Distance to core and selection of export products-destinations

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Distance to core and selection of export products-destinations

Distance du noyau et sélection des destinations des produits d’exportation

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Classification JEL: F14, F13, D21, O24, L25
Distance to core and selection of export products-destinations

Abstract

This paper examines aspects of heterogeneous multi-product firms that are seldom studied in the empirical literature, specifically the effects of skewness in export sales towards the best-performing products (core products) on the creation of new commercial product-country links. Additionally, this paper examines the factors that affect the differences in the trading of core products compared to fringe products. The results reveal that if the distance to the core increases by one standard deviation, then the probability of creating a new product-country link decreases by 3.5 percent. Distance to the core is negatively correlated with the ratio of the importing-country’s demand at the product-level.

Résumé

Cet article examine des aspects des entreprises multiproduits qui sont rarement étudiés dans la littérature empirique, en particulier les effets de l’asymétrie de la composition des flux d’exportation vers les produits les plus performants (produits de base) dans la création de nouveaux liens commerciaux. De plus, cet article examine les facteurs qui expliquent les différences dans le commerce des produits de base par rapport aux produits marginaux. Les résultats révèlent que si la distance du noyau augmente d’un écart-type, la probabilité de créer un nouveau lien produit-pays diminue de 3,5%. La taille de l’entreprise, la productivité et la distance par rapport à un marché influent sur la sélection du marché au niveau de l’entreprise.
Introduction

Numerous studies have shown that the size and productivity of firms play a key role in their entry into export activity (Bernard and Jensen, 1995; Robert and Tybout, 1997; Bernard and Jensen, 1999; Bernard et al., 2007). These findings are reiterated by Melitz (2003), who show that the productivity-exports relationship results from a self-selection process in which only the most productive firms are capable of overcoming the high entry cost involved with exporting.

Whereas the theoretical and empirical literature regarding heterogeneous firms (Lawless, 2009; Eaton et al., 2008, 2011) has emphasized the self-selection of firms in foreign markets, the existing models of heterogeneous multi-product firms, in contrast, emphasize within-firm selection of products across destinations. These models establish that firms have product-specific competencies that allow them to produce certain products more successfully (core products) than other products in terms of either efficiency (Eckel and Neary, 2010; Arkolakis et al., 2014; Mayer et al., 2014) or quality (Manova and Zhang, 2012; Eckel et al., 2015).

Core products account for a high proportion of foreign sales by firms (Bernard et al., 2011), and whereas all other products (fringe products) represent the largest number of traded products, their sales volumes are smaller. This skewness in the export sales distribution of firms toward the best-performing products can be observed at both the global level and in each of the destination markets of exporting firms (Mayer et al., 2014).

Due to the lack of detailed data, few studies have investigated the impact of this skewness on the creation of new commercial links by firms. Furthermore, little is known about the elements that influence the differences in the trading of core products compared to other products.

Answers to these questions are important for several reasons. First, although it is relevant to know the most probable commercial destinations to which firms will export, it is even more relevant to distinguish the probability of success or failure of various export products in generating new commercial transactions; in addition, the issue gains greater relevance if the fact that fringe products represent a substantial portion of products exported by multiproduct firms is considered.

Second, it is valuable to know how these factors affect the trading of core products compared with all other products, as such knowledge enables an understanding of the constraints that firms face in increasing the sales of their fringe products. For example, if the effort required by firms is too excessive, their best option would be to reallocate resources to the core product or other nearby products and base their strategy for expanding their commercial links around these products.

This paper contributes to the empirical literature in numerous aspects. First, we focus on the case of Mexico. This country is an interesting case for this assessment:
foreign sales represent nearly 30% of its gross domestic product (GDP), and more than 80% of its total exports are concentrated in the United States and Canada (WTO, 2013).

Second, we found that the commercial distance of the products of a firm from its core product influences the entry of new products into new markets, regardless of the type of product exported (homogeneous or differentiated) or the type of export firm examined (non-maquiladora or maquiladora).

Third, doubling the relative demand for non-core goods compared to core products would lead to a 7.3 percent reduction in the distance to the core. Products closer to the core are more sensitive to changes in relative demand, as reflected by an elasticity of -0.12, whereas goods further from the core are less sensitive. These differences are associated with the degree of substitutability between the exported product and the core product, whereby goods with greater substitutability will have a greater possibility of their distance to the core decreasing in the face of positive variations in their external demand.

According to our results, a strategy for firms to diversify their export markets could be based on concentrating their efforts on products that are very close to a firm’s core products or that have a high degree of substitutability. This process would involve a reallocation of resources toward these products and discontinuation of the remaining products. This option can allow firms to enter different markets and compete successfully in destinations where competition may be tougher, such as in countries with high-income consumers. However, the lower transportation costs needed to reach the markets of the United States and Canada make it highly probable that firms would direct sales to these countries as a first option, thus affecting efforts to diversify sales destinations and further increasing concentration in that market. This strategy must therefore be accompanied by mechanisms to reduce transportation costs or improve access to other markets.

This paper is structured as follows. Section 2 discusses the related literature. In Section 3, the model is developed, and the predictions to be evaluated are derived. Section 4 describes construction of the database, the variables employed and the empirical approach followed. Section 5 presents the results of the evaluation, and finally, Section 6 provides conclusions.
related to exporters’ entry into different markets. In this regard, the theoretical model developed in this paper is consistent with these investigations, as only the most productive firms have the capacity to face the fixed costs incurred by their entry into exporting activity. In addition, the existence of differing productivity levels between firms and transportation costs specific to particular destinations implicitly determine the markets that firms can serve.

This paper is also related to recent publications that explore firms’ export behavior, including that of multi-product and multi-destination firms. Some of these studies have examined the hypothesis that firms have core competencies that enable them to produce certain products more successfully (core products) than other products. This idea, together with detailed information regarding trade flows at the product level, explains observed trade patterns, which are not explainable with the standard models of heterogeneous firms proposed by MELITZ.

ECKEL and NEARY (2010) develop a model of multiproduct oligopolistic firms and flexible manufacturing in which firms face increasing marginal costs when supplying products that are beyond their core competencies. The model shows that an increase in competition may prompt firms to focus on products that are very close to their core competencies, which would lead to a decrease in the varieties of products exported.

In addition, MAYER et al. (2014), using a monopolistic competition model, find that destination markets in which competition is tougher and the economic geography is favorable lead firms to skew their export sales toward products with better performance, thereby internally modifying the distribution of their products for export. In their study, MAYER et al. (2014) use as a measure of global skewness (for each firm) the ratio of the local export sales in each destination market of the globally first-ranked product to that of the globally second-ranked product.

Unlike MAYER et al. (2014), in this manuscript, a variable that measures the trade distance of each product exported, relative to the product ranked first in terms of worldwide sales, is used. This measure has the advantage of taking into account not only the second-ranked product but also the entire diversity of products exported by firms, including fringe products.

This manuscript follows the theoretical framework of AW and LEE (2017), which considers two strands of literature. In one, firms set export prices based on cost competition (BERNARD et al., 2011; MAYER et al., 2014; ARKOLAKIS et al., 2014), whereas in the other, firms set export prices based on quality competition (MANOVA and ZHANG, 2012; CHEN and JUVENAL, 2016). With these components, two new testable predictions are derived using a partial-equilibrium heterogeneous-firm model.
Theoretical framework

In this section, we present a partial-equilibrium heterogeneous-firm model in which firms are heterogeneous in terms of both productivity, as in MELITZ (2003), and in quality. Resolution of the model yields two testable predictions that answer the research questions. The first is related to the impact that the commercial distance of the products of a firm from the core product has on export flows. The second explains the differences in the trading of core products compared to other goods, in terms of transport costs, fixed costs and demand for the products.

3.1. General Assumptions

In this document, we assume the world is made up of \( i = 1, ..., J \) symmetric countries and, in each one of them, we find two goods: a local good (H) and the foreign good (F). The first is produced under constant returns to scale and perfect competition, which is taken as numeraire. The second is produced under increasing returns to scale and imperfect competition and is traded with other countries.

