Essays in International Economics

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A Dissertation presented to the Graduate Faculty of the University of Virginia in Candidacy for the Degree of Doctor of Philosophy

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May, 2014

The Matching and Sorting of Exporting and Importing Firms: Theory and Evidence

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April 2014

Abstract

The first chapter of this dissertation develops a general equilibrium model of international trade with heterogeneous exporters and heterogeneous importers. This theory is guided by new findings drawn from a matched exporter-importer dataset that characterizes the relationships between exporting and importing firms. I find that most exporters have a single importing partner, that highly productive exporters tend to trade with highly productive importers, and that the value traded is positively correlated with both exporter and importer productivities. The model analyzes the selection of exporters and importers into trading pairs and features simultaneous free entry into exporting and into importing. This theory provides a rationale for the fixed costs of entering export markets, associating them with the costs of searching for importing firms that distribute a product to final consumers abroad. The model is consistent with the response of exporting and importing firms to the recent Colombia-U.S. free trade agreement.

The second chapter studies quantitatively the consequences of the matching and sorting of exporters and importers for global trade flows across sectors and destinations. For this purpose I estimate the parameters of the model, including the search costs that govern the sorting of exporters and importers.

Contents

Acknowledgements

I am indebted to my advisors for their guidance and support. They have taught me a profession I love, for which I am very grateful. I thank James Harrigan, John McLaren, Ariell Reshef, Alan Taylor and Peter Debaere.

During these years at the University of Virginia, the students participating in the international trade research group at the University of Virginia have been fantastic companions and I am also grateful to them.

I also wish to express my gratitude to my wife, my parents and my sister for their love and support throughout the years. I dedicate this work to them.

Chapter One: The Matching and Sorting of Exporting and Importing Firms

I. Introduction

The interaction between exporting and importing firms is at the center of international markets. "International trade is between firms, not between nations," as Bertil Ohlin (1933, p.238) stated, yet canonical models of international trade based on increasing returns to scale and love of variety abstract from these interactions by assuming that exporters sell directly to final consumers in foreign markets. Also at least since Ohlin (1933) it has been noted that only some firms export, and that firm heterogeneity and market structure may be relevant to understand trade flows. Empirical patterns regarding the participation of individual firms in export markets have been documented systematically by a large literature starting with Glejser et al (1980), Bricout (1991) and Bernard and Jensen (1995) and have motivated a new set of models (based on Melitz (2003)) that capture the implications of firm heterogeneity for aggregate trade flows and the effects of trade policy, shifting the attention of the literature to the reallocation of resources within sectors. Importing firms, on the other hand, have received less attention in this literature, but similar patterns of heterogeneity have been reported (Bernard et al (2007)). This paper studies the interaction between exporting and importing firms proposing a model to analyze the selection of exporters and importers into trading pairs. The model provides a rationale for the fixed costs of entering export markets, associating them to the costs of searching for importing firms that distribute a product to final consumers abroad. The general equilibrium model features simultaneous free entry into exporting and into importing. This theory is guided by new findings drawn from a matched exporter-importer dataset that characterizes exporting and importing firms. The model is consistent with the response of exporting and importing firms to the recent Colombia-U.S. free trade agreement.

Section II puts forth a set of empirical observations based on a dataset that describes the transactions between exporting and importing firms. I focus on French exporters to Colombia and use records registered by Colombian Customs that report the identity of the Colombian importer and the foreign exporter in all transactions that occurred during 2010.

I combine this information with balance sheet indicators on the French and Colombian firms to complete a dataset that includes a measure of the productivity of exporters and importers and the nature of the transactions between them. I find that most exporters have a single importing partner, that highly productive exporters tend to trade with highly productive importers, and that the value traded is positively correlated with both exporter and importer productivities.

Section III develops a general equilibrium model on the interaction between exporting and importing firms that is consistent with these findings and that guides the subsequent empirical analysis. In this theory, selling products to final consumers involves production and distribution. Exporting firms engaged in international trade must find distributors in foreign markets. Often, this can be a costly activity, and these search costs can be interpreted as a barrier to international trade and as a component of the fixed costs of exporting. Exporters decide how much effort to put into searching for partners in foreign markets, generating a sorting pattern between exporters and importers. The model predicts that more productive exporters search more and are matched with more productive importers; and that the traded value between two firms depends positively on the productivity of both the exporter and the importer.[1] This model contributes to the literature of firm heterogeneity and trade in terms of the understanding of the fixed costs of entry into foreign markets and to the role of distribution channels in international trade. This work is closely related to a recent set of papers that study the matching between individual buyers and individual sellers across borders.[2] These subjects have been highlighted by recent surveys of this literature as areas open for further research.[3] Current understanding of fixed costs is limited: a recent survey by Bernard et al. (2011) describes them as a black box. My theory proposes that the

[1]The result on the positive sorting between exporters and importers rests upon the complementarity in the production function that synthetizes the activities of exporters (manufacturers) and importers (distributors) and is consistent with the empirical findings. This assumption of the baseline model can be relaxed using a more general CES production function. This opens a more general discussion on the nature of the interaction of firms across borders. For a discussion of these topics see Milgrom and Roberts (1990), Kremer and Maskin (2006) and Grossman and Maggi (2000).

[2]See Blum, Claro, and Horstmann (2012), Eaton et al (2012), Bernard, Moxnes, and Ulltveit-Moe (2013), and Carballo, Ottavianio, and Volpe-Martincus (2013). Eaton et al (2012) focus on the dynamics of the relationships between buyers and sellers. Bernard, Moxnes, and Ulltveit-Moe (2013), and Carballo, Ottavianio, and Volpe-Martincus (2013) focus on the effect of market characteristics on the number of buyers that an exporter trades with, while I focus on the sorting of exporters and importers of different types (productivities). Differently than these papers, I study the case of heterogeneous exporters and heterogeneous importers with free entry in both sides. On the empirical side, this paper is the only one that aside from observing the identity of buyers and sellers, adds additional information on their characteristics.

[3]In the conclusions to his recent survey of this literature Redding (2011) suggests that an "area for further work is the microeconomic modeling of the trade costs that induce firm selection into export markets, including the role of wholesale and retail distribution networks."

costs of searching for partners in foreign markets are a component of these fixed costs. These search costs, while still fixed with respect to production, are variable in another dimension: firms optimize their expenditure on these fixed costs. This assumption helps explain the fact that many small, less productive firms engage in international trade: they sell small amounts to small distributors.[4] The understanding of distribution networks in the context of international trade is also limited, although there is awareness that expenditure in distribution is sizable. Anderson and van Wincoop (2004) calculate that the expenditure in distribution is equivalent to a 55% ad-valorem tax. My model shows that introducing a distribution sector that stands between producers and final consumers has implications for the magnitude of trade flows and for the pattern of trade. This paper is also related to a certain extent to a recent literature on intermediaries in international trade, which is surveyed by Bernard et al (2011).[5]

To acknowledge search frictions when studying the matching between exporters and importers is a natural choice. In fact Tinbergen's (1962) justification for the role of distance in the inaugural gravity equation was not only an approximation for transport costs but also a representation of information frictions. Associating the search costs incurred by exporters to overcome informational barriers to the fixed cost of exporting is also an old idea that dates back until at least Glejser et al (1980). As Rauch (1999) argued, one reason why distance depresses trade flows is that proximity reduces search costs of learning about prices abroad, which is a necessity for differentiated products not traded in exchanges. Rauch (1999) showed that the negative effect of distance on trade flows is more important for differentiated products. I incorporate his suggestion of exploring more disaggregated data as well as theoretical analysis as ways to better understand the role of search costs. Search costs are difficult to measure, but the scarce evidence about them suggests they are relevant. Kneller and Pisu (2011) analyze the results of a survey that asks exporting firms in the United Kingdom about barriers to exporting. "Identifying who to make contact with in the first instance" and "establishing an initial dialogue with a prospective customer or business partner" are identified as trade barriers by 53.7% and 42.8% of firms in their sample of 448 firms, whereas "exchange rates and foreign currency" are mentioned as an obstacle by 41.7% of firms, and "dealing with legal, financial and tax regulations overseas", by 42.2% of these UK exporters. Empirical work regarding search frictions in international trade has been scarce. An exception is Allen (2012) who introduces information frictions in the context of

[4] The model of Arkolakis (2010) also features a mechanism in the same spirit, related to advertising expenditure of exporting firms.

[5] Work in this literature includes Antras and Costinot (2011), Blum et al (2010 and 2012), Bernard et al (2011) and Ahn et al (2011) among others.

the Eaton and Kortum (2002) model and, based on trade in agricultural commodities across the islands of the Philippines, concludes that the largest part of the effect of distance on trade flows is due to search costs rather than transport costs. In subsection III.J I extend the model to a many-country, partial equilibrium version to derive a gravity equation. This equation features both the traditional ad-valorem trade costs as well as search frictions representing the difficulties of finding partners in foreign markets, consistent with Tinbergen's (1962) insight.

Finally in section IV I study the response of exporting and importing firms to a trade liberalization episode: the recent free trade agreement between Colombia and the U.S. This agreement brought large tariff cuts for U.S. exporters to Colombia. I use this episode to examine whether trade liberalization induces the reorganization of trading partnerships. Tariff concessions faced by U.S. exporters would induce them to spend more in search costs and find more productive importers according to the model. Comparing across industries, I find that U.S. firms in industries facing larger tariff cuts increased their exports relatively more and were more likely to switch to trading with a new partner after the agreement.

Section V concludes, proposing ideas for future research.

II. Initial Observations

In this section I put forth some simple observations drawn from a new dataset that describes the commercial relationships between exporting firms in France and importing firms in Colombia during 2010. These observations will guide the model used to study the matching and sorting of exporting and importing firms in section III.

II.A Construction of the Matched Exporter-Importer Dataset

I use a dataset that includes the detail of all export transactions and characteristics of both exporting and importing firms. The customs agency of Colombia records the universe of international transactions entering the country. The information collected includes the identity of the Colombian importer and of the foreign exporter.[6] I merge this data with balance sheet data of French and Colombian firms. I choose France as the exporting country due to its economic significance, its diversified production structure, and the fact that in France both public and private firms file financial statements.[7] A key advantage of studying the exports of France to Colombia is that French firms export a large variety of differentiated products that fit well the assumptions of a model of monopolistic competition. A disadvantage is that Colombia is not one of France's major export destinations. Similar data with the identity of exporters and importers is being used by others, but, to the best of my knowledge, this is the first paper to match these identities to additional data on these firms, including their revenue and a measure of their productivity.[8]

I define a firm in France by a "SIREN" number and a firm in Colombia by their tax ID number, "NIT". There are 958 exporting firms in France which I can identify and assign

[6]Colombian importers are identified by their name and a tax ID number. Foreign exporters into Colombia are identified by their name, city, street address, country, and telephone number (sometimes replaced by an email address). The data on foreign firms is comprehensive and well recorded. This data is available from the official statistical agency of Colombia's government.

[7]The balance sheet data of French firms includes their name and the address of every establishment, which makes the matching process with the customs data easy. It is collected by the "Greffe des Tribunaux de Commerce" (the Register of the Commerce Tribunals). It is legal information about companies collected from a government website. Apparently, there are other sources of French firm level revenue data available but I am not sure that they include the address of every establishment, which is key for matching it to the Colombian customs data.

[8]See Blum, Claro, and Horstmann (2012), Eaton et al (2012), Bernard, Moxnes, and Ulltveit-Moe (2013), and Carballo, Ottavianio, and Volpe-Martincus (2013). Eaton et al (2012)

a SIREN number to and approximately 50 exporters that were not identified. Some of these were individuals rather than firms. In terms of value, the matched dataset I use represents 99.4% of the exports from France to Colombia. I keep the French exporters which report their revenue, which reduces the number of exporters to 858. There are 988 Colombian importers in the data initially, and 878 in the final dataset used.

II.B Most Exporters and Importers have a Single Partner

A first observation from this dataset is that the match between exporters and importers is mostly one-to-one. This table shows that out of the 963 exporters, 740 trade with only one importer, while 16 trade with 4 importers and 1 trades with 10 importers. It also shows that out of 950 importers, 721 trade with only one exporter, 23 trade with 4 exporters and 1 trades with 9 exporters.

Table II.1: Distribution of the Number of Importers with which an Exporter Trades, and of the Number of Exporters with which an Importer Trades.

