-product pairs by including firm×product fixed effects. The dependent variable is the log free on board export unit value by firm, destination and CN8 product. Explanatory variables are the distance to the destination country, the wealth of the destination country measured by the GDP per capita, the size of the destination country measured by the GDP, the level of competition in the destination country measured by the average unit value of imports in this country, and the tariffs faced by French exporters. Two measures of tariffs are used: a simple average and a weighted average of tariffs. They are computed at the country and industry levels. In columns 1, 3, 5 all destinations are considered. In columns 2, 4, 6 only exports outside EU countries are considered. Standard errors in parenthesis are clustered in the country dimension. ^{c}, ^{b}, ^{a} indicate significance at the 10%, 5% and 1% level.