3.2. Demand

Consumers in all countries share identical and homothetic preferences to consume both goods. The utility function of the representative individual in country \( j \) is defined as a Cobb-Douglas function, as follows:

\[
U_j = H_j^{1-\mu} F_j^\mu, \quad 0 < \mu < 1
\]

(1)

Terms \((1 - \mu)\) and \(\mu\) represent the percentage of expenditures for local goods and foreign goods, respectively, made by consumers living in \( j \). In turn, \( F_j \) is a good that comprises different varieties of foreign goods with a constant elasticity of substitution (CES) between each variety.

\[
F_j = \left[ \sum_{i=1, \ i \neq j}^J [q_{ij}(\omega) \gamma_i(\omega)]^{\frac{1}{\sigma}} \right]^{\frac{\rho}{\sigma}}, \quad 0 < \rho < 1
\]

(2)

In this expression, \( q_{ij}(\omega) \) is the amount of variety \( \omega \) elaborated in \( i \) and consumed in \( j \); \( \gamma_i(\omega) \) reflects the quality of the goods.\(^1\) Meanwhile, \( \sigma = \frac{1}{1 - \rho} \), the elasticity of substitution between varieties of the goods differentiated, is assumed to be strictly greater than one.\(^2\) In addition, considering that the available income of consumers in country \( j \) for the two types of products is \( R_j \) and solving for the maximization of the representative consumer utility, we obtain the demand in \( j \) for the variety produced in country \( i \).

\[
q_{ij}(\omega) = \frac{p_{ij}(\omega)^{-\sigma} \gamma_i(\omega)^{1-\sigma}}{p_j^{1-\sigma}} \mu R_j
\]

(3)
where $P_j$ represents the price index for foreign goods in $j$, which depends on the prices of varieties sold in $j$.

$$P_j = \left[ \sum_{i=1, \ i \neq j}^{N} p_{ij}(\omega)^{1-\sigma} \gamma_{ij}(\omega)^{\sigma-1} \right]^{\frac{1}{1-\sigma}}$$ (4)

### 3.3. Production and Behavior of the Firm

Firms produce multiple products using work as input, which, as is standard in the literature, is assumed to be the sole production factor. Moreover, there is a *continuum* of consumers/workers in all countries that offer their unit of work time inelastically. Without loss of generality, wages are normalized to one.

Firms are heterogeneous in two ways: in productivity ($\varphi_i$), as in MELITZ (2003), and in quality ($\gamma_i$). Therefore, each firm elaborates products with different levels of productivity and quality. Firms face a marginal cost, in units of work, in producing a good that decreases in productivity but increases in quality:

$$C_i(\omega) = \varphi_i(\omega)^{-1}\gamma_i(\omega)^\theta$$ (5)

where $\theta$ reflects the cost elasticity of quality, which is assumed to be $0 \leq \theta < 1$ so as to ensure the concavity of the function of profits and permit the marginal cost to increase with quality, but not excessively.³

As in AW and LEE (2017), the varieties elaborated by each firm are ranked as a function of their productivity and quality such that products with the highest level in each of these variables are ranked first ($n = 1$), goods with the second highest level in said aspects are ranked second ($n = 2$) and so on, yielding:

$$\varphi^n_i (\varphi_k, n) = \varphi_i n^{-\alpha_1}, \quad 0 \leq \alpha_1 < 1 \quad (6.1)$$

$$\gamma^n_i (\gamma_i, n) = \gamma_i n^{-\alpha_2}, \quad 0 \leq \alpha_2 < 1, \quad n = 1,2,3,... \quad (6.2)$$

The preceding expressions characterize two strands of literature: the first is that the efficiency of firms decreases as $n$ increases (BERNARD et al., 2011; MAYER et al., 2014; ARKOLAKIS et al., 2014), and the second is that quality decreases as $n$ increases (MANOVA and ZHANG, 2012; CHEN and JUZENAL, 2016). By incorporating (6.1) and (6.2) in (5), the marginal cost of a firm for $n^{th}$ product is equal to:

$$C^n_i (\varphi_i, \gamma_i, n) = \varphi_i^{-1} \gamma_i^{\theta} n^{\alpha_1-\theta\alpha_2}, \quad n = 1,2,3,... \quad (7)$$

Such that, at a given level of productivity and quality, the firm’s marginal cost can increase or decrease as a function of rank $n$ and, with regard to the dominant effect, be it $\alpha_1$ or $\alpha_2$. If $\alpha_1 > \theta\alpha_2$, goods closest to the firm’s “core” product ($n = 1$) would result in high efficiency and, therefore, a relatively lower marginal cost. On the other hand, if $\alpha_1 < \theta\alpha_2$, products with better quality would have low efficiency, and their marginal cost will be higher.
To sell to destination \( j \), firms should incur two types of transaction costs. The first are fixed costs \( (F_{ij}) \), in work units, considered to include entry costs as well as the operation, promotion, and distribution and training costs incurred by a firm to export to \( j \). The second are transport costs, which are assumed of the iceberg type, that is, if a unit of goods is shipped to another country, only a fraction arrives at the final destination, such that \( p_{ij} = p_i \tau_{ij} \), in which \( p_i \) in the price in country \( i \) and \( \tau_{ij} \) are shipping costs.

In particular, company profits the \( n \)th product sold can be expressed as:

\[
\pi^n_{ij} = p_{ij}q_{ij} - (\varphi_i^{-1} \gamma_i^\theta n^{\alpha_1-\theta \alpha_2}) q_{ij} \tau_{ij} - F_{ij}
\]  

(8)

Solving the problem of maximizing profits for the \( n \)th product, we obtain the optimum price for that good:

\[
p^n_i = \frac{\gamma^\theta n^{\alpha_1-\theta \alpha_2}}{\rho \varphi_i}
\]  

(9)

With \( \alpha_1 > \theta \alpha_2 \), more efficient firms are capable of charging low prices for products with a low \( n \) so as to attract a greater number of foreign consumers. Meanwhile, when \( \alpha_1 < \theta \alpha_2 \), producers of high-quality goods with a good reputation among consumers can set high prices, which decreases as the numerical value of \( n \) increases.4

Incorporating (3), (6.2) and (9) into (10), firms \( i \) with capacity \( (\varphi_i, \gamma_i) \) have the following function of profits when selling the \( n \)th product to destination \( j \).

\[
\pi^n_{ij} = (p \varphi_i)^{\theta-1} \tau_{ij}^{1-\sigma} \frac{\mu R_i}{\sigma P_j^{1-\sigma}} \gamma_i^{(\sigma-1)(1-\theta)} n^{(\sigma-1)[\alpha_2(\theta-1)-\alpha_1]} - F_{ij}
\]  

(10)

Firms wishing to sell a particular product to destination \( j \) may do so if \( \pi^n_{ij}(\varphi_i, \gamma_i, n) \geq 0 \). As in MELITZ (2003), we suppose free entry of companies into the marketplace. Therefore, with a zero-profit condition for a firm in \( i \) who wants to export to destination \( j \), it is such that:

\[
\varphi_i = \left( \frac{\mu R_i}{\sigma P_j^{1-\sigma}} \right)^{-\frac{1}{\sigma-1}} (p)^{-1} \tau_{ij}^{(1-\theta)} \gamma_i^{(1-\theta)} n^{\alpha_2(1-\theta)+\alpha_1} F_{ij}^{\frac{1}{\sigma-1}}
\]  

(11)

From the preceding, we can observe that a cut-off \( \varphi_i \) is required for a given level of quality \( (\gamma_i) \), and a value \( n \) allows \( \pi^n_{ij}(\varphi_i, \gamma_i, N) = 0 \). Such that firms with productivity \( \varphi^*_i \) greater than \( \varphi_i \) can serve market \( j \), obtaining positive profits. Meanwhile, a firm with productivity under \( \varphi_i \) cannot do so, because export costs to destination \( j \) may be greater than the profits obtained by selling to this marketplace.