Number of Exporters	963				
Number of Importers	950				
Importers per Exporter			Exporters per Importer		
Exporters matched to one importer	740	76.8%	Importers matched to one exporter	721	75.9%
Exporters matched to two importers	139	14.4%	Importers matched to two exporters	143	15.1%
3	41	4.3%	3	33	3.5%
4	16	1.7%	4	23	2.4%
5	10	1.0%	5	12	1.3%
6	5	0.5%	6	9	0.9%
7	3	0.2%	7	2	0.2%
8	2	0.2%	8	2	0.2%
10	1	0.1%	9	1	0.1%
11	1	0.1	12	1	0.1%
13	1	0.1%	15	1	0.1%
14	1	0.1%	21	2	0.2%
16	2	0.2%			
18	1	0.1%			

Notes: This table shows the distribution for the number of importers with which each exporter trades (left side), and the distribution for the number of exporters with which each importer trades (right side).

It is also worth noting that exporters ship the large majority of the value exported to their main partners (importers). The (unweighted) average across exporters of the value shipped to their main partner is 93.3%.

II.C Who Trades with Whom

The second observation is that there is a positive correlation between the productivity of exporters and importers that trade together. I start by measuring the size of exporters and importers in terms of revenue as a proxy for their productivity. The size of French exporters is measured by their total revenue (from domestic and export sales). This information is available for 89% of the initial 963 French firms. The size of Colombian importers is measured by their revenue as well, which is available for 74% of Colombian firms since a majority but not all file financial statements. Since there is a mechanical relationship between a firm's exports and another firm's imports, I also compute their revenue minus their bilateral trade. Next, I measure the productivity of exporters and importers. The model developed in the next section characterizes firms in terms of their productivities. The measurement of productivity is subject to constraints imposed by the availability of data. In the case of French exporters, I estimate a regression of revenue on a measure of cost including industry fixed effects and define productivity as the residual. The measure of cost is the expenditure on wages. In the case of the Colombian importers, I estimate the same regression and in this case the measure of cost is a balance sheet measure of labor costs. After obtaining these productivity measures, I explore who trades with whom by estimating the following equation, where each observation i corresponds to a trading pair.

$$(importer's\, productivity)_i = \beta_1 (exporter's\, productivity)_i + \phi_p + \epsilon_{ip} \tag{2.1}$$

I include industry fixed effects, ϕ_p. I consider only one relationship per exporter, the one with their most productive partner, as this will be the relevant result for the model discussed in section III. Table II.2 shows the results of the estimation of this equation. The results in the first column are obtained when using a measure of size (revenue) as a proxy for productivity. The results in the second column use their revenue minus their bilateral trade. The results in the third column correspond to using the measure of productivity described earlier.

Table II.2: The Productivities of Exporters and Importers in a Trading Relationship are Positively Correlated.

Dependent Variable: Importer's Productivity

Measure of Productivity	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.2011***	0.1875***	0.1555**
	0.0603	0.0614	0.0655
Standardized Coefficients for Exporter's Productivity	0.2119	0.1974	0.1214
HS4 Fixed Effects	Yes	Yes	Yes
R-squared within	0.0434	0.0379	0.0421
Observations	666	666	542

*Notes: The first column on the left shows the results for the estimation of equation (2.1) using firms' (log) revenue as a proxy for their productivity. The second column shows the results using their revenue minus the bilateral trade between them. The third column uses the measure of productivity described in the text. Standard errors are reported under the estimated coefficients. Errors are clustered by HS-4 product. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.*

II.D Firm-level Gravity: the Value Traded Depends on the Productivity of Both Exporters and Importers

Third, I observe that the value traded between an exporter and an importer once they have established a partnership depends on the productivity of both. I estimate the following equation.

$$log(value)_i = \beta_1(exporter's\, productivity)_i + \beta_2(importer's\, productivity)_i + \phi_p + \epsilon_{ip} \quad (2.2)$$

Each observation i corresponds to an exporter-importer pair. As before, I consider only one relationship per exporter. The independent variable is the total value traded between these firms. I include product fixed-effects computed for the main HS-4 product traded between each pair and I use OLS for the estimation. I use the same three proxies for productivity as in the previous estimation. Table II.3 shows the results of the estimation of this equation. The estimated standardized coefficients for β_1 and β_2 are positive and statistically significant. The exception is the coefficient for importers in column (2), with a p-value slightly above 0.1. The magnitudes of the coefficients suggest that exporter and importer productivity have a similar relevance for the magnitude of trade flows between firms.

Table II.3: The Value Traded Depends on the Productivity of Both Exporters and the Importers

Dependent Variable: (log) Traded Value

Measure of Productivity	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.3741***	0.3645***	0.6855 ***
	0.0000	0.0545	0.2125
Importer's Productivity	0.1561***	0.1452	0.4047 ***
	0.0850	0.0566	0.1427
Standardized Coefficients for Exporter's Productivity	0.3435	0.3380	0.2058
Standardized Coefficients for Importer's Productivity	0.1363	0.1278	0.1556
HS4 Fixed Effects	Yes	Yes	Yes
R-squared within	0.1422	0.1336	0.0603
Observations	666	666	544

*Notes: The first column shows the results for the estimation of equation (2.2) using firms' (log) revenue as a proxy for their productivity. The second column shows the results using revenue minus bilateral trade. The third column shows the results using the measure of productivity described in the text. Standard errors are reported under the estimated coefficients. Errors are clustered by exporter, importer, and HS-4 product. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.*

III. Theory

I consider a model with two countries, one industry, and labor as the single factor of production. Countries have identical technology and preferences, but may differ in size. Trade is a consequence of increasing returns to scale in production and love of variety preferences, as in Krugman (1979). Selling to final consumers in each country requires production and distribution. In each country, there is a set of producers who manufacture differentiated varieties. They must search for a distributor in each market they enter in order to reach the final consumers with their varieties. Both producers and distributors are heterogeneous in their productivities, as in Melitz (2003). Search is costly and is modeled as in Stigler (1961). The model features search costs as an additional barrier to trade besides the standard ad-valorem trade costs. The search costs are an interpretation of the fixed costs of production. The search process determines a probabilistic assignment of producers to distributors. The model thus generates selection of exporting and importing firms into trading pairs. I discuss the open economy case with costly trade.

III.A Consumption

Consumers in each country demand the differentiated varieties (w) produced by firms. Preferences are represented by the following utility function with constant elasticity of substitution $\epsilon = 1/(1-\alpha)$.

$$U = \left(\int_{w \epsilon \Omega} q(w)^{\alpha} dw \right)^{1/\alpha},$$

where Ω is the endogenous set of varieties consumed. The demand for a firm's variety is then the following.

$$q(w) = \frac{E}{P^{1-\epsilon}} \cdot p_f^{-\epsilon} = A \cdot p_f^{-\epsilon}, \tag{3.1}$$

where p_f is the price paid by final consumers, and the term A, a measure of the demand level determined in the equilibrium, combines the expenditure and the price index in a given market: $A = \frac{E}{P^{1-\epsilon}}$. The price index in each country is

$$P = \left(\int_{w \epsilon \Omega} p_f(w)^{1-\epsilon} dw \right)^{1/(1-\epsilon)}$$

III.B Production, Distribution and Search

Selling to final consumers requires production and distribution. Producers must search for a distributor in each market they enter. Both producers and distributors are heterogeneous in their productivities, which they draw upon entry from a probability distribution. I model the producers' search for distributors in a simple manner that resembles Stigler (1961). Searching is represented by sampling the distribution of distributors. Producers choose how much to search. A search effort of n leads to sampling the population of distributors n times (or allegorically, "meeting" n distributors). The cost of this search effort in terms of local labor is $\lambda \cdot n$, where λ is a parameter that captures search costs and varies across markets. Within this sample, producers choose the most productive distributor. Since distributors are not constrained in their capacity, a producer only needs one distributor to reach as many final consumers as he decides. By increasing the search effort, a producer meets a larger sample of distributors and, on average, ends up in a relationship with a more productive partner. Balancing this with the cost of searching is the producers' problem.[9] Distributors are passive in terms of the search process: they simply wait to be found by producers.[10]

The outcome of the search process is random. After searching n times, the type (productivity) of the distributor found and chosen is stochastic and follows a distribution which is that of the maximum within a sample of size n drawn from the population of distributors. For reasons of tractability discussed in the appendix, I assume the productivities of distributors are drawn from a Fréchet distribution with shape parameter γ. Mathematically, the probability of meeting and choosing a distributor of productivity θ_D is given by the following density function.[11]

[9] For simplicity, the search process is modeled as simultaneous rather than sequential. Any model of search will be based on the idea that searching is costly and that a larger search effort leads to a better expected outcome (in this case, finding a more productive importer).

[10] Importers may be matched and distribute the varieties of more than one exporter. A setting with bilateral search would be an interesting extension, but should not alter the key predictions of the model.

[11] The maximum out of a sample of size n drawn from a distribution $F(\theta)$ is a random variable with distribution $F^n_{max}(\theta) = \{F(\theta)\}^n$. The density function of this order statistic is calculated by taking the derivative of $\{F(\theta)\}^n$ with respect to θ. The density function of a Fréchet distribution is $f(\theta) = \gamma \cdot \theta^{-\gamma-1} \cdot e^{-\theta^{-\gamma}}$ and the distribution function is $F(\theta) = e^{-\theta^{-\gamma}}$.

$$f_{max}^{n}(\theta_D) = \frac{dF_n^{max}(\theta_D)}{d\theta_D} = n \cdot \gamma \cdot \theta_D^{-\gamma-1} \cdot e^{-n \cdot \theta_D^{-\gamma}}. \tag{3.2}$$

Producers manufacture differentiated varieties and operate in a context of monopolistic competition. As I have discussed, both production and distribution are necessary to sell a variety to final consumers. Producers sell the good to distributors at the wholesale price p_w which is set by the producer. Distributors take this wholesale price as part of their cost, which also includes the cost of the distribution activity required to reach final consumers.[12]

Distributing one unit of the good to final consumers requires $\frac{1}{\theta_D}$ units of labor for a distributor of productivity θ_D. The wage for the labor hired by producers and distributors depends on the country in which they are located.

I will use as an example in the discussion the case of a producer in Home selling to a distributor in Foreign. The unit cost function for the distributor is the following. The subscript DF describes the type of firm (a distributor) and its location (Foreign).

$$cost_{DF} = p_w^{v} \left(\frac{w_F}{\theta_{DF}} \right)^{1-v}. \tag{3.3}$$

This cost function corresponds to a Cobb-Douglas production function. The term v captures the relative importance of distribution.

Distributors maximize their profits by setting their final price p_f (the price charged to final consumers) equal to a constant markup over cost: $p_f = \frac{\epsilon}{\epsilon-1} \cdot cost_D$. The quantity sold is $q = A \cdot p_f^{-\epsilon}$. This is also the quantity demanded by the distributor from the producer. Given the behavior of distributors, producers face a "shifted" demand curve, which is a function of the wholesale price p_w.

I include an ad-valorem trade cost modeled in the standard "iceberg" form, such that $\tau > 1$ units of the good need to be shipped for one unit to arrive to distributors. Producers maximize their profits by choosing a wholesale price $p_w = \frac{\epsilon v}{\epsilon v - 1} \cdot \tau \cdot cost_{PH}$, where $cost_{PH} = \frac{w_H}{\theta_{PH}}$ is the unit cost for a producer of productivity θ_{PH}. This yields revenue $R_{PH} = p_w \cdot q$ and operating profits

[12] This generates "double marginalization". See Tirole (1988, section 4.1) for a discussion of the literature on vertical relationships. Alternatives settings include bargaining between the producer and the distributor, two-part tariffs, vertical integration or vertical restraints. Ultimately, the nature of the contracts between exporters and importers or more in general between manufacturers and retailers is an empirical matter.

$$\pi^{Hf}_{PH}(\theta_{PH},\theta_{DF}) = A_F \cdot \left(\frac{\epsilon v}{\epsilon v - 1}\right)^{-\epsilon v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \frac{1}{\epsilon v - 1} \cdot \tau^{1-\epsilon v} \cdot \left(\frac{w_H}{\theta_{PH}}\right)^{1-\epsilon v} \cdot \left(\frac{w_F}{\theta_{DF}}\right)^{-\epsilon(1-v)} \tag{3.4}$$

for producers.[13] The superscript Hf in this expression is used to indicate that these profits are obtained from goods produced in Home and sold in Foreign.