3.4. Testable prediction 1

From expression (10), it can be stated that if the export status of firms \( E^n_{ij} \) takes a value of one when \( \pi^n_{ij} \geq 0 \) and zero otherwise, then:
The first term on the right-hand side of (12) stipulates that the decision of firm $i$ to export to a specific market $j$ depends positively on its level of productivity ($\varphi_i$) and that more productive firms will have a greater capacity to serve foreign markets. Similarly, the probability of exporting will also increase with both the total spending on imported products in the destination country ($\mu R_j P_1 - \sigma_j$) and the firm’s brand reputation or aggregate quality ($\gamma_i^{(\sigma-1)(1-\theta)}$). Simultaneously, the probability of entering the export activity decreases as a result of transportation costs ($\tau_{ij}^{1-\sigma}$) and specific fixed costs associated with each destination market ($F_{ij}$).

Similarly, the possibility of exporting a given number of products to a particular destination increases (decreases) according to how close (distant) these products are to (from) the firm’s core product, which is independent of whether the value of $\alpha_1$ dominates $\theta \alpha_2$. Finally, $\varepsilon_{ij}$ is a random term that denotes unobservable factors in firms’ export decisions.

### 3.5. Testable prediction 2

Without loss of generality, if in (10), we assume that the demand for imported goods are product specific, we find that

$$
\pi_{ij}^n = (\rho \varphi_i)^{\sigma-1} \tau_{ij}^{1-\sigma} \left( \frac{\mu R_j}{\sigma P_j^{1-\sigma}} \right)^{\gamma_i^{(\sigma-1)(1-\theta)}} n^{(\sigma-1)[\alpha_2(\theta-1) - \alpha_1]} - F_{ij}
$$

If the zero-benefit condition is applied to (13) and it is clear for $n$, an equation that explains the position of product $n$ (with respect to the core) as a function of factors internal and external to the firm is obtained. This expression can be obtained for any product $k$, and the ratio of product $n$ with respect to product $k$, with $n, k \in N$ and $n < k$, can be expressed as:

$$
\frac{n}{k} = \left( \frac{\mu R_j}{\sigma P_j^{1-\sigma}} \right)^{1} \left( \frac{\mu R_i^n}{\sigma P_i^{1-\sigma}} \right)^{\frac{1}{b}}
$$

where $b = (\sigma - 1)[\alpha_2(\theta - 1) - \alpha_1]$.

That is, the differences in the position of products within a firm can be explained by heterogeneity in the demand exerted by consumers abroad.
In particular, if the demand in \( j \) for product \( k \) increases more than proportionately to that for \( n \), the ratio of \( n/k \) will be reduced; this effect will be stronger when the degree of substitution between said goods is greater (low \( \sigma \)), and conversely, it will be weaker when the \( \sigma \) value is high.

\[\text{-4-}\]

Data and empirical strategy

Our principal source of data is the Mexican Customs. The data include aggregate export flows at the levels of firm, country of destination, product-tariff code with 8-digit classification from the Harmonized System (HS) and year for the period from 2004 to 2010. These data were merged with data for a random sample of manufacturing firms recorded by the Annual Industrial Survey (Encuesta Industrial Anual: EIA) prepared and processed by the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía: INEGI) of Mexico. The EIA contains information about the numbers of employees, production, sales and wages of manufacturing establishments (excluding maquiladoras) with greater than 15 employees in 21 manufacturing industries. The period covered by the EIA data is from 2003 to 2009, and from this source, information about labor productivity (value added/number of employees), firm size (number of employees) and location of the production plant was obtained.

For purpose of analysis, in our final database, we include only firms that matched in the EIA and trade data, and for firms with more than one establishment in the EIA, we include the plant with the greater commercial activity only. In addition, we control for null trade flows; only countries that accounted for up to 95 of the export operations firms are considered. Finally, data from 2003 were excluded from the database because this year was used as a reference for the construction of the dependent variable in the first prediction.

Information regarding the distances between Mexico and different export destination were calculated using the great-circle equation, with the location data (longitude and latitude) of the capitals of countries from the CEPII (2012) database. Import figures (HS 6-digit) were obtained from the COMTRADE database of the United Nations.

The final database, which includes 3,524 firms that exported to at least one of 79 possible destination countries during the period of 2004–2010, represents an unbalanced panel as a result of the imperfect matches of the included variables.

4.1. Testable prediction 1

In the estimation of expression (12), a database that includes all positive firm-product-country export flows combined for the different years covered by the study
was built; this definition was used to avoid creating a database that would be too large to analyze owing to a lack of computing resources.

The dependent variable \( E_{ijt} \) is a dummy variable that takes a value of 1 if firm \( i \) began exporting product \( n \) to destination \( j \) at time \( t \) (and did not do so at time \( t - 1 \)) and zero otherwise. Labor productivity is used as a proxy for \( \phi_i \) and is calculated as value added per number of employees at the firm level, whereas in the expression \( \left( \frac{\mu R_j}{p_j^{1-\sigma}} \right) \), imports by destination countries at the HS 6-digit product level are used.

The term \( (\gamma_i) \) refers to the firm’s brand and represents a reputation of quality in the eyes of consumers; this variable was estimated using a modified form of the methodology of KHANDELWAL et al. (2013). The procedure consisted of two steps. First, quality was estimated at the firm-product-country and year levels using information about trade flows. Second, an index of quality at the firm level was calculated; this index considers the relative importance of the products exported by the firm and has the advantage that it estimates the export-weighted quality of the basket of products sold by the firm, as the theoretical model requires. Regarding the fixed costs \( (\sigma_f_{ij}) \), no information at that level of detail was available; therefore, these costs were estimated using firm-product fixed effects under the assumption that these do not change significantly over time.

As with many studies in the international trade literature, transportation costs \( (\tau_{ij}) \) are proxied by the physical distance between different trading locations.

To identify the core products of firms, we followed MAYER et al. (2014) and ECKEL et al. (2015) in defining core products as those with the highest level of export sales each year; the next place is occupied by the product with the second-highest level of sales, and so on. Using this criterion, products exported annually by each firm can be ranked. However, direct inclusion of this measure in the estimates could lead to bias and incorrect interpretation because this is an ordinal variable, and it is assumed that the distance between all places in the scale is the same; that is, the distance between positions 1 and 2 is the same as the distance between positions 4 and 5. To address this problem, the following action was taken:

\[
\ln \text{distance to core}_{it}^n = \ln \left( \frac{\text{export sales}_{it}^{core}}{\text{export sales}_{it}^n} \right)
\]

where \( \text{export sales}_{it}^n \) represents the export sales of product \( n \) by firm \( i \) at time \( t \), whereas \( \text{export sales}_{it}^{core} \) corresponds to the export sales of the core product of firm \( i \). This measure has several advantages, in particular, that the ranking is maintained between any products \( n \) exported by the firm with respect to its core product, that the commercial distances between all products are not assumed to be identical, and that conclusions regarding the impact of the commercial distance of a product from the core product on the dependent variable can be drawn.
An important aspect also taken into account in this assessment is the size of firms, which, according to the empirical evidence (Bernard and Jensen, 2004), is a factor that influences the export decisions of firms.

Because the empirical evaluation of (12) involves estimation of a panel model with a large number of fixed effects defined by each firm-product combination, the use of a probit model would create problems of incidental bias in the parameters, as described by Lancaster (2000). A possible solution would be to use a linear probability model. However, such a regression also produces inconsistencies because the estimated probability is not always between zero and one. To overcome these disadvantages, a conditional logit model, such as that proposed by Chamberlain (1980), is used.

In addition, other issues, such as possible endogeneity and clustering in the estimation of (12), must be addressed. Bernard and Jensen (1999) showed that there is double causality between export capacity and productivity. To resolve this issue, the covariates are lagged for a period, as suggested by Bernard and Jensen (2004). To address the clustering issue that arises with respect to aggregated variables when microdata are used in a regression, causing standard errors to be underestimated, as described by Moulton (1986, 1990), all the standard errors in the estimates are clustered at the destination-country level.