Knowing their operating profits $\pi^{Hf}_{PH}(\theta_{PH},\theta_{DF})$ from a potential relationship with a distributor of productivity θ_{DF}, producers choose their optimal search effort n^*, solving:

$$max_n \int_0^\infty f^n_{max}(\theta_{DF}) \cdot \pi^{Hf}_{PH}(\theta_{PH},\theta_{DF}) d\theta_{DF} - w_H \cdot \lambda \cdot n. \tag{3.5}$$

The first term in equation 3.5 represents the expected operating profits for the producer obtained from a trading relationship with a distributor of productivity θ_{DF}, given a search effort n. The integrand is the probability of being matched with a certain distributor times the operating profits that the producer obtains from the relationship. The second term is the cost of the search effort.

The optimal search intensity of this producer in Home for a distributor in Foreign is the following[14]

$$n^*(\theta_{PH}, Z^{Hf}, \lambda \cdot w_H) = k \cdot \left(\frac{Z^{Hf} \cdot \theta_{PH}^{\epsilon \cdot v - 1}}{\lambda \cdot w_H}\right)^{\frac{\gamma}{\gamma - \epsilon \cdot (1-v)}}, \tag{3.6}$$

where $k = \left(\frac{\epsilon \cdot (1-v) \cdot \Gamma\left(\frac{\gamma - \epsilon \cdot (1-v)}{\gamma}\right)}{\gamma}\right)^{\frac{\gamma}{\gamma - \epsilon \cdot (1-v)}}$.

The term Z^{Hf} combines the wages in each country as well as the aggregate expenditure and price index in Foreign, $A_F = \frac{E_F}{P_F^{1-\epsilon}}$.

$$Z^{Hf} = A_F \cdot \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1}\right)^{-\epsilon \cdot v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \left(\frac{1}{\epsilon \cdot v - 1}\right) \cdot \tau^{1-\epsilon \cdot v} w_H^{1-\epsilon \cdot v} \cdot w_F^{-\epsilon \cdot (1-v)}$$

[13] I impose $\epsilon > 1/v$ focusing on the case in which revenue and profits are increasing in the producer's productivity, consistent with a large empirical literature.

[14] Refer to the appendix for the derivation. It is necessary to impose a large enough shape parameter $\gamma > \epsilon \cdot (1-v)$.

The operating profits of importing firms in Foreign from their relationship with a single exporter in Home are:

$$\pi_{DF}^{Hf}(\theta_{PH},\theta_{DF}) = A_F \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1}\right)^{1-\epsilon \cdot v} \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \frac{1}{\epsilon - 1} \tau^{(1-\epsilon)\cdot v} \left(\frac{w_H}{\theta_{PH}}\right)^{(1-\epsilon)\cdot v} \left(\frac{w_F}{\theta_{DF}}\right)^{(1-\epsilon)\cdot(1-v)} \tag{3.7}$$

Importers may be matched and distribute the varieties of more than one exporter. The expected profits of an importer in Foreign obtained from the distribution of varieties produced in Home are:

$$\pi_{DF}^{Hf}(\theta_{DF}) = \int_0^\infty \frac{f_{max}^{n^*(\theta_{PH},Z^{Hf},\lambda \cdot w_H)}(\theta_{DF})}{M_{DF} \cdot f(\theta_{DF})} \cdot \pi_{DF}^{Hf}(\theta_{PH},\theta_{DF}) \cdot M_{PH} \cdot f(\theta_{PH}) d\theta_{PH} \tag{3.8}$$

The first term in the integrand is the probability of being chosen as a trading partner by an exporter of productivity θ_{PH}. The second term stands for the profits from one such relationship. I aggregate over the distribution of exporters to obtain the total expected profits of the Foreign importer obtained from distributing home varieties.

III.C Equilibrium

Given wages in each country, the zero expected profit conditions obtained from the free entry assumption for producers and distributors in each country pin down the mass of firms in each of these categories. The relative wage is determined from the balanced trade condition.

The zero profit condition for Home producers states that expected profits from domestic sales and from exports are equal to the entry cost. Recall that in each term, the subscripts indicate the type of firm and its location (PH for instance stands for a producer in Home). The superscripts denote the direction of trade (Hf for instance stands for trade from Home to Foreign).

$$\bar{\pi}_{PH}^{Hh} + \bar{\pi}_{PH}^{Hf} = w_H \cdot f_{PH}^{entry} \tag{3.9}$$

The zero profit condition for Foreign producers is:

$$\bar{\pi}_{PF}^{Ff} + \bar{\pi}_{PF}^{Fh} = w_F \cdot f_{PF}^{entry} \tag{3.10}$$

To calculate the expected profits of Home producers, recall that the outcome for each producer is uncertain, depending on the success of the search process. Conditional on their productivity parameter θ_{PH}, profits from export sales $\pi_{PH}^{Hf}(\theta_{PH}, \theta_{DF})$ are distributed with density function $f_{max}^{n^*(\theta_{PH}, Z^{Hf}, \lambda \cdot w_H)}(\theta_{DF})$ and profits from domestic sales $\pi_{PH}^{Hh}(\theta_{PH}, \theta_{DH})$, with density function $f_{max}^{n^*(\theta_{PH}, Z^{Hh}, \lambda \cdot w_H)}(\theta_{DH})$,

$$\bar{\pi}_{PH}^{Hh} = \int_0^\infty \int_0^\infty \pi_{PH}^{Hh}(\theta_{PH}, \theta_{DH}) f_{max}^{n^*(\theta_{PH}, Z^{Hh}, \lambda \cdot w_H)}(\theta_{DH}) f(\theta_{PH}) d\theta_{DH} d\theta_{PH} \tag{3.11}$$

$$\bar{\pi}_{PH}^{Hf} = \int_0^\infty \int_0^\infty \pi_{PH}^{Hf}(\theta_{PH}, \theta_{DF}) f_{max}^{n^*(\theta_{PH}, Z^{Hf}, \lambda \cdot w_H)}(\theta_{DF}) f(\theta_{PH}) d\theta_{DF} d\theta_{PH} \tag{3.12}$$

Analogous expressions are obtained for the profits of Foreign producers.

Free entry into distribution leads to the zero expected profit condition that states that expected profits from marketing domestic and imported varieties are equal to the entry cost. The zero profit condition for Home and Foreign distributors are:

$$\bar{\pi}_{DH}^{Hh} + \bar{\pi}_{DH}^{Fh} = w_H f_{DH}^{entry} \tag{3.13}$$

$$\bar{\pi}_{DF}^{Ff} + \bar{\pi}_{DF}^{Hf} = w_F f_{DF}^{entry} \tag{3.14}$$

Again, an individual distributor has a stochastic outcome conditional on its productivity. I calculate an entrant's expected profits across productivities and outcomes. Entry of firms into distribution reduces the chance for each one of being found and chosen by a producer. Consider the expected profits for a Home distributor from sales of domestic varieties

$\bar{\pi}_{DH}^{Hh}$ and of imported varieties $\bar{\pi}_{DH}^{Fh}$,

$$\bar{\pi}_{DH}^{Hh} = \int_0^\infty \pi_{DH}^{Hh}(\theta_{PH}, \theta_{DH}) f(\theta_{DH}) d\theta_{DH}$$
$$= \int_0^\infty \int_0^\infty \pi_{DH}^{Hh}(\theta_{PH}, \theta_{DH}) f_{max}^{n^*(\theta_{PH}, Z^{Hh}, \lambda \cdot w_H)}(\theta_{DH}) f(\theta_{PH}) d\theta_{DH} d\theta_{PH} \quad (3.15)$$

$$\bar{\pi}_{DH}^{Fh} = \int_0^\infty \pi_{DH}^{Fh}(\theta_{PF}, \theta_{DH}) f(\theta_{DH}) d\theta_{DH}$$
$$= \int_0^\infty \int_0^\infty \pi_{DH}^{Fh}(\theta_{PF}, \theta_{DH}) f_{max}^{n^*(\theta_{PF}, Z^{Fh}, \lambda \cdot w_F)}(\theta_{DH}) f(\theta_{PF}) d\theta_{DH} d\theta_{PF} \quad (3.16)$$

The profits of Foreign distributors are calculated under the same principles.

The price indices in each market and industry determine the level of demand. These price indices depend on the mass of producers selling in each market. The price index in the Home market is the weighted average of prices of domestic and imported varieties:

$$P_H = \Big(M_{PH} \cdot \int_0^\infty \int_0^\infty (p_f^{Hh}(\theta_{PH}, \theta_{DH}))^{1-\epsilon} f_{max}^{n^*(\theta_{PH}, Z^{Hh}, \lambda \cdot w_H)}(\theta_{DH}) f(\theta_{PH}) d\theta_{DH} d\theta_{PH}$$
$$+ M_{PF} \cdot \int_0^\infty \int_0^\infty (p_f^{Fh}(\theta_{PF}, \theta_{DH}))^{1-\epsilon} f_{max}^{n^*(\theta_{PF}, Z^{Fh}, \lambda \cdot w_F)}(\theta_{DH}) f(\theta_{PF}) d\theta_{DH} d\theta_{PF} \Big)^{\frac{1}{1-\epsilon}} \quad (3.17)$$

The price index in Foreign is:

$$P_F = \Big(M_{PF} \cdot \int_0^\infty \int_0^\infty (p_f^{Ff}(\theta_{PF}, \theta_{DF}))^{1-\epsilon} f_{max}^{n^*(\theta_{PF}, Z^{Ff}, \lambda \cdot w_F)}(\theta_{DF}) f(\theta_{PF}) d\theta_{DF} d\theta_{PF}$$
$$+ M_{PH} \cdot \int_0^\infty \int_0^\infty (p_f^{Hf}(\theta_{PH}, \theta_{DF}))^{1-\epsilon} f_{max}^{n^*(\theta_{PH}, Z^{Hf}, \lambda \cdot w_H)}(\theta_{DF}) f(\theta_{PH}) d\theta_{DF} d\theta_{PH} \Big)^{\frac{1}{1-\epsilon}} \quad (3.18)$$

Finally, the balanced trade condition determines the relative wages. The aggregate revenue obtained by Home's exporters is equal to the aggregate revenue obtained by Foreign's exporters.

$$R_{PH}^{Hf} = R_{PF}^{Fh} \tag{3.19}$$

Again, consider that conditional on an exporter's productivity, his revenue is a stochastic outcome. The balanced trade condition is then the following:

$$\int_0^\infty \int_0^\infty r_{PH}^{Hf}(\theta_{PH}, \theta_{DF}) \cdot f_{max}^{n^*(\theta_{PH}, Z^{Hf}, \lambda \cdot w_H)}(\theta_{DF}) \cdot f(\theta_{PH}) \cdot M_{PH} d\theta_{DF} d\theta_{PH}$$
$$= \int_0^\infty \int_0^\infty r_{PF}^{Fh}(\theta_{PF}, \theta_{DH}) \cdot f_{max}^{n^*(\theta_{PF}, Z^{Fh}, \lambda \cdot w_F)}(\theta_{DH}) \cdot f(\theta_{PF}) \cdot M_{PF} d\theta_{DH} d\theta_{PF} \tag{3.20}$$

III.D Sorting of Exporters and Importers

The first key result describes the sorting of producers (exporters) and distributors (importers).

Proposition I. There is positive assortative matching between exporters and importers. Higher productivity θ_P of exporters leads to

i) Higher search intensity $n^*(\theta_P)$

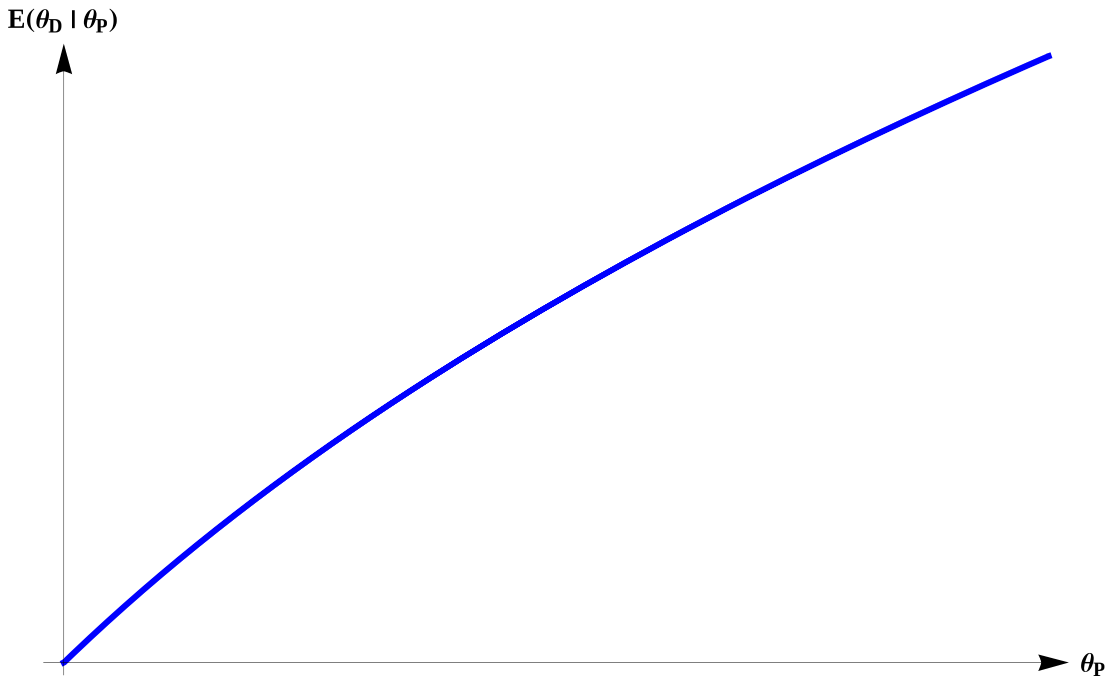
ii) Higher expected productivity $E[\theta_D|\theta_P]$ of an exporter's trading partner.

Proof: See Appendix.

More productive producers search more and thus enter partnerships with more productive distributors on average. Figure 3.1 illustrates the positive relationship between the productivity of a producer and the expected productivity of the distributor he chooses.[15] The intuition behind this result is that searching is more profitable for exporters of higher productivity, since the advantage of finding a better importer is magnified by the producer's own productivity. This is a consequence of the complementarity between exporter and importer productivities in the joint production-distribution function (equation 3.3).

[15]The outcome of the search process is random. An optimal search effort $n^*(\theta_P)$ leads to a match with an importer of expected productivity $\int_0^\infty \theta_D \cdot f_{max}^{n^*}(\theta_D) \cdot d\theta_D$. The prediction illustrated in Figure 3.1 is $\frac{d \int_0^\infty \theta_D \cdot f_{max}^{n^*}(\theta_D) \cdot d\theta_D}{d\theta_P} > 0$.

Figure III.1: The Match between Exporters and Importers



Notes: This graph represents the relationship between the productivity of an exporter of productivity θ_P (in the horizontal axis) and the expected productivity $E[\theta_D|\theta_P]$ of the importer he chooses after searching with optimal intensity $n^*(\theta_P)$.

III.E Effect of Search Costs on Sorting and Trade Flows

The second key result concerns the effect of search costs on the sorting between exporters and importers and on trade flows.

Proposition II. A decline in search costs leads exporting firms to:

i) Increase their search intensity $n^*(\theta_P)$

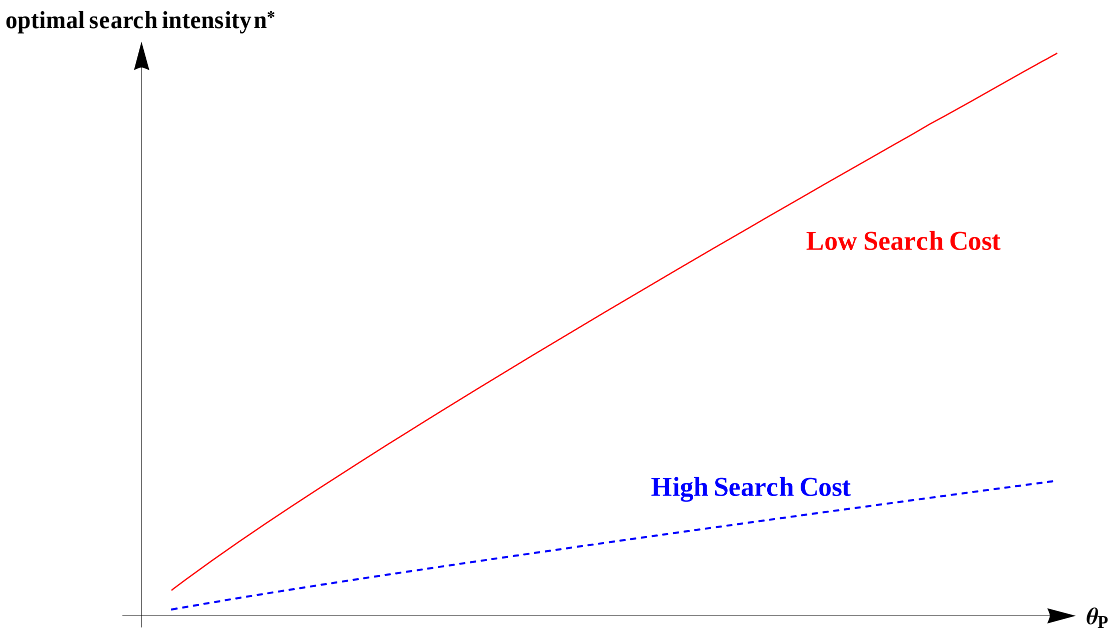
ii) Find and choose partners of higher expected productivity $E[\theta_D|\theta_P]$

iii) Export a larger expected value.

Proof: See Appendix.

As the search for importing firms becomes less expensive, exporters increase their search effort, and are matched on average to more productive importers. Figure III.2 illustrates this result. This channel through which frictions in international trade affect trade flows is additional to that of transport costs. In my model search costs are a type of fixed costs.[16] Differently than in the Melitz (2003) model, fixed costs have an effect on aggregate trade flows through the intensive margin, as shown in figure III.3.[17]

Figure III.2: Exporters' Optimal Search Intensity



Notes: This graph represents the relationship between the productivity θ_P of exporters (in the horizontal axis) and their optimal search intensity $n^*(\theta_P)$ in the cases of high (dotted line) and low (solid line) search costs λ.

III.F Variation in Distribution Intensity

The effect of search costs on the search effort and on the revenue and profits of a producer depends on the relative importance of distribution in the combined production-distribution cost function. The intensity in distribution services is represented by v. For high values of v distribution is less relevant than production; the type of distributor chosen is less

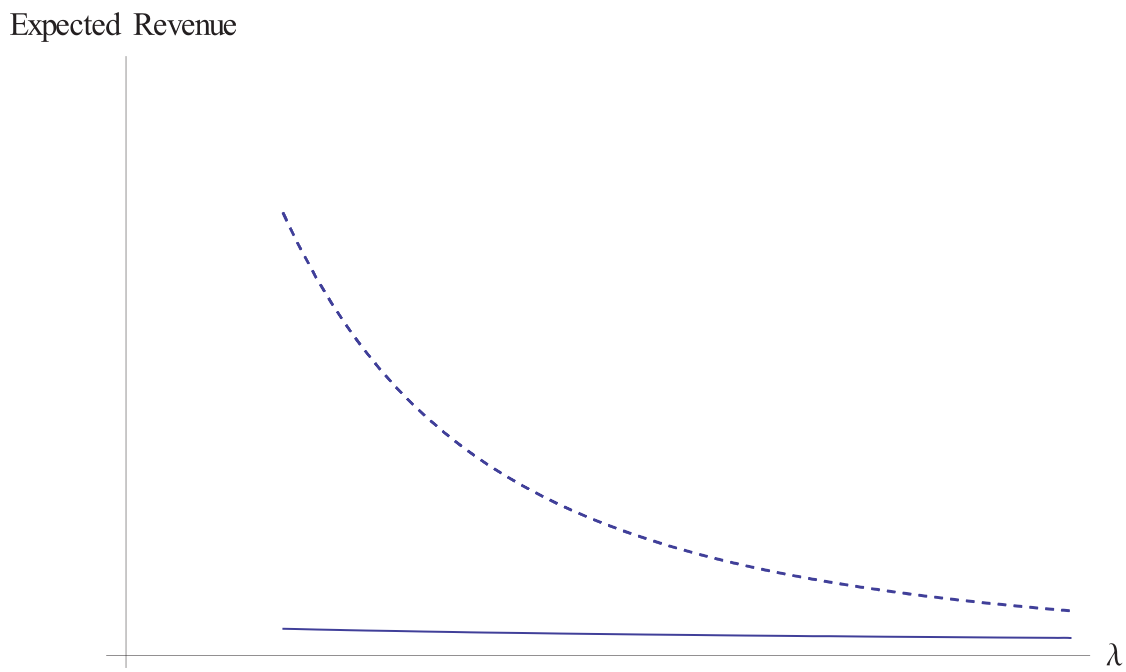
[16] Search costs are fixed costs in the sense that they are fixed with respect to the quantity produced. They are variable in a different dimension, as firms choose how much to search.

[17] The effect on the extensive margin of Melitz (2003) is generated with additional fixed cost as in section III.I.

relevant for a producer's revenue. Consequently, the problem of searching for a distributor becomes less relevant, we are in a situation closer to the Melitz (2003) model, and the effect of search costs on producers' search intensity, revenue and profits is lower. This result is illustrated in Figure III.3.

Figure III.3: The Effect of Search Costs on Producers' Revenue depends on Distribution Intensity.

$v = \frac{1}{4}$ dashed line $\qquad v = \frac{3}{4}$ solid line



Notes: This graph represents the relationship between search costs λ and the expected revenue of a producer of productivity θ_P (held constant in this graph). The dashed line shows the relationship for a product for which distribution is relatively important compared to production. In the solid line, distribution is unimportant, and the negative effect of search costs on the producer's revenue is lower. In other words, the dashed line has a steeper slope.

III.G "Firm-Level Gravity"

Trade flows between firms depend on the productivity of exporters and importers, generating a relationship that resembles the gravity equation for trade between countries. I term this relationship "firm-level gravity".

Proposition III. The volume of trade between two firms depends:

i) Positively on the productivity of the exporter and the importer.

ii) Negatively on ad-valorem trade costs.

Proof: By inspection of the revenue function describing the traded value between an exporting and an importing firm.[18]

In contrast, in models based on Melitz (2003) trade flows depend on the characteristics (typically productivity) of exporting firms only.

III.H Wages and Welfare

Differences in country size lead to differences in wages. As in the two-country Melitz (2003) model with symmetric trade costs (see Felbermayr and Jung (2011) it can be shown that:

Proposition IV. The larger country has a higher wage.

Proof: See Appendix.

This result is equivalent to that in Krugman (1980) with homogeneous firms. Under costly trade, a wage differential is needed offset the attractiveness of the larger market to producers in order to keep labor fully employed in both markets.

Welfare is measured by the real wage in each country, $W_i = \frac{w_i}{P_i}$. As in the Melitz (2003) model, under costly trade welfare is higher in the larger country. In this case, this is found numerically, simulating the model for a wide variety of parameters.

III.I Selection into export markets

The model described earlier in this section does not generate an export productivity cutoff that explains the selection of highly productive firms into export markets as in Melitz (2003). The model can be extended to include an additional fixed cost of entry into export

[18]The revenue of a producer in Home trading with a distributor in Foreign is the following

$$R_{PH}^{Hf}(\theta_{PH}, \theta_{DF}) = A_F \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1} \right)^{1-\epsilon \cdot v} \left(\frac{\epsilon}{\epsilon - 1} \right)^{-\epsilon} \tau^{(1-\epsilon)\cdot v} \left(\frac{w_H}{\theta_{PH}} \right)^{(1-\epsilon)\cdot v} \left(\frac{w_F}{\theta_{DF}} \right)^{(1-\epsilon)\cdot(1-v)} = Z_d \cdot \theta_{PH}^{\epsilon \cdot v - 1} \cdot \theta_{DF}^{\epsilon \cdot (1-v)}$$

markets (F) to generate this result. The problem for a producer in Home searching for an importer to reach final consumers in Foreign becomes:

$$max_n \int_0^{\infty} f_{max}^n(\theta_{DF}) \cdot \pi_{PH}^{Hf}(\theta_{PH}, \theta_{DF}) d\theta_{DF} - w_H \cdot \lambda \cdot n - w_H \cdot F \qquad (3.21)$$

Firms with productivity below $\underline{\theta_{PH}} = k \cdot (\frac{F \cdot \lambda^{\delta-1}}{(Z^{Hf})^{\delta}})^{\frac{1}{\delta \cdot (\epsilon \cdot v - 1)}}$ do not export, where $\delta = \frac{\gamma}{\gamma - \epsilon \cdot (1-v)}$.