4.2. Testable prediction 2

For the empirical evaluation of the second prediction, logarithms are applied to expression (14). For the construction of the ratio $n/k$, the numerator is identified as the core product ($n = 1$) sold by the firm in country $j$ in year $t$, and the denominator represents any other good sold in the same country in the same period. The advantage of this definition is that it reflects the distance to the core of each of the products exported within each sales market.

In addition, this expression, which is specific to destination, is closely related to the variable used to evaluate prediction 1, which is a global measure. In the database used, the overall Spearman’s rank correlation between the specific destination measure and the global measure is 0.8236, suggesting that the ranking of products sold by firms globally is generally consistent with the sales ranking of the products across different destination markets.

For the construction of the ratio that considers the demand of product $k$ with respect to good $n$, the imports made by the destination countries are used at the HS 6-digit level. The ordinary least squares method is used to test this hypothesis, whereas in the other predictions, problems of endogeneity and clustering in the estimations are addressed. Likewise, in the estimation, the physical distance, a dummy variable referring to the previous experience in the destination market and a covariate referring to the possible effects of export spillovers are introduced as controls.
Similarly, to determine whether there are differentiated effects of the independent variable on different points in the distribution of the dependent variable, quantile regression is used. For the latter, we follow the approach proposed by ABREVAYA and DAHL (2008) for the estimation of quantiles using panel data, which involves the use of a correlated random-effects model that considers unobservable fixed effects as a linear function of other covariables in the model. In addition, this model, unlike that proposed by CANAY (2011), is appropriate for panels with short time series, as is the case with our database.

4.3. Descriptive statistics

Table 1 presents a summary of the new trade flows identified in the database. One result that stands out is that 7.2% of the total flows and 43.4% of export sales pertain to the core product. Moving down the ranking, the percentage of new product-country pairs decreases sharply in any of the geographical areas considered. This behavior is even more pronounced for the sum of the first five products of the firms in the sample, which account for 24.3% of total flows and 84.3% of export sales. These percentages are even greater for the first ten products, which account for 37% of the flows and 94.1% of export sales.

Table 2 presents descriptive statistics for the main variables. The data reflect differences in productivity levels and firm size between the different geographical regions considered. The mean productivity and firm size increase as the destination market distance increases; this is clear if the North American Free Trade Agreement (NAFTA) region comprising the United States and Canada is compared with that of Asia. In the first case, the mean values obtained for the productivity and firm size logarithms are 5.910 and 6.017, respectively. For Asia, the mean productivity is 6.082, and the mean firm size is 6.178. This suggests that to access more distant markets, firms must make additional efforts in terms of productivity to overcome the transportation costs of reaching remote markets; in addition, these data suggest selection between firms and destinations, as noted in the empirical literature regarding heterogeneous firms.

In addition, the figures for the imports by destination country reflect the fact that consumers in the NAFTA region generate the highest demand for products. The results suggest that the greater the demand generated by consumers for imported products and the shorter the distance to those buyers are, the more feasible trade with these destinations will be.

Regarding the distance to the core product, the results indicate that on average, products sold in the combined markets of the United States and Canada are farther from the core product than are those sold in other trade regions. This result may indicate there is a greater skew toward the top products of firms in that market in terms of greater demand generated by consumers.
### Table 1 – Breakdown of the new product-destination pairs of the database

<table>
<thead>
<tr>
<th>Flows</th>
<th>Export sales</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NAFTA</strong></td>
<td><strong>Latin America</strong></td>
</tr>
<tr>
<td>Top 1</td>
<td>1.3%</td>
</tr>
<tr>
<td>Top 2</td>
<td>1.3%</td>
</tr>
<tr>
<td>Top 3</td>
<td>1.2%</td>
</tr>
<tr>
<td>Top 4</td>
<td>1.1%</td>
</tr>
<tr>
<td>Top 5</td>
<td>1.1%</td>
</tr>
<tr>
<td>Top 6</td>
<td>1.0%</td>
</tr>
<tr>
<td>Top 7</td>
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</tr>
<tr>
<td>Top 8</td>
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<tr>
<td>Top 9</td>
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</tr>
<tr>
<td>Top 10</td>
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</tr>
<tr>
<td>+ 10</td>
<td>21.3%</td>
</tr>
<tr>
<td><strong>All</strong></td>
<td>31.5%</td>
</tr>
<tr>
<td><strong>1-5</strong></td>
<td>6.0%</td>
</tr>
<tr>
<td><strong>1-10</strong></td>
<td>10.3%</td>
</tr>
</tbody>
</table>

Source: Own elaboration using new trade flows from the database. Note: The NAFTA region comprises the United States and Canada.
## Table 2 – Descriptive statistics of the variables used

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>United States and Canada</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln Firm size</td>
<td>6.017</td>
<td>1.167</td>
<td>8.856</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Productivity</td>
<td>5.910</td>
<td>1.031</td>
<td>17.833</td>
<td>-0.765</td>
</tr>
<tr>
<td>Ln Destination country’s demand</td>
<td>12.545</td>
<td>1.849</td>
<td>18.143</td>
<td>-0.650</td>
</tr>
<tr>
<td>Ln Physical distance</td>
<td>6.969</td>
<td>0.346</td>
<td>8.092</td>
<td>6.862</td>
</tr>
<tr>
<td>Ln Distance to core</td>
<td>6.568</td>
<td>4.350</td>
<td>20.093</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Quality index</td>
<td>0.748</td>
<td>0.414</td>
<td>2.298</td>
<td>-1.420</td>
</tr>
<tr>
<td><strong>Latin America</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln Firm size</td>
<td>5.927</td>
<td>1.237</td>
<td>8.856</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Productivity</td>
<td>6.107</td>
<td>1.037</td>
<td>16.902</td>
<td>-0.448</td>
</tr>
<tr>
<td>Ln Destination country’s demand</td>
<td>7.592</td>
<td>2.230</td>
<td>15.635</td>
<td>-6.908</td>
</tr>
<tr>
<td>Ln Physical distance</td>
<td>7.852</td>
<td>0.621</td>
<td>8.931</td>
<td>6.969</td>
</tr>
<tr>
<td>Ln Distance to core</td>
<td>5.834</td>
<td>4.150</td>
<td>21.457</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Quality index</td>
<td>0.757</td>
<td>0.386</td>
<td>2.298</td>
<td>-1.857</td>
</tr>
<tr>
<td><strong>Asia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln Firm size</td>
<td>6.178</td>
<td>1.135</td>
<td>8.856</td>
<td>0.693</td>
</tr>
<tr>
<td>Ln Productivity</td>
<td>6.082</td>
<td>0.922</td>
<td>15.127</td>
<td>0.929</td>
</tr>
<tr>
<td>Ln Destination country’s demand</td>
<td>10.584</td>
<td>2.278</td>
<td>17.860</td>
<td>-5.809</td>
</tr>
<tr>
<td>Ln Physical distance</td>
<td>9.482</td>
<td>0.123</td>
<td>9.747</td>
<td>9.281</td>
</tr>
<tr>
<td>Ln Distance to core</td>
<td>4.525</td>
<td>4.284</td>
<td>20.438</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Quality index</td>
<td>0.778</td>
<td>0.388</td>
<td>2.155</td>
<td>-1.382</td>
</tr>
<tr>
<td><strong>Europe</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln Firm size</td>
<td>6.135</td>
<td>1.072</td>
<td>8.856</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Productivity</td>
<td>6.173</td>
<td>1.046</td>
<td>15.127</td>
<td>-0.733</td>
</tr>
<tr>
<td>Ln Destination country’s demand</td>
<td>11.498</td>
<td>1.893</td>
<td>17.312</td>
<td>1.099</td>
</tr>
<tr>
<td>Ln Physical distance</td>
<td>9.156</td>
<td>0.052</td>
<td>9.345</td>
<td>9.046</td>
</tr>
<tr>
<td>Ln Distance to core</td>
<td>5.116</td>
<td>4.418</td>
<td>19.988</td>
<td>0.000</td>
</tr>
<tr>
<td>Ln Quality index</td>
<td>0.751</td>
<td>0.389</td>
<td>2.187</td>
<td>-1.951</td>
</tr>
</tbody>
</table>

*Source: Own elaboration using new trade flows from the database.*
Results

This section presents the results of the empirical evaluation of the testable predictions of the theoretical model. The findings are presented in two subsections, which in turn are subdivided into different parts; in each of them, the estimates are presented, and the coefficients obtained are analyzed.