III.J Gravity in a Many-Country World

In partial equilibrium one can think of a many-country version of the model and derive a gravity equation that relates the volume of trade between two countries to their income and trade costs. The aggregate gravity equation derived from this model includes both the usual trade costs as well as search costs. Recall that Tinbergen's (1962) explanation for the role of distance in the inaugural gravity equation was not only an approximation for transport costs but also a representation of information frictions: "The factor of distance may also stand for an index of information about export markets".

Consider an M-country version of the model described earlier. Preferences in each country are identical, and transport costs and search costs vary across country pairs but are symmetric ($\tau_{ij} = \tau_{ji}$ and $\lambda_{ij} = \lambda_{ji}$). There is a mass of exporting firms in each country (producers), which can also sell domestically. To derive the gravity equation of a many-country case, I can write the total exports from country j to country i by integrating across j's exporters. The value of total exports of country i to country j is then expressed as (to shorten notation, throughout this section I will use θ_E to denote the productivity of the exporters and θ_I the productivity of the importers):

$$R_{ij} = M_i \cdot \int_0^{\infty} \int_0^{\infty} R_E(\theta_E, \theta_I, Y_j) \cdot f_{max}^{n^*(\theta_E, Y_j, \lambda_{ij} \cdot w_i)}(\theta_I) f(\theta_E) d\theta_I d\theta_E = Y_j \cdot M_i \cdot \Gamma(\tau_{ij}, \lambda_{ij}, Y_j) \qquad (3.22)$$

M_i is the number of exporting firms in country i and the function $\Gamma(\tau_{ij}, \lambda_{ij}, Y_j)$ is used to encompass a group of variables and parameters that includes trade costs, search costs and the income level of the importing country.

As in Helpman, Melitz and Rubinstein (2008), the fact that total income equals total expenditure in the exporting country is used to write the exporting country's income as the sum of the revenue from its exports to all countries (plus domestic sales). Using this equation, one can write the number of firms in the exporting country as a function of the exporting country's income level. The income in country i is equal to its exports to every country:

$$Y_i = \sum_h M_i \cdot \int_0^\infty \int_0^\infty R_E(\theta_E, \theta_I, Y_h) \cdot f_{max}^{n^*(\theta_E, Y_h, \lambda_{ih} \cdot w_i)}(\theta_I) f(\theta_E) d\theta_I d\theta_E$$

from where

$$M_i = \frac{Y_i}{\sum_h \Phi(\tau_{ih}, \lambda_{ih}, Y_h)} \tag{3.23}$$

The function $\Phi(\tau_{ij}, \lambda_{ij}, Y_h)$ is introduced to represent a number of variables and parameters. The next step is to replace the number of firms in the exporting country, M_i, back in equation (3.21) using (3.22). This leads to the resulting gravity equation that incorporates both standard ad-valorem trade costs as well as search frictions.

$$R_{ij} = Y_i \cdot Y_j \cdot \frac{\Gamma(\tau_{ij}, \lambda_{ij}, Y_j)}{\Phi(\tau_{ij}, \lambda_{ij}, Y_h)} \tag{3.24}$$

III.K Final Prices and Border Prices

The model features a final price paid by consumers in the destination market, p_f, and the price of the transaction at the border (the "border price", "international price" or "wholesale price", p_w) paid by the importer to the exporter. The ratio between these prices is typically large and has been studied by Berger et al (2012) and others.[19]

Consider again the many country world of subsection III.J. In the model, this price ratio p_f/p_w varies across exporting firms and destinations. It also depends on industry characteristics.

[19] Berger et al (2012) find that for U.S. imports the gap $(p_f - p_w)/p_w$ is on average in the range 50% - 70%. Berger et al (2012) measure p_f using the BLS' CPI microdata and p_w using the BLS' IPP microdata.

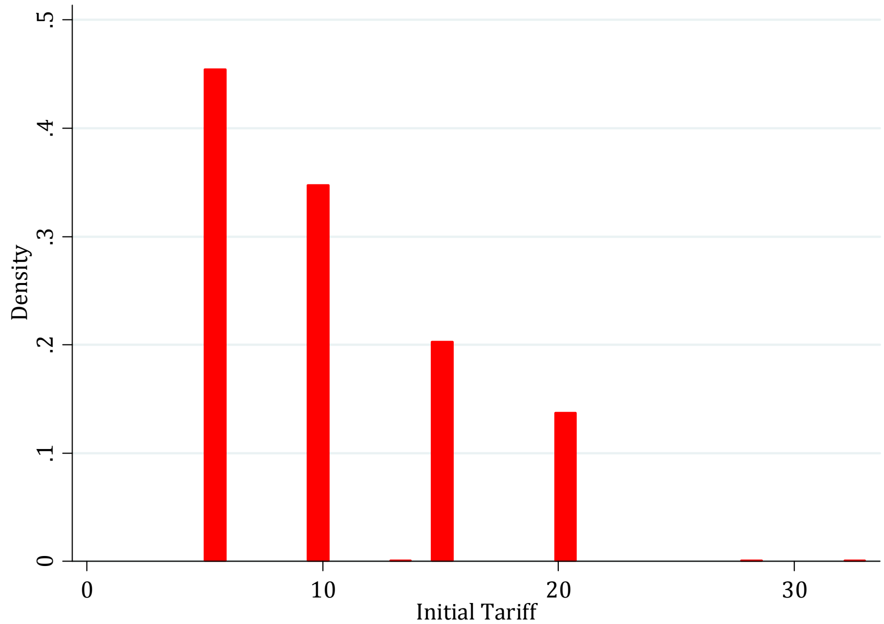
Consider the variation in the expected price ratio for a given exporting firm across destinations, $E[p_f/p_w|\theta_E]$. Large search costs lead exporters to reduce their search intensity. This results in matches with low-productivity importers (i.e. a higher marginal cost for the distribution of the products) and the price ratio of border to retail prices p_f/p_w increases. Exporting firms that face high entry barriers in the Colombian market (for instance an exporter from Pakistan to Colombia which will likely face a large search cost parameter) have a large p_f/p_w ratio, while firms facing small entry barriers (a small search cost parameter) have a small p_f/p_w ratio.

IV. Trade Liberalization and Exporter-Importer Sorting: the U.S. - Colombia Free Trade Agreement

In this section I study the response of exporting firms in the U.S. and importing firms in Colombia to the recent free trade agreement between these two countries. The model described in section III is concerned with the equilibrium in the cross-section and is silent about the transition dynamics induced by a trade-liberalization. Nevertheless, in general terms one would expect that the increased profitability of exports to Colombia in industries facing the largest tariff reductions would provide incentives for U.S. exporters to raise their expenditure in fixed costs (search costs) and switch trading partners. Potentially there are costs to switching partners. Exporters that retain their relationship with a certain importer are still expected to increase their revenue in response to the trade liberalization due to the reduced ad-valorem trade costs.

The free trade agreement signed by the U.S. and Colombia became operational on May 15th 2012. U.S. exporters to Colombia faced large tariff cuts in many industries. Many of these were effective immediately and reduced tariffs to zero. Due to the short span of the post-liberalization period, I focus on these industries. These tariff cuts concern a large number of U.S. firms that export to Colombia, as well as a large number of Colombian importers from the U.S. The following figure illustrates the density of the tariff cuts faced by U.S. exporters.

FIGURE IV.1: Tariff Cuts for U.S. Exports to Colombia.



Notes: This figure shows the density of tariffs faced by U.S. exporters to Colombia according to their pre-FTA value at the HS-10 digit level. This figure is restricted to product categories that were liberalized immediately and completely.

IV.A Data on U.S. Exporters and Colombian Importers

I use the information on import transactions collected by Colombian customs described in section II.A. These records contain the name of the Colombian importer and the US exporter in each international transaction. The data includes the name, address, city and telephone number or email address of the US exporters, which I use to define their identity. On the importing side, I observe the tax ID number of the Colombian importers.

IV.B Results

As a first step, I investigate whether the tariff concessions made by Colombia to U.S. exporters raised their revenue in this market. The second step will be to determine whether switching trading partners was a mechanism used by these U.S. exporters to increase their revenue.

I focus on the intensive margin, identifying U.S. firms exporting to Colombia both before and after the agreement. The reason is that these are the firms I will study when analyzing the reorganization of trading partnerships. For the same reason I focus on firms that had a single trading partner before and after the liberalization. Since the adjustment may take time, I define the pre-liberalization period as June 2007-May 2008 and the post-liberalization period as June 2012-May 2013. Following Bustos (2011) I estimate the following equation, with the change in (log) exports of firm f as the dependent variable. The independent variable of interest is the change in tariffs associated to that firm. I also include the firms exports in the pre-agreement period as a control. I include the interaction between firm size (exports) and the change in tariffs to study the differential response across firms.

$$\Delta \text{Exports}_{ft} = \beta_1 \cdot \Delta \text{Tariff}_{ft} + \beta_2 \cdot \text{Exports}_{f,t-1} + \beta_3 \cdot \Delta \text{Tariff}_{ft} \cdot \text{Exports}_{f,t-1} + \epsilon_{ft} \quad (4.1)$$

The tariff associated to each firm is computed as a weighted average of the tariff of each of the firm products, using product shares in the pre-agreement period as weights. I include industry-level dummies at the HS-2 digit level. This means I am comparing manufacturers of photographic cameras to manufacturers of video recorders, rather than to producers of pharmaceuticals. I cluster standard errors according to the tariff category associated to each firm.

I find that U.S. exporters facing larger tariff cuts did increase their revenue by more. A one standard deviation larger tariff reduction is associated with 0.26 standard deviations higher revenue. The interaction term suggests that smaller firms increased their revenue by more. The results are reported in table IV.1. Descriptive statistics are found in the appendix.

Next, I ask whether firms facing larger tariff concessions where more likely to switch their import partners. I focus on firms which exported to Colombia both before and after the agreement. I restrict the sample to firms with a single partner before and after the liberalization. I estimate the following equation. The dependent variable $Switch_{ft}$ takes a value of one for exporters that switch importers between 2007-2008 and 2012-2013. The independent variables are again the change in tariffs associated to each firm, computed in the same way as before, firm size (total exports measured before the agreement) and the interaction between these. I include HS 2-digit level industry dummies to compare across similar industries. Since I include these dummies I estimate a linear regression model rather than of a probit model.

$$\text{Switch}_{ft} = \beta_1 \cdot \Delta\text{Tariff}_{ft} + \beta_2 \cdot \text{Exports}_{f,t-1} + \beta_3 \cdot \Delta\text{Tariff}_{ft} \cdot \text{Exports}_{f,t-1}\epsilon_{ft} \tag{4.2}$$

I find that firms in industries facing larger tariff cuts where more likely to switch to a new trading partner, as shown in the lower panel of table IV.1. The relative short span of the data deters me from comparing switching between before and after the agreement to switching in "normal times". Overall the results support the idea that firms have incentives to switch to trading with more productive importing partners due to the increased profitability in an export market that results from a liberalization.

Table IV.1: Response of Exporting and Importing Firms to the U.S. - Colombia Free Trade Agreement.

Dependent Variable: $\Delta(log)\text{Exports}_{ft}$

		Standardized Coefficients
ΔTariff_{ft}	0.5183**	0.2625
	0.2254	
$(log)\text{Exports}_{f,t-1}$	-0.4209***	-0.4222
	0.0475	
$\Delta\text{Tariff}_{ft} \cdot (log)\text{Exports}_{f,t-1}$	-0.0521**	-0.2897
	0.0220	
HS-2 Fixed Effects	Yes	Yes
R-Squared within	0.2549	
Observations	2177	

Dependent Variable: Switch_{ft}

		Standardized Coefficients
ΔTariff_{ft}	0.0863*	0.1903
	0.0476	
$(log)\text{Exports}_{f,t-1}$	-0.0520***	-0.2272
	0.0086	
$\Delta\text{Tariff}_{ft} \cdot (log)\text{Exports}_{f,t-1}$	-0.0054	-0.1323
	0.0042	
HS-2 Fixed Effects	Yes	Yes
R-Squared within	0.0820	
Observations	2177	

*Notes: This table shows the results of the estimation of equations 4.1 (top) and 4.2 (bottom). Standard errors are reported under the estimated coefficients. Errors are clustered by tariff category. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.*

V. Conclusions

This paper has studied the interaction between exporting and importing firms, in the context of international trade based on increasing returns to scale with heterogeneous exporters and heterogeneous importers. Analyzing jointly the behavior of exporting and importing firms requires taking into account the selection of these firms into trading pairs. The paper proposes a simple model in which exporters search for importing firms, with whom they need to partner to reach final consumers abroad. The sorting of exporters and importers into trading pairs varies across destinations and across sectors, and has consequences for aggregate trade flows. These consequences are quantified in the next chapter.

Distribution networks or marketing channels could be important for understanding trade flows. Within the literature on heterogeneous firms in international trade, a recent survey by Redding (2011) suggests that an "area for further work is the microeconomic modeling of the trade costs that induce firm selection into export markets, including the role of wholesale and retail distribution networks."

This paper has stepped away from the typical assumption of frictionless international markets. In this model, finding partners in foreign markets is costly. This is an old idea, yet an underexplored one. In this regard, a set of general questions for further research is the following. Is the relatively high volume of trade experienced in the recent decades (the so-called second wave of globalization) a consequence of lower transport costs and tariffs or a product of the increased access to information? Second, in their efforts to promote exports governments frequently subsidize information acquisition. Is this a reasonable policy?

Much is left for future research. One task left pending is to study bargaining in a context where a set of heterogeneous exporters are confronted to a set of heterogeneous importers. For instance, one could ask whether it is good or bad news when a small exporter lets say a coffee farmer in a developing country - signs a contract with a very large wholesaler abroad? More generally, how are the gains from trade split between exporting and importing countries?

To conclude, one can use this model as a starting point to study other features of trade contracts. Exporting and importing firms in this model have to set prices and quantities, but trade contracts in practice are probably more complex. One can study other characteristics of these contracts, such as their duration, the invoice currency, vertical restraints, financing terms, etc.

Chapter Two: Consequences of the Matching and Sorting of Exporting and Importing Firms for Aggregate Trade Flows

I. Introduction

The matching and sorting of exporting and importing firms has consequences for aggregate trade flows across countries and across industries. Trade frictions influence the search effort of firms and through this mechanism they depress trade flows. The goal of this chapter is to quantify these effects.

In section II I estimate the structural parameters of the model, including the search costs that govern the sorting of exporters and importers. In subsection II.A I estimate the parameters of the two-country model using the matched exporter-importer data on French exporters and Colombian importers, and use the estimated parameters to discuss the effects of trade liberalization. A trade liberalization induces exporters to increase their expenditure in fixed costs (i.e. search costs), leading them to find more productive importers and sell more. I also describe the effects of a reduction of search costs. Facilitating trade by reducing search costs is probably the goal of export promotion agencies. These agencies act as matchmakers, organizing trade fairs and connecting importers and exporters. In a world with very low tariffs (see Krugman (2013)) other instruments of trade policy, such as these agencies, have become relatively more important. Qualitatively, the effect of a reduction in search costs is equivalent to that of a reduction of tariffs. Next, I focus on the implications of this model for aggregate trade flows across destinations in a many-country interpretation of the model in partial equilibrium. The matching and sorting of exporters and importers across countries depends on the extent of search frictions. Through this channel, search frictions affect global trade flows across destinations and across sectors. As search costs rise, the search effort of exporters falls and consequently they are matched with less productive importers and sell less. To study the implications of my model for aggregate trade flows empirically, I estimate the search cost parameters from one exporting country to all its export destinations in subsection II.B. I estimate the elasticity of search costs to distance to the export market and linguistic differences between countries with the purpose of understanding how geography affects trade flows through this mechanism. I focus on a remote yet open country, Chile, for which data on firms' exports across destinations is available. I estimate the model using data on firms in the wine industry, which resembles monopolistic competition and has a large number of exporting firms. Presumably, Chilean wine exporters have to overcome large search costs when entering foreign markets, as they face a geographical and linguistic difference in their largest markets. I find a positive elasticity of search costs to distance. The magnitude of these estimated search costs is large: in exports of these firms to the U.S. their expenditure in search costs is three times higher than their expenditure in transport costs observed in the data.

In section III I study the variation across industries of the effect of search frictions on trade flows. As search for trading partners becomes costly, firms reduce their search effort, are matched with less productive partners, and sell less. The intensity of this effect varies across industries. In industries in which distribution is important relative to production (distribution-intensive industries) this effect is stronger. If distance is correlated with search costs, as shown in section II, one would expect to find a larger elasticity of trade flows to distance in industries intensive in distribution services. I test this idea using both product level and firm level trade data across sectors and destinations. I characterize industries based on their distribution-intensity using a measure constructed from input-output tables. I find that as the model suggests the elasticity of trade flows to distance is more negative in distribution-intensive industries.

II. Estimation and Simulated Policy

In this section I estimate the structural parameters of the model, including the search costs that govern the sorting of exporters and importers. In subsection II.A I estimate the parameters of the two-country model using the matched exporter-importer data on French exporters and Colombian importers, and use the estimated parameters to discuss the effects of a trade liberalization and of a decrease in the search costs of finding trading partners in foreign markets. In subsection II.B I generalize the model to a multi-country partial equilibrium version and I estimate search costs across destinations using standard data on firm level exports across countries. I estimate the elasticity of these search costs to distance and linguistic differences between countries with the purpose of understanding how geography affects trade flows. I also compare the magnitude of expenditure in search costs to transport costs.

II.A Estimation Based on Matched Exporter-Importer Data

First I estimate the structural parameters of the model using the matched dataset of French exporters and Colombian importers introduced earlier in section II of Chapter One. I use the estimated model to study the response of firms to two policy experiments. The first experiment is a trade liberalization: a reduction in ad-valorem trade costs (tariffs or transport costs). The second one is a reduction in search costs. This type of policy has received little attention in the literature since search costs are usually not a feature of international trade models. Reducing search costs, however, seems to be the role of export promotion agencies and trade fairs which provide information about foreign markets and facilitate matches. In a world with very low tariffs (see Krugman (2013)) other instruments of trade policy, such as the activities of trade promotion agencies, have become relatively more important. Further, one can ask whether the improvement in information technologies has contributed to globalization by reducing the search costs involved in entering foreign markets.

To estimate the parameters of the model I derive a likelihood function based on the probability of observing matches between exporting and importing firms depending on their types (productivities). The model predicts that the probability that an exporter of productivity θ_E is matched with an importer of productivity θ_I is given by the following density function:

$$f^n_{max}(\theta_I) = \frac{dF^n_{max}(\theta_I)}{d\theta_I} = n \cdot \gamma \cdot \theta_I^{-\gamma-1} \cdot e^{-n \cdot \theta_I^{-\gamma}} \tag{2.1}$$

This probability depends on the exporter's optimal search intensity $n^*(\theta_E, Z/\lambda)$, which is a function of his own productivity θ_E. The exporter's search intensity is also a function of the ratio between the search cost parameter λ and a term Z that encompasses demand conditions in the destination country and wages in the source and destination countries. Equation 2.1 is used as the argument of the likelihood function which is maximized to obtain estimates for the parameters.

$$L(\delta|X) = \prod_{i=1}^{N} f^{n^*(\theta_E, Z/\lambda)}_{max}(\theta_I) \tag{2.2}$$

In equation 2.2, N stands for the number of observations (matched exporter-importer pairs) and $\delta = (\epsilon, v, \gamma, Z/\lambda)$ represents the set of parameters to be estimated. The data consists of the information on the productivities of the exporters and importers in each observed trading pair $X = (\theta_E, \theta_I)$. This estimation is sensible to the scaling of the data. For this reason I normalize the distribution of exporters and importers' productivities such that the standard deviation is equal to the standard deviation of the Fréchet distribution, which is a function of the shape parameter γ. Note that the estimation in section II.B is not subject to these concerns because I use data on exporters' revenue only.

I estimate the parameters using the data on French exporters and Colombian importers. To be able to use the data on all different sectors, I am using for now the log of firms' sales as a proxy for their productivity, to avoid pooling data on productivity across sectors. The estimated coefficients and their standard errors are the following.

Table II.1: Estimated Parameters.

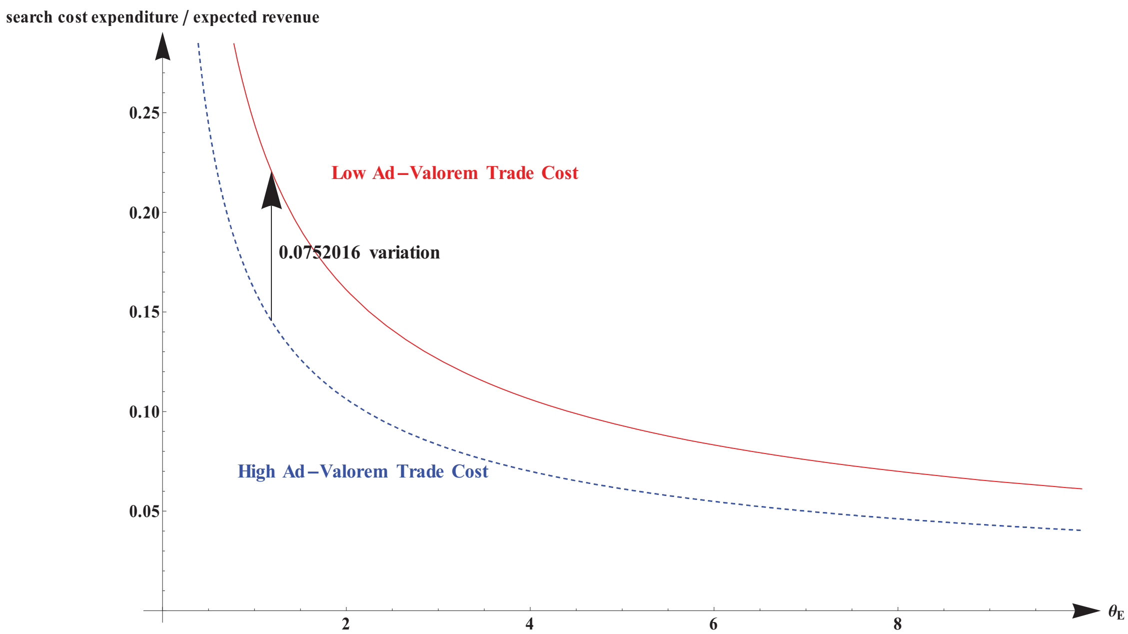
Parameter	Symbol	Coefficient	Std. Error
Elasticity of Substitution	ϵ	4.804	0.073
Relative Production Intensity	v	0.439	0.091
Shape parameter of firm's Frechet distribution	γ	3.521	1.260
Aggregate Demand Parameter Relative to Search Costs	$\frac{Z}{\lambda}$	0.964	0.380

Note: this table shows the set of estimated that maximize the likelihood function in equation 2.2. The standard errors are computed by bootstrapping.

II.A.1 Trade Liberalization

A trade liberalization is represented by a reduction in ad-valorem trade costs τ by half and is interpreted as a reduction in tariffs or trade costs. Regardless of the initial level of these trade costs, reducing them by half implies scaling the demand level by $0.5^{1-\epsilon \cdot v} > 1$. The simulation is done keeping the aggregate parameters constant. This is consistent with the fact that France is a small commercial partner of Colombia. The reduction in these ad-valorem trade costs is akin to an increase in demand for French products. Ignoring the transition dynamics, in the new equilibrium French exporters search more than before to find more productive distributors in Colombia, and thus sell more. The following figures show the ratio of search cost expenditure to expected revenue before and after the liberalization.

Figure II.1: The Effect of a Trade Liberalization.



Notes: This figure shows the effect of a trade liberalization (a reduction by half of ad-valorem trade costs) on the ratio of search cost expenditure to expected revenue of exporters. The parameters are those estimated from the France-Colombia data. The black arrow shows the increase in this ratio for the exporter with median productivity.

II.A.2 A Reduction in Search Costs

A fall in search costs is represented by a decline of the search cost parameter λ. Qualitatively, the effects are the same than a decline in tariffs shown in figure II.1. Recall that an exporter's decision on how much to search is a function of the ratio Z/λ, where Z is proportional to ad-valorem trade costs (tariffs or transport costs).

II.B Search Costs Across Destinations

In this subsection I estimate the structural parameters of the model using data on firm-level exports across countries, with the focus placed on estimating search costs, for the following reasons. First, the variation of search costs across destinations impacts the sorting of exporters and importers. Higher search costs lead exporters to search less and find less productive distributors, reducing trade flows. I estimate search costs across destinations, allowing the search cost parameter of the model to be a function of distance and an indicator of linguistic proximity. These possible determinants of search costs -distance and linguistic proximity - were suggested by Rauch (1999). This allows me to understand the effect of geography on trade flows through the mechanism described. Second, there is variation in search intensity across exporting firms. The results obtained allow me to calculate the amount spent by each firm in searching for a match in each destination. This captures the size of the fixed costs of exporting, which as I discussed earlier, in this model are equivalent to the expenditure in search costs. This is relevant from a policy perspective, since the impact of attempts to reduce search costs and facilitate the matching of exporters and importers (such as trade promotion agencies) varies across firms and destinations, and the model with the estimated parameters can be used to improve the effectiveness of these efforts. Finally, the results allow me to compare the relevance of search costs relative to other barriers to international trade. Traditionally, the focus regarding barriers to trade has been put in transport costs and tariffs, which are more tangible and easier to measure. I compare the estimated search costs to the transport costs observed in the dataset of export transactions that I use.