5.1. Distance to core and the possibility of exporting new products to new markets

This section evaluates the impact of distance to core on the probability of creating a new trade link. As a starting point, the estimate is performed on all new trade flows in the sample. Additional estimates are subsequently performed on different subsamples, which are defined according to type of product (homogeneous and differentiated). Finally, a sample of maquiladoras is used to corroborate the results.

5.1.1. Distance to the core and the creation of new trade transactions

The first column of Table 3 reports the estimation results of testable prediction 1, concerning the impact of distance to core on decisions to create new trade links. The signs of the coefficients are consistent with those obtained in equation (12), and the coefficients are, in general, significant at the 1% level. The findings demonstrate that firms that are larger, are more productive, and have a higher quality index have a better chance of creating new product-country export transactions; in addition, as the demand created by consumers located at $j$ increases with respect to the products provided by exporting firms, the probability of selling an additional product-country combination is greater.

However, this possibility is limited by the transportation costs involved in reaching more distant markets. Similarly, the expectation of success in the creation of a new commercial transaction for product $n$ is limited by the distance of the product from the core product of the firm. Specifically, it was found that a 10% increase in the distance to the core reduces the probability of creating an additional external link by $0.44\% \approx (\exp(-0.044 \times 0.10) - 1) \times 100$. However, a small coefficient does not mean that this covariable explains a small part of the variance of the dependent variable, since its explanatory power depends on its own variability.

Therefore, the explanatory power can be determined by considering how the probability of establishing a new external link is modified when the distance to the core increases by one standard deviation with respect to its mean. The calculation indicates that the explanatory power of the measure of distance to the core is -12.6, which expressed in percentage points equals -3.5 percent.$^{13}$

To verify the consistency of the initial estimate, various controls related to the firm’s exporting behavior are gradually introduced. The first control is the persistence
demonstrated by firms with respect to export activity (Roberts and Tybout, 1997; Bernard and Jensen, 2004), as, despite facing shocks to their productivity or changes in the international environment, most exporters remain in the market in the next period. To take into account this characteristic, column 2 of Table 3 incorporates the logarithm of the value of exports at the firm-year level lagged one period. This variable has an insignificant effect, since part of the effect of the persistence in export activity may be being collected by the measure of distance to the core, which also lagged one period and reduces its magnitude without diminishing its statistical significance. Likewise, the incorporation of this variable reduces the size of almost all the coefficients of the other covariables considered in the regression without affecting its sign or becoming statistically insignificant.

Another factor that affects the probability of introducing an additional product or serving a different market is the familiarity that firms have with certain destinations. Firms carry out commercial transactions more easily in countries with which they have more contact than in markets that they are less familiar with. In column 3, a dummy variable is incorporated into the original estimate. This variable takes a value of 1 if the firm exported to the same country in a previous year and zero otherwise. The results for this variable suggest that previous experience in exporting to a particular country increases the probability of trading new products in that market.

An additional factor that can affect the generation of trade relations is the number of products traded; specifically, firms with a greater number of exported products are more likely to trade more products in different markets (Bernard et al., 2011). To control for this heterogeneity among firms in the estimation, we included the logarithm of the number of products exported lagged one period. The calculated parameter (column 4) shows a positive relationship between this measure and the probability of exporting; in addition, the coefficients for the variables related to firm size and productivity decrease compared with the first estimate because larger and more productive firms have enough capacity to sell a wider range of products.

One factor of interest in various studies is the possible positive and significant effect of the geographical proximity of other exporting firms on the probability that a firm will sell abroad. This suggests that there are positive externalities, known as export spillovers, that contribute to a reduction in fixed costs incurred by firms entering into exporting activities. To confirm this result, the fifth column reports the findings that result from taking into account possible export spillovers originating from agglomerations of other nearby exporters (Clerides et al., 1998; Greenaway and Kneller, 2008).

The measure of export spillovers used is the number of other firms located in the same municipality that sold the same product to the same country in the previous year; this measure is specific to product-country combinations and is similar to that used by Koenig et al. (2010). In this case, we found statistical evidence that suggests that new country-product pairs are positively influenced by concentrations of other
Distance to core and selection of export products-destinations

neighboring exporters; for the remainder of the variables, no substantial changes from the original cost estimate are observed.

Table 3 – Distance to core and probability of creating new product-country trade links
Dependent variable: $\text{Dummy } E_{ijt}^n$

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln firm size$_{it}$</td>
<td>0.207** (3.90)</td>
<td>0.134+ (1.82)</td>
<td>0.181** (3.47)</td>
<td>0.174** (3.36)</td>
<td>0.207** (3.91)</td>
<td>0.163** (3.19)</td>
</tr>
<tr>
<td>Ln productivity$_{it}$</td>
<td>0.057* (2.25)</td>
<td>0.056* (2.07)</td>
<td>0.060* (2.48)</td>
<td>0.053* (2.11)</td>
<td>0.056* (2.22)</td>
<td>0.058* (2.39)</td>
</tr>
<tr>
<td>Ln destination country’s demand$_{njt}$</td>
<td>0.021** (6.16)</td>
<td>0.009* (2.26)</td>
<td>0.010* (3.25)</td>
<td>0.021** (6.15)</td>
<td>0.017** (4.72)</td>
<td>0.007* (2.09)</td>
</tr>
<tr>
<td>Ln physical distance$_{ij}$</td>
<td>-0.182** (-12.20)</td>
<td>-0.126** (-5.89)</td>
<td>-0.121** (-7.85)</td>
<td>-0.183** (-12.14)</td>
<td>-0.168** (-11.50)</td>
<td>-0.112** (-8.38)</td>
</tr>
<tr>
<td>Ln distance to core$_{n_it}$</td>
<td>-0.044** (-6.28)</td>
<td>-0.038** (-5.39)</td>
<td>-0.047** (-6.56)</td>
<td>-0.044** (-6.33)</td>
<td>-0.044** (-6.38)</td>
<td>-0.047** (-6.70)</td>
</tr>
<tr>
<td>Ln quality index$_{it}$</td>
<td>0.264** (3.71)</td>
<td>0.310** (3.49)</td>
<td>0.261** (3.73)</td>
<td>0.277** (3.90)</td>
<td>0.265** (3.72)</td>
<td>0.270** (3.84)</td>
</tr>
<tr>
<td>Ln export sales$_{it}$</td>
<td>0.007 (0.46)</td>
<td>0.619** (30.03)</td>
<td>0.581** (26.62)</td>
<td>0.108** (5.63)</td>
<td>0.051** (3.37)</td>
<td></td>
</tr>
<tr>
<td>Dummy market experience (t-1)</td>
<td></td>
<td>0.619** (30.03)</td>
<td></td>
<td>0.108** (5.63)</td>
<td>0.051** (3.37)</td>
<td></td>
</tr>
<tr>
<td>Ln number of products$_{it}$</td>
<td></td>
<td>0.108** (5.63)</td>
<td></td>
<td>0.011** (6.80)</td>
<td>0.008** (5.94)</td>
<td></td>
</tr>
<tr>
<td># other firms in the area, same product-same destination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudo R$^2$</td>
<td>0.07</td>
<td>0.05</td>
<td>0.16</td>
<td>0.06</td>
<td>0.06</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Conditional logit model estimations. The statistics (in parentheses) are constructed using standard clustered errors at the destination country level. All independent variables, except for the quality index, are lagged one period. **, *, and + indicate significance levels of 1%, 5% and 10%, respectively. The dependent variable only considers new export flows and is constructed at the firm-product-country-year level. All regressions include firm-product fixed effects and year fixed effects. The subscripts of the variables identify firms ($i$), products ($n$), countries ($j$) and time ($t$).