I use the cross-sectional variation in exporters' revenue across firms and destinations to estimate the parameters of the model with maximum likelihood. After deriving the probability distribution of exporters' revenue from the model, I describe the data, the details of the estimation procedure and the results. Then I use the model and the estimated parameters to address the issues discussed above.

In the model, export revenue is stochastic. Recall that an exporter searches with optimal intensity $n^*(\theta_E, \lambda_d, Z_d)$, which depends on the search cost parameter λ_d associated to each destination. The outcome of the search process, (the productivity θ_I of the exporter's trading partner), is stochastic and has a density function given by equation 3.2 in section III of Chapter One:

$$f^n_{max}(\theta_I) = \frac{dF^n_{max}(\theta_I)}{d\theta_I} = n \cdot \gamma_I \cdot \theta_I^{-\gamma_I - 1} \cdot e^{-n \cdot \theta_I^{-\gamma_I}} \quad (2.3)$$

Once an exporter is matched, the revenue R_E obtained by the exporter from destination d is:

$$R_{E,d}(\theta_E, \theta_I) = p_w \cdot q \cdot A_d \cdot \tau^{1-\epsilon\, v} \cdot \left(\frac{\epsilon\, v}{\epsilon\, v - 1}\right)^{1-\epsilon\, v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \left(\frac{w_E}{\theta_E}\right)^{1-\epsilon\, v} \left(\frac{w_d}{\theta_I}\right)^{-\epsilon(1-v)}$$

$$= Z_d \cdot \theta_E^{\epsilon\, v-1} \cdot \theta_I^{\epsilon(1-v)}, \tag{2.4}$$

where for convenience I use Z_d as a term that captures a combination of parameters and is proportional to A_d .

To calculate the probability distribution for an exporter's revenue in a given market, $R_{E,d}(\theta_E, \theta_I)$, note that mathematically $R_{E,d}$ is a transformation of θ_I.[20] The density function for $R_{E,d}$ is:

$$Pr\{R_{Ed} = r_{E,d}|\theta_E\} = \frac{1}{\epsilon \cdot (1-v)} \cdot \frac{1}{Z_d \theta_E^{\epsilon \cdot v - 1}} \cdot r_{E,d}^{1-\epsilon\, v} \cdot f_{max}^{n^*(\theta_E, \lambda_d, Z_d)} \left(\left(\frac{r_{E,d}}{Z_d\, \theta_E^{\epsilon \cdot v-1}} \right)^{1/(\epsilon(1-v))} \right) \tag{2.5}$$

Note that this expression is conditional on the exporter's productivity θ_E.

An important feature in the data is the abundance of zeros: firms that do not export to some destinations. The original version of the model described in section III of Chapter One does not generate zeros, since there is no export productivity cutoff. The model can be extended to include an additional fixed cost of exporting to generate these zeros. This extension is convenient for the empirical estimation in this section. The exporter's problem becomes:

$$max_n \int_0^\infty f_{max}^n(\theta_I) \cdot \pi_E(\theta_E, \theta_I) \cdot d\theta_I - n \cdot \lambda \cdot w_E - F \cdot w_E$$

Firms with productivity below $\underline{\theta_E} = k \cdot \left(\frac{F \cdot \lambda^{\delta-1}}{Z^\delta}\right)^{\frac{1}{\delta \cdot (\epsilon \cdot v - 1)}}$ do not export. The cutoff productivity is a function of destination characteristics, so the prevalence of zeros varies across markets, as in the data.

[20] In general, let x be a random variable such that the density function of its distribution is $f(x)$. Then the distribution of a variable $y = g(x)$ has a density function $f(g^{-1}(y)) \cdot |\frac{\partial g^{-1}}{\partial y}|$.

Since productivity is difficult to measure, I calculate the unconditional distribution of an exporter's revenue in a given destination. In the description of the model in section III of Chapter One, I stated that the productivity distribution of exporting firms is assumed to be Fréchet. The unconditional productivity distribution for an exporter's revenue is:

$$Pr\{R_{E,d} = r_{E,d}\} = \begin{cases} \int_{\underline{\theta_E}}^{\infty} Pr\{R_{E,d} = r_{E,d} \,|\, \theta_E\} \cdot f(\theta_E) d\theta_E & \text{for } r_{E,d} > 0 \\ \\ \int_{0}^{\underline{\theta_E}} f(\theta_E) d\theta_E & \text{for } r_{E,d} = 0. \end{cases} \tag{2.6}$$

This means that the probability that a firm exports zero revenue to a destination (i.e. does not enter the market) is equal to the probability that its productivity is lower than the export cutoff. To calculate the probability that revenue takes a specific positive value, I integrate the conditional density in 2.5 over the probability distribution of exporter productivities above the export cutoff.

I define an entry variable such that $entry_{E,d} = 1$ if an exporter E enters a market d and $entry_{E,d} = 0$ if it does not (i.e. if it has zero revenue in a market). Using this notation, I rewrite equation 2.6 as:

$$Pr\{R_{E,d} = r_{E,d}\} = \left\{ \int_{\underline{\theta_E}}^{\infty} Pr\{R_{E,d} = r_{E,d} \,|\, \theta_E\} \cdot f(\theta_E) d\theta_E \right\}^{entry_{Ed}} \cdot \left\{ \int_{0}^{\underline{\theta_E}} f(\theta_E) d\theta_E \right\}^{1-entry_{Ed}} \tag{2.7}$$

This is the density function that I will estimate using maximum likelihood, with data on exporting firms' revenue across destinations.[21].

I estimate the model using data from a specific sector, Chilean firms that manufacture and export wine, for several reasons. This is an industry which resembles monopolistic competition and in which distribution represents a very relevant fraction of the final price paid by consumers.[22] This industry consists of a large number of firms (more than 300

[21]In fact, for reasons of computational efficiency, it is preferable to use the distribution of the natural logarithm of revenue. The expression in equation 2.6 when revenue is measured in logarithms becomes

$$Pr\{\text{Log}R_{Ed} = r_{E,d} | \theta_E\} = \frac{1}{\epsilon(1-v)} \cdot \frac{1}{Z_d \cdot \theta_E^{\epsilon v - 1}} \cdot (\mathrm{e}^{r_{E,d}})^{1-\epsilon\, v} \cdot f_{max}^{n^*(\theta_E, \lambda_d)} \left(\frac{\mathrm{e}^{r_{E,d}}}{Z_d \cdot \theta_E^{\epsilon\, v - 1}} \right)^{1/(\epsilon(1-v))} \cdot \mathrm{e}^{r_{E,d}}$$

[22]The distribution margins computed from the U.S. input-output table indicate that for every dollar paid

exporters) that sell their product in many destinations. Finally, these firms sell a very specific good, bottles of wine, which makes observations across firms comparable. I estimate the parameters of the model using data on revenue $R_{E,d}$ across exporting firms and destinations in the cross-section of year 2010. More details on the data, including descriptive statistics, are provided in the Appendix.

To estimate the parameters of the model, I use the variation of exporters' revenue across exporting firms and destinations. I write the search cost parameter as a function of distance and linguistic proximity between the exporter country (Chile) and each destination. The variable $language_d$ is 1 for destinations whose official language is the same as the exporting country (Spanish) and zero for countries with a different language.

$$\lambda_d = \mu_0 + \mu_1 \cdot \text{distance}_d + \mu_2 \cdot \text{language}_d \tag{2.8}$$

I write a likelihood function based on equation 2.7. Each observation i is an element of the matrix of data $X = (R_{Ed}, distance_d, language_d, entry_{E,d})$, which consists of exporter-destination combinations. The variable $entry_{E,d}$ is equal to one when exporter E sells in destination d and zero otherwise. The set of parameters to be estimated is $\delta = (\mu_0, \mu_1, \mu_2, \epsilon, \upsilon, \gamma_I, \gamma_E, Z_d)$. All these parameters are common across destinations, except Z_d. The term Z_d captures variables that are determined in equilibrium: the wages in Home and destination d, and the income and price level in d. It also includes transport costs. Parameters μ_0, μ_1, and μ_2 describe the relationship between search costs and distance and linguistic proximity. The term represents the relative importance of production compared to distribution (see equation 3.3 in chapter 1). The term ϵ is the elasticity of substitution. Finally γ_I and γ_E are the shape parameters in the probability distributions of importers and exporters' productivities. The likelihood function takes the following form.

$$L(\delta|X) = \prod_{i=1}^{N} Pr\{R_{E,d} = r_{E,d}\} \tag{2.9}$$

I estimate the parameters using data on all 346 wine exporters to the largest 30 destinations in terms of the extensive margin (the number of firms present in each destination). This means that the total number of observations is $N = 346 \cdot 30 = 10380$. It is necessary

by a final consumer for a bottle of wine, 44 cents go to distribution (wholesaling and retailing).This is also seen by comparing some of the unit values of Chilean wine observed in the Customs database with final consumer prices in the U.S.

to impose as a restriction that $\gamma_I > (1 - \upsilon) \cdot \epsilon$, so that the integral in equation 3.5 in chapter 1 converges. The results of the estimation are shown in the following table:

Table II.2: Estimated Parameters.

Parameter	Symbol	Coefficient	Std. Error
Constant Term in Search Costs	μ_0	2.194	0.016
Elasticity of Search Costs to Distance	μ_1	1.446	0.022
Elasticity of Search Costs to lingustic difference dummy	μ_2	1.299	0.085
Elasticity of Substitution	ϵ	6.082	0.847
Relative Production Intensity	υ	0.622	0.119
Shape parameter of exporters' Frechet distribution	γ_I	3.451	0.343
Shape parameter of importers' Frechet distribution	γ_E	4.180	0.516

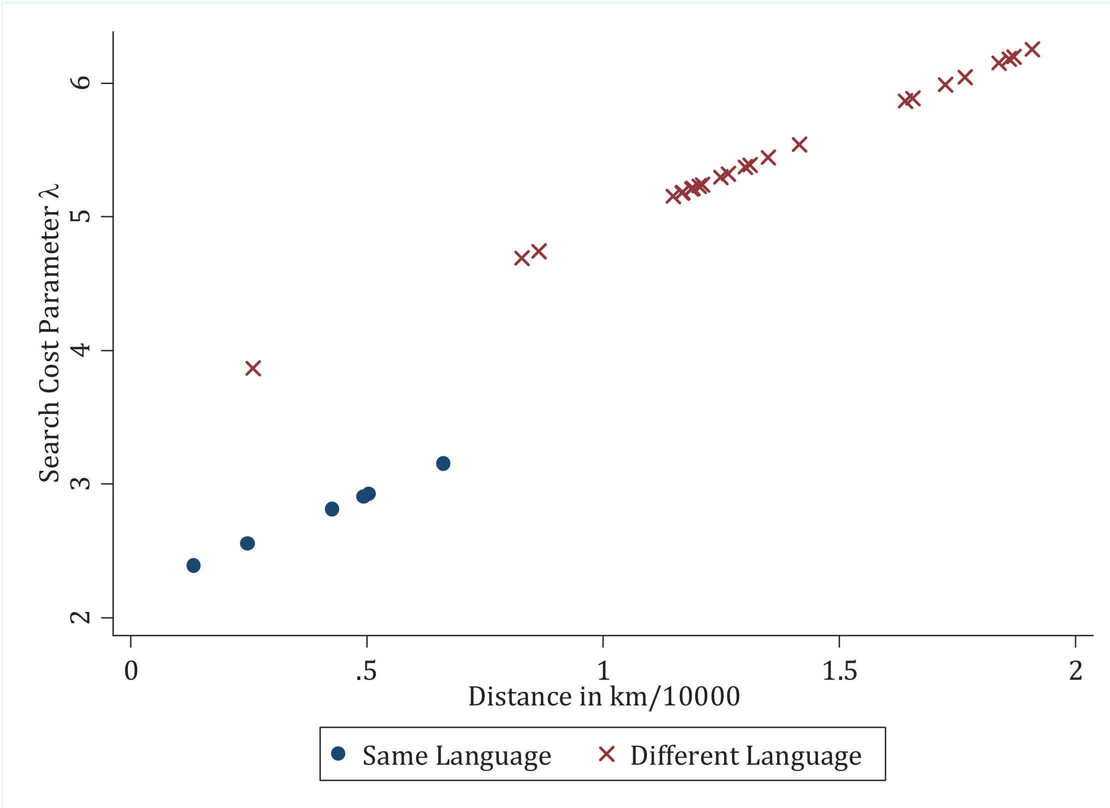
Note: this table shows the set of estimated that maximize the likelihood function in equation 2.9. I omit the 30 destination-specific coefficients Z_d. The standard errors are computed using the score method.