Column 6 lists all the variables used as controls, excluding the variable that measures persistence in export activity; the influence of this variable is captured by the dummy variable related to prior experience selling to a destination country. This specification revealed that the reductions in the magnitudes of the coefficients related to size, imports of product $n$ by country $j$ and distance were eliminated by the
presence of other variables that influence the export decisions of firms. Regarding the parameter of the variable concerning distance to core, it does not change substantially in dimension, and its significance does not change.

The results presented in Table 3 indicate that the commercial positions of the products of a firm with respect to its core product are relevant to the generation of new trade ties with other export markets. Therefore, if a product has a very distant place in the ranking of a firm, the product will have less of a chance of being exported to a new market.

5.1.2. Effect of distance to the core considering different types of product and firms

A second important issue is the effect of distance to the core considering different types of products and firms. To elaborate on this subject, the sample was divided into two sub-samples according to the type of product exported, differentiated or homogeneous, in accordance with RAUCH (1999) at the 4-digit STIC Rev. 2, and a correlation matrix between the Harmonized System 2007 and STIC Rev. 2\(^{15}\) was used to link both sources of information. For purposes of comparison, column 1 of Table 4 reports the final regression in Table 3, and in the next two columns, the estimated parameters are presented separated by type of product.

The estimates in columns 2 and 3 provide interesting results. First, from the standpoint of the theoretical model used, the signs of the coefficients obtained are similar to those in the first column, which suggests that the impact of distance to the core on decisions to create new trade links is maintained regardless of the type of product under consideration, as stated by testable prediction 1. In addition, the effect of increasing distance to the core by one standard deviation with respect to its mean leads to a 2.9 percent decrease in the probability of creating new links abroad in the case of differentiated products, and for homogeneous goods, the same increase yields a reduction of 3.8 percent.

The second result is that firms that trade differentiated products exhibit greater sensitivity and/or significance in the variables associated with firm size, productivity and transportation cost compared with their counterparts. The finding regarding transportation costs had already been reported by RAUCH (1999), who asserts that the greater sensitivity is related to the additional costs of pairing sellers and buyers.

In this case, our hypothesis is that to export a greater volume of differentiated products, firms must be larger and more productive to improve the features of their products, as they are competing based on quality (ECKEL et al., 2015). This improvement may result in modernization of the product, quality improvement or greater differentiation, which can lead to changes in terms of trade and delivery costs between countries, thereby resulting in higher transportation costs. Additionally, by selling higher quality products, firms will be more likely to enter markets in which consumers have a high preference for that type of product; thus, familiarity with selling in certain destinations is important.
Distance to core and selection of export products-destinations

Regarding the previous model regressions, it is important to verify whether the results obtained can be extended to different types of manufacturing firms. For Mexico and many countries, this point is very important, as a significant portion of their manufacturing firms export processed products; that is, they assemble or transform imported inputs (duty-free and with tax incentives) into products for export. In Mexico, this is the case for firms that export under the program known as Maquila.

Table 4 – Distance to core and probability of creating new product-country trade links considering different types of product and firms – Dependent variable: Dummy $E_{ijt}$

<table>
<thead>
<tr>
<th>Study sample (Type of products)</th>
<th></th>
<th></th>
<th>Maquiladoras sample (Type of products)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln firm size$_{it}$</td>
<td>0.163** (3.19)</td>
<td>0.196** (3.97)</td>
<td>0.087 (0.63)</td>
<td>0.007* (2.09)</td>
<td>0.006 (1.57)</td>
</tr>
<tr>
<td>Ln productivity$_{it}$</td>
<td>0.058* (2.39)</td>
<td>0.056* (1.96)</td>
<td>0.065+ (1.94)</td>
<td>0.007 (1.12)</td>
<td>0.003 (0.37)</td>
</tr>
<tr>
<td>Ln destination country’s demand$n_{jt}$</td>
<td>0.007* (2.09)</td>
<td>0.006 (1.57)</td>
<td>0.009+ (1.89)</td>
<td>0.007 (1.12)</td>
<td>0.003 (0.37)</td>
</tr>
<tr>
<td>Ln physical distance$_{ij}$</td>
<td>-0.112** (-8.38)</td>
<td>-0.113** (-7.42)</td>
<td>-0.105** (-6.86)</td>
<td>-0.152** (-7.73)</td>
<td>-0.169** (-7.53)</td>
</tr>
<tr>
<td>Ln distance to core$n_{it}$</td>
<td>-0.047** (-6.70)</td>
<td>-0.047** (-6.28)</td>
<td>-0.048** (-6.34)</td>
<td>-0.055** (-6.06)</td>
<td>-0.052** (-5.69)</td>
</tr>
<tr>
<td>Ln quality index$_{it}$</td>
<td>0.270** (3.84)</td>
<td>0.218* (2.64)</td>
<td>0.490** (4.74)</td>
<td>0.661** (5.29)</td>
<td>0.250+ (1.92)</td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td>0.16</td>
<td>0.17</td>
<td>0.15</td>
<td>0.23</td>
<td>0.26</td>
</tr>
<tr>
<td>Observations</td>
<td>306,327</td>
<td>243,133</td>
<td>63,194</td>
<td>156,097</td>
<td>125,614</td>
</tr>
</tbody>
</table>

Conditional logit model estimations. The statistics (in parentheses) are constructed using standard clustered errors at the destination country level. All independent variables, except for the quality index, are lagged one period. Estimates also included as covariables: dummy market experience and the log of number of products; the spillover measure only included in columns 1 to 3. **, *, and + indicate significance levels of 1%, 5% and 10%, respectively. The dependent variable only considers new export flows and is constructed at the firm-product-country-year level. All regressions include firm-product-fixed effects and year fixed effects. The subscripts of the variables identify firms ($i$), products ($n$), countries ($j$) and time ($t$).

To take this situation into account, additional estimates were made using a random sample of 1,254 firms classified as maquiladoras, constructed based on trade flow information from the Mexican Customs. Column 4 presents the estimate for all firms in the sample, and the resulting coefficients, with the exception of those related to country imports $j$, have the same signs and significance levels as those of their counterparts in column 1.
Table 5 – OLS and quantile regressions of the effect of transport costs and relative foreign demand on distance to the core

Dependent variable: Ln distance to core

<table>
<thead>
<tr>
<th></th>
<th>OLS regressions</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0,1</td>
<td>0,25</td>
<td>0,5</td>
<td>0,75</td>
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<tr>
<td>Ln destination</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>country’s demand</td>
<td>-0.106**</td>
<td>-0.079*</td>
<td>-0.073*</td>
<td>-0.080**</td>
<td>-0.075**</td>
<td>-0.120**</td>
<td>-0.107**</td>
<td>-0.090**</td>
<td>-0.065**</td>
</tr>
<tr>
<td></td>
<td>(-4.63)</td>
<td>(-2.61)</td>
<td>(-2.51)</td>
<td>(-2.78)</td>
<td>(-2.70)</td>
<td>(-3.48)</td>
<td>(-3.61)</td>
<td>(-4.43)</td>
<td>(-3.30)</td>
</tr>
<tr>
<td>Ln physical distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.877*</td>
<td>-0.812*</td>
<td>-0.876*</td>
<td>-0.804*</td>
<td>-0.491**</td>
<td>-0.705**</td>
<td>-1.182**</td>
<td>-1.393**</td>
<td>-1.335**</td>
</tr>
<tr>
<td></td>
<td>(-2.33)</td>
<td>(-2.19)</td>
<td>(-2.37)</td>
<td>(-2.23)</td>
<td>(-11.34)</td>
<td>(-12.17)</td>
<td>(-17.42)</td>
<td>(-13.12)</td>
<td>(-12.31)</td>
</tr>
<tr>
<td>Dummy market</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>experience (t-1)</td>
<td>1.207**</td>
<td>1.223**</td>
<td>1.291**</td>
<td>2.885**</td>
<td>4.256**</td>
<td>4.667**</td>
<td>4.272**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(11.94)</td>
<td>(11.38)</td>
<td>(11.67)</td>
<td>(26.91)</td>
<td>(27.96)</td>
<td>(20.79)</td>
<td>(18.65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln ratio spillover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mesure(n)_{jt}</td>
<td>0.008</td>
<td>0.087</td>
<td>-0.425**</td>
<td>-0.132</td>
<td>0.024</td>
<td>0.031</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.80)</td>
<td>(-3.47)</td>
<td>(-1.01)</td>
<td>(0.21)</td>
<td>(0.27)</td>
<td>(0.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>6.557**</td>
<td>13.23**</td>
<td>11.75**</td>
<td>13.23**</td>
<td>11.70**</td>
<td>3.626**</td>
<td>5.851**</td>
<td>10.866**</td>
<td>14.816**</td>
</tr>
<tr>
<td></td>
<td>(21.35)</td>
<td>(4.35)</td>
<td>(3.99)</td>
<td>(4.41)</td>
<td>(4.06)</td>
<td>(11.56)</td>
<td>(12.71)</td>
<td>(18.29)</td>
<td>(17.56)</td>
</tr>
</tbody>
</table>

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Table 5 – (suite)

<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
<th>Column 6</th>
<th>Column 7</th>
<th>Column 8</th>
<th>Column 9</th>
<th>Column 10</th>
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</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>0.790</td>
<td>0.806</td>
<td>0.810</td>
<td>0.806</td>
<td>0.810</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>F-test</td>
<td>5.926</td>
<td>10.89</td>
<td>29.15</td>
<td>10.09</td>
<td>27.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
<td>193,753</td>
</tr>
</tbody>
</table>

Estimates by ordinary least squares (columns 1 to 5) and quantile regression (columns 6 to 10). Statistics (in parentheses) are constructed using standard clustered errors at the destination country level. All independent variables are lagged one period except for the distance and the dummy variable. The regression models include year and firm-product fixed effects variables (columns 1 to 5) and year and firm fixed effects (columns 6 to 10). **, *, and + indicate a level of significance of 1%, 5% and 10%, respectively. The dependent variable is constructed at the level of firm-country-year. The subscripts of the variables identify firms (i), products (n), countries (j) and time (t).
However, the reported results of coefficients are not directly comparable with those reported in the first column because the regression of the sample of maquiladora firms is not controlled for by firm productivity or size. One solution would be to include firm-year fixed effects within the estimate; however, it is not possible to add these high-dimensional fixed effects in a conditional logit model in addition to the firm-product fixed effects that the regression already considers. The strategy that we follow in this manuscript is to consider that the absence of these firm-year fixed effects causes a bias upward in the results obtained for the variable distance to the core; therefore, by discounting this bias, it is feasible to compare with greater prudence the coefficient of said variable with those reported in column 1.

Regarding the effect of distance to the core on the probability of creating a new trade link, the coefficient reported in column 4 is slightly higher than that reported in the first column. However, if this parameter is discounted, the estimated bias would have a magnitude of approximately -0.044, very close to the parameter in column 1 of Table 4. In addition, an increase of one standard deviation in the distance to the core with respect to its mean decreases the probability of success in creating an additional trade link by 3.1 percent, 0.4 percent larger in the study sample. For differentiated products, the same calculation yields a reduction of 2.9 percent in the probability of exporting, and for homogeneous products, the value is 2.5 percent.

The above results provide evidence that distance to the core matters in the creation of new product-country commercial links, both for non-maquiladora export firms and maquiladoras, regardless of the product they sell abroad, differentiated or homogeneous.

5.2. Effect of transport costs and relative foreign demand on distance to the core

This section examines the effect of different factors on the specific or local measure of distance to core. Initially, estimates are performed using ordinary least squares and quantile regressions, considering the variables corresponding to the ratio of foreign demand between products, the physical distance between countries and some controls. Subsequently, the analysis is complemented by separating the sample into homogeneous and differentiated goods. For both cases, only new export flows are considered.

5.2.1. Influence on new export flows

Table 5 presents the results obtained in the empirical evaluation of testable prediction 2. In the first column, only the ratio of imports from destination \( j \) for product \( n \) with respect to imports by the same country for the core product is considered. The coefficient obtained reflects an inverse and significant relationship between this ratio and the distance to the specific destination core, which is in accordance with the hypothesis derived from the theoretical model.
Table 6 – Quantile regressions of effect of transport costs and relative foreign demand on distance to the core, by type of products – Dependent variable: $\ln \text{distance to core}_{ijt}$

<table>
<thead>
<tr>
<th></th>
<th>Differentiated</th>
<th>Homogeneous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 0.25 0.5 0.75 0.9</td>
<td>0.1 0.25 0.5 0.75 0.9</td>
</tr>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>$\ln \text{destination country's demand}_{ijt}$</td>
<td>-0.103* (-2.32) -0.102** (-2.89) -0.091** (-3.23) -0.076** (-2.92) -0.075** (-3.50) -0.173** (-8.77) -0.137** (-9.41) -0.101** (-5.60) -0.059** (-4.16)</td>
<td>-0.003 (-0.17)</td>
</tr>
<tr>
<td>$\ln \text{physical distance}_{ijt}$</td>
<td>-0.539** (-11.76) -0.735** (-13.28) -1.205** (-15.81) -1.347** (-10.78) -1.278** (-11.59) -0.202** (-3.51) -0.448** (-7.51) -0.944** (-10.65) -1.435** (-14.58)</td>
<td>-1.529** (-14.35)</td>
</tr>
<tr>
<td>Dummy market experience (t-1)</td>
<td>1.444** (12.63) 3.007** (22.84) 4.352** (29.58) 4.596** (21.62) 4.185** (18.21) 0.493** (2.89) 2.267** (18.85) 3.665** (21.82) 4.586** (17.07) 4.596** (13.90)</td>
<td></td>
</tr>
<tr>
<td>$\ln \text{ratio spillover mesure}_{ijt}$</td>
<td>-0.273* (-1.99) -0.007 (-0.06) 0.112 (0.85) 0.109 (0.79) 0.100 (0.75) -1.222** (-8.72) -0.905** (-7.16) -0.699** (-5.65) -0.521** (-4.37) -0.459** (-4.29)</td>
<td></td>
</tr>
</tbody>
</table>
Table 6 – (suite)

| Observations | 143,75 | 143,75 | 143,75 | 143,75 | 50,003 | 50,003 | 50,003 | 50,003 | 50,003 |

Estimates by quantile regressions. Statistics (in parentheses) are constructed using standard clustered errors at the destination country level. All independent variables are lagged one period except for the physical distance and the dummy variable. The regression models include year and firm fixed effects variables. **, * and + indicate a level of significance of 1%, 5% and 10%, respectively. The dependent variable is constructed at the level of firm-country-year. The subscripts of the variables identify firms (i), products (n), countries (j) and time (t).
In the second column of Table 5, the distance variable is included. The findings indicate that in more distant destinations, export products are closer to the core than in nearby countries. On the other hand, the coefficient relative to the ratio of imports exhibits a reduction in its dimension but maintains its sign and significance. Specifically, if the ratio of imports were doubled, the distance to the core would decrease by 7.3 percent.

When considering the exporting experience (column 3), it is observed that products exported to countries with which firms are more familiar have a greater distance to the core compared to the distance they would have in lesser-known commercial destinations. With the incorporation of this measure, the remaining covariates reduce their magnitude very slightly without altering their statistical significance. In the fourth column of Table 5, a variable that considers the ratio of the spillover measure between product \( n \) and the core product is added; the coefficient obtained is not statistically significant. In column 5, all covariates of the previous regressions are included; the results do not show substantial modifications in the dimension or sign of the estimated parameters.

Columns 6, 7, 8, 9 and 10 of Table 5 present the parameters obtained considering quantiles 10, 25, 50, 75 and 90, respectively. The results reveal that the negative effect of the import ratio on the dependent variable becomes less pronounced as the distance of the products to the core increases, that is, when the value of that variable moves from the lower part of the distribution to the upper part. In terms of testable prediction 2, this heterogeneous effect would be associated with differences in the substitution elasticity between the goods exported by the firms, with which products with high substitutability would have a greater possibility of exhibiting reduced distance to the core in the event of positive changes in their foreign demand.

On the other hand, familiarity with the export of products to certain destination markets becomes relevant as the gap between an export product and the core product increases. However, if transportation costs increase, firms are likely to reduce the gap.

From the coefficients presented between columns 6 through 10 of Table 5, it can be observed that the ratio of the spillover measures only influences the lower part of the distribution of the dependent variable, which could imply that the proximity of other nearby exporters generates positive externalities that help improve the commercialization of non-core products.

5.2.2. Influence on new export flows and type of product

In Table 6, the results of the quantile estimation are reported for both differentiated products (columns 1 to 5) and homogeneous products (columns 6 to 10).

It can be observed that the coefficients of the first three covariates have the same signs as those obtained in the previous table. That is, the elasticity of the import ratio over the distance to core decreases in magnitude as the dependent variable moves
upward along the distribution; for its part, the dimension for both the physical distance and the dummy variable related to the exporting experience increases as the gap with respect to the core product becomes larger.

Specifically, throughout the distribution of the dependent variable, it is not perceived that the differentiated products register greater sensitivity in the first three covariables compared to the homogeneous products. A marked exception in the findings is seen in the variable corresponding to the spillover measure, which only influences the distance to core in the case of homogeneous products.

When considering the findings presented in Tables 5 and 6, it can be concluded that the commercial distance of exported products to the core across countries is related to differences in product demand and transportation costs. Changes in the relative demand of exported products with respect to core products reflect a higher elasticity in the lower part of the distribution of the dependent variable. According to our second prediction, the above can explain why there is a high degree of substitutability between the exported product and the core product.

**Conclusions**

This paper examined the impact of the heterogeneity of product trading by a firm on the probability of successfully generating new commercial transactions. It also investigated the elements that influence the differences in the trading of core products compared to other products.

It was found that larger and more productive firms have a higher probability of creating new product-country trade links. In addition, as the cost of reaching a larger number of foreign consumers decreases, the probability of selling new varieties of products to more markets increases.

Specifically, if the distance to core increases one standard deviation from the mean, the probability of creating a new commercial link is reduced by 3.5 percentage points. Based on this result, products that are very distant in the ranking of export sales of a firm will be less likely to enter an additional market. This result is also found when a sample of maquiladoras is considered and when different subsamples, in which homogeneous and differentiated products are distinguished, are considered.

In addition, distance to the core is negatively correlated with the ratio of the importing-country’s demand at the product level. The higher the relative demand for a single product in an importing country is, the lower the distance between the product under analysis and the core product.

Based on the results, diversification of selling markets could arise if the firms, through targeted efforts, focused on products that are very close to the core or with a
high degree of substitutability. However, in the case of Mexico, due to its proximity to one of the largest trading regions in the world, the NAFTA zone, sales of such products could likely be directed toward that area, thereby affecting efforts to diversify sales destinations and increasing the already high concentration in that market. Therefore, to complement this strategy, policies to reduce transportation costs or increase access to remote markets should be implemented.

Acknowledgements

The author would like to thank Rosella NICOLINI, Ana Miriam RAMÍREZ and the two anonymous reviewers for their valuable comments and recommendations. In addition, the author is indebted to Gerardo DURAND and Gabriel ROMERO of the National Institute of Statistics and Geography (INEGI), Mexico, and the staff of the Ministry of Economy for access to the data used in the preparation of this paper, which were made anonymous to comply with the confidentiality requirements established by Mexican law. The opinions and conclusions presented are the sole responsibility of the author.
References


Distance to core and selection of export products-destinations


Notes

1 - This term can be associated with a reputation for quality or a firm´s brand name.

2 - Though varying in their methodologies used, different studies provide evidence in favor of this supposition in different countries, including for the U.S.-Canada (HEAD and RIES, 2001) and for a cluster of countries (ERKEL-ROUSSE and MIRZA, 2002).

3 - In an empirical evaluation, Aw and Lee (2017) found evidence of the parameter \( \theta \) being less than one.

4 - Using data from Chinese customs brokers, MANOVA and ZHANG (2012) provide evidence on exporting companies charging high prices for core products.

5 - To maintain confidentiality, information processing was performed at the INEGI facilities and supervised by its staff. The final database includes only anonymized data.

6 - The value added is calculated as the total revenue from production minus the total input costs.

7 - An adaptation of the methodology of KHANDELWAL et al. (2013) was used to obtain the residual of the ordinary least squares regression of the following equation: 

\[
\begin{align*}
\log x_{ijt} + \sigma \log p_{ijt} &= \alpha_n + \\
&+ \alpha_i + \alpha_j + \epsilon_{ijt}^n
\end{align*}
\]

where \( x_{ijt}^n \) and \( p_{ijt}^n \) denote the natural logarithms of the quantity and price (unit value), respectively, of product \( n \) exported by firm \( i \) to a destination country \( j \) in year \( t \). The terms \( \alpha_n, \alpha_i, \alpha_j \) and \( \alpha_t \) correspond to the fixed effects of product, firm, destination country and year, respectively. The logarithm of the estimated quality \( \delta_{ijt}^n \) depends on the residual of estimation \( \epsilon_{ijt}^n \) and the substitution elasticity \( \sigma \) such that 

\[
\delta_{ijt}^n = \frac{\epsilon_{ijt}^n}{(\sigma - 1)}.
\]

In the estimation of this equation, the unit value is equal to export sales divided by the quantity exported (expressed in kilograms), and it is calculated for each effect in the HS 6-digit. The substitution elasticity is drawn from the estimate of BRODA et al. (2006) for Mexico.
8 - The calculation was performed as follows: \( \gamma_{jt} = \sum_{j=1}^{J} \sum_{n=1}^{N} w_{ijt}^{n} \times \delta_{ijt}^{n} \), where \( w_{ijt}^{n} = \frac{\text{(export value)}^{n}_{ijt}}{\sum_{j=1}^{J} \sum_{n=1}^{N} \text{export value}_{ijt}^{n}} \).

9 - Other factors assumed to remain mostly unchanged over time — for example, the export strategies or preferences to sell certain products abroad — are also controlled for with the inclusion of these effects.

10 - When the time dimension of the panel is short, imprecision in the estimate of the large number of fixed effects contaminates the other parameters of the estimate due to the non-linearity of the model.

11 - The technique proposed by Chamberlain (1980) uses conditional maximum likelihood estimation to correct for inconsistency in the parameters.

12 - A problem with applying traditional quantile regression is controlling for the unobserved heterogeneity.

13 - As suggested by Head and Mayer (2004), the calculation is performed using the expression \( \left[ (1 + \frac{\sigma_{X}}{\bar{X}})^{\beta} - 1 \right] \times 100 \), where \( \sigma_{X} \) and \( \bar{X} \) represent the standard deviation and mean of variable \( X \), and \( \beta \) is the coefficient obtained in the regression.

14 - To express the probability in percentage points, this result is multiplied by the average probability of the database, which is 0.217.


16 - Accounting for both firm-product and firm-year fixed effects in a conditional logit model could be problematic for two reasons. The first is that both fixed effects are high dimensional, which implies large computational requirements to estimate a non-linear model; the second is that incidental parameter problems could arise (Chamberlain, 1980), resulting in inconsistent estimates.

17 - Charbonneau (2017) developed a new estimator that enables the consistent estimation of a binary logit model that considers an individual-specific fixed effect and a choice-specific fixed effect. However, this estimator does not apply to this research because both sets of unobserved effects are firm specific.

18 - To obtain an approximation of the possible bias, our strategy consisted of running various alternative regressions. The estimates considering different types of fixed effects that are firm specific. The estimate bias was of around 21%. The empirical analysis is detailed the discussion paper version of this study available at: https://ssrn.com/abstract=3232400.

19 - To calculate the ratio, it was considered as a measure \( 1 + \# \) of other firms in the area, same product-same destination.)