I now use these parameters to discuss the questions mentioned at the start of this section.

II.B.1 Results: Search Costs across Destinations

Search costs can vary across destinations and I estimate their elasticity with respect to distance and linguistic proximity. The following graph shows this relationship. Estimated search costs vary from a minimum for Uruguay to a maximum that is almost three times higher for China.

Figure II.2: Variation of Estimated Search Costs Across Countries.



Notes: This graph shows the relationship between search costs (in the vertical axis), distance (in the horizontal axis) and language. The round markers are used for search costs of Spanish-speaking countries. The cross markers are for all the rest. I include the 30 destinations used in the estimation.

The following exercise is useful to illustrate the magnitude of these search costs. First, if China had the same search cost as Uruguay (i.e. if China were very close to Chile and if it were a Spanish speaking country), the revenue of the median exporter would increase by 90%. This is keeping actual transport costs and the level of demand constant.[23] If China were a Spanish speaking nation and remained at its current distance from Chile, the revenue of Chile's wine exporters (considering the median exporter) in that market would increase by 15%.

[23]This means that the comparison is done in partial equilibrium. Since in reality Chile is a small economy and is not the only trade partner of China or the US, this seems more reasonable in order to get more realistic estimates.

II.B.2 Results: Search Costs versus Transport Costs

Economists have a fairly clear idea about the magnitude of transport costs in international trade. The relevance of search costs, on the other hand, is less understood. To compare them, I calculate the average expenditure in transport costs as a share of revenue of Chilean wine exporters selling in the U.S. market. With this measure, transport costs as a share of revenue are 6.9%. On the other hand, using the estimated coefficients, the expenditure in search costs represents 25.8% of exporters' expected revenue in this market (considering the median exporter). This result means that as a share of exporting firms' revenue, search costs are more than three times more relevant.

III. Implications for Trade Flows Across Industries

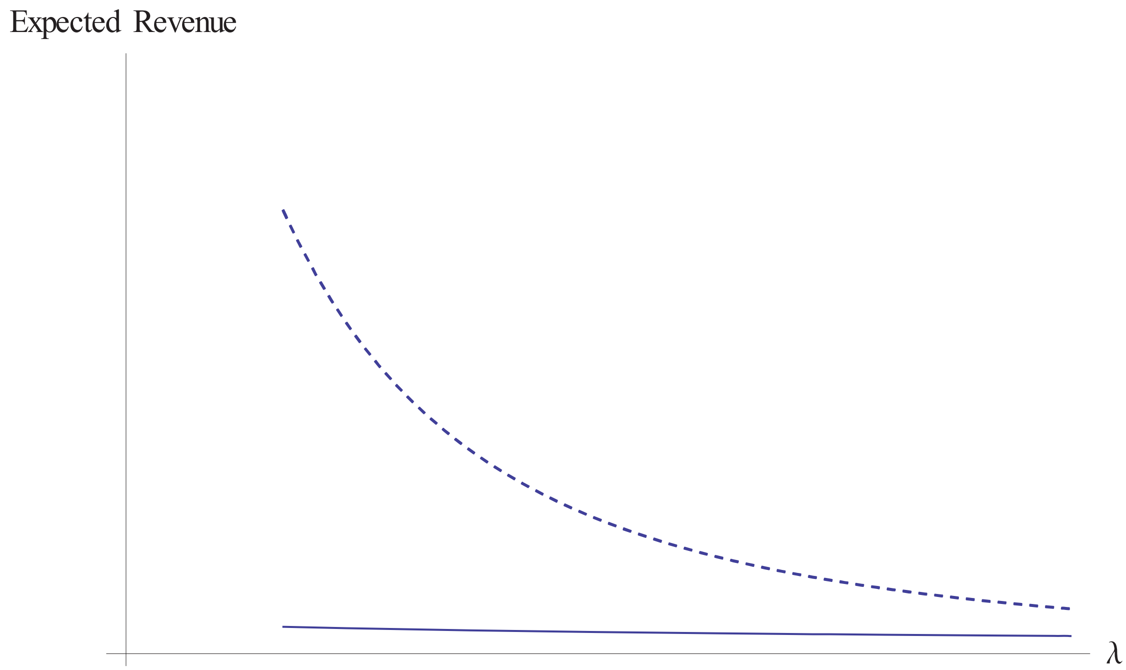
The model predicts that search frictions depress trade flows. The magnitude of this effect depends on the distribution-intensity of an industry. The negative effect of search frictions on trade flows is stronger for distribution-intensive industries. This section explores the effect of search frictions on trade flows across industries. The empirical work in this section is based on partial equilibrium results of a multi-country and multi-industry interpretation of the model.

III.A Mechanism

Search costs impact aggregate trade flows at the intensive margin. Exporters facing large search costs search less and are matched, on average, to less productive importers. This reduces their volume of sales. The negative effect of search costs on trade flows at the intensive margin is strengthened when products are intensive in distribution services. When the distribution is unimportant, there are few incentives to firms to respond to variation in search costs. In this case we are back to the Melitz (2003) model in which firms' exports depend on distance only through transport costs. This is illustrated in figure III.1.

Figure III.1: The Effect of Search Costs on Producers' Revenue depends on Distribution Intensity.

$v = \frac{1}{4}$ dashed line $\qquad$ $v = \frac{3}{4}$ solid line



Notes: This graph represents the relationship between search costs λ and the expected revenue of a producer of productivity θ_P (held constant in this graph). The dashed line shows the relationship for a product for which distribution is relatively important compared to production. In the solid line, distribution is unimportant, and the negative effect of search costs on the producer's revenue is lower. In other words, the dashed line has a steeper slope.

If an additional fixed cost of exporting is included to generate an export productivity cutoff, as in section II, search costs also have an effect on the extensive margin. High search costs reduce the number of exporting firms.

III.B Empirical Strategy

As discussed by Rauch (1999), it seems reasonable to think that search costs increase with geographical and cultural distance. This is consistent with the results in section II. However, the effect of distance on trade flows can represent several frictions at the same time. First, transport costs are increasing in distance. Second, as Rauch (1999) argued, distance can be a measure for search costs, together with language, colonial ties and other elements. Third, distance can be related to endowment-driven comparative advantage. Countries that are close together often produce similar goods, and export them to distant countries that do not.[24] Taking distance as a proxy for search costs, my model suggests that the exports of a given firm should fall with distance, but empirically, it is difficult to disentangle search costs from other elements represented by distance. For this reason, I focus on the different effect of distance on trade flows across products. The prediction to be tested is that in industries intensive in distribution services, the elasticity of trade flows to distance is larger.

III.C Measuring Distribution Margins

The variation in the importance of distribution across products can be measured using input-output tables. Wine, for example, has a distribution margin of 0.44% (measured at purchaser prices). This means that for every dollar paid by a final consumer for a bottle of wine, 44 cents go to distribution (wholesaling and retailing).

I compute distribution margins using the Input-Output table of the economy of the United States in 2002, provided by the BEA. Distribution margins have been used to study exchange rate passthrough by Goldberg and Campa (2010) and others. I use a concordance also provided by the BEA to map the computed margins from the codes used in the Input-Output table to 10-digit HS codes. I calculate distribution margins for the set of products that are destined for final consumers (or personal consumption expenditures in the terminology of the IO table). I obtain distribution margins for 200 different product categories. Some examples are provided in the Appendix.

III.D Results Based on Firm Level Export Transactions

I first test the prediction that the effect of distance on trade flows is more significant in distribution intensive industries using data on the export transactions of individual firms across destinations. I use data on the exports of Chilean firms in 2010. The data is described in the Appendix.

In equation 3.1 the exports of product p by firm f to destination d depend on distance and characteristics of the destination country (GDP, GDP per capita, remoteness and

[24] Countries that are close-by often have a comparative advantage in the same or similar industries. In Chile, endowment-driven comparative advantage could be a strong reason for trade. An example of this argument is that Chile is more likely to sell grapes, apples and berries to the U.S. and Europe than to neighboring Argentina which is similar to Chile in terms of development and climate.

landlockedness). I observe transport costs and control for them in the regression. I include an interaction term between the distance to a destination and the distribution margin of a product to capture the mechanism in the theory. The prediction of the model is that β_6 is negative. I include firm fixed effects, which means β_6 is identified by the variation across products and within firms of the effect of distance on exports.

$$log(value)_{pfd} = \beta_1 \cdot transport\, costs_{pfd} + \beta_2 \cdot distance_d + \beta_3 \cdot GDP_d + \beta_4 \cdot GDPPC_d +$$

$$\beta_5 \cdot margin_p + \beta_6 \cdot distance_d \cdot margin_p + \beta_7 \cdot remoteness_d + \beta_8 \cdot landlocked_d + \mu_f + \epsilon_{pfd} \quad (3.1)$$

It is important to take into account that firms select into markets based on their own characteristics as well as market characteristics. This can be understood as a situation with corner solution responses: some firms export zero to some destinations. I am interested in calculating the effect of distance on $E[log(value)_{pfd}|value_{pfd} > 0]$. This expectation is not equal to the linear predictor, which is the reason why OLS estimation is not adequate. I use the two-stage procedure by Heckman to correct equation 3.1.[25]. The first stage consists of an entry equation, using a probit model to estimate the probability of entry into a market.[26] For each firm-product observation with positive exports, I construct the set of all possible destinations, and define the dependent variable in the first stage equation as a dummy indicating entry. The first stage equation is the following

$$Pr(value_{pfd} > 0) = \gamma_0 + \gamma_1 \cdot distance_d + \gamma_2 \cdot GDP_d + \gamma_3 \cdot GDPPC_d + \gamma_4 \cdot margin_p$$

$$+\gamma_5 \cdot distance_d \cdot margin_p + \gamma_6 \cdot remoteness_d + \gamma_7 \cdot landlocked_d + \epsilon_{pfd} \quad (3.2)$$

I do not include the transport cost variable in the entry equation because it is a observed only for non-zero flows. The second stage is identical to equation 3.1 but augmented with a term for the estimated inverse Mills ratio from the first stage, $\hat{\beta_\lambda} \cdot \hat{\lambda}_{pfd}$, which means that identification relies on functional form. In both the OLS and the two-stage estimations, I

[25]This use of the Heckman procedure, and the reason why it is appropriate to study corner solution responses, is discussed in detail by Wooldridge (2010) (see chapter 18)

[26]The alternative of estimating a tobit model is not a good solution in this case: in a tobit model the effect of the independent variables on entry and on the value exported are not independent.

cluster standard errors by destination country, exporting firm and product, acknowledging that these dimensions are non-nested. Cameron, Gelbach and Miller (2011) explain the details of how to compute them. For clustering purposes, product groups are defined by the original categories of the input-output table used to calculate distribution margins.

The results of the OLS estimation, reported in the first column of table III.1, are consistent with the model and show that β_6 is in fact negative and has a relevant magnitude. The effect of transport costs on exported value is negative. Once I control for transport costs, the effect of distance on trade flows is positive for sectors in which the distribution margin is small. This could be due to the argument on the relationship between endowment-driven comparative advantage and distance discussed above. For products with large distribution margins, distance has a slightly negative effect on trade flows at the intensive margin.

In the two-stage estimation, the interaction effect between distance and distribution margins is not equal to β_6. Instead, one should include an interaction term in both the first and the second stage and calculate the interaction effect as shown by Frondel and Vance (2012).

$$\frac{dE[log(value)_{pfd}|value_{pfd} > 0]}{ddistance_d} = \hat{\beta}_2 + \hat{\beta}_6 \cdot \cdot margin_p + \hat{\beta}_\lambda \cdot \hat{\lambda}'_{pfd}(\vec{\hat{\gamma}} \cdot \vec{\hat{x}}) \cdot (\hat{\gamma}_1 + \hat{\gamma}_5 \cdot margin_p) \quad (3.3)$$

where $\vec{x}$ stands for the vector of independent variables in the first stage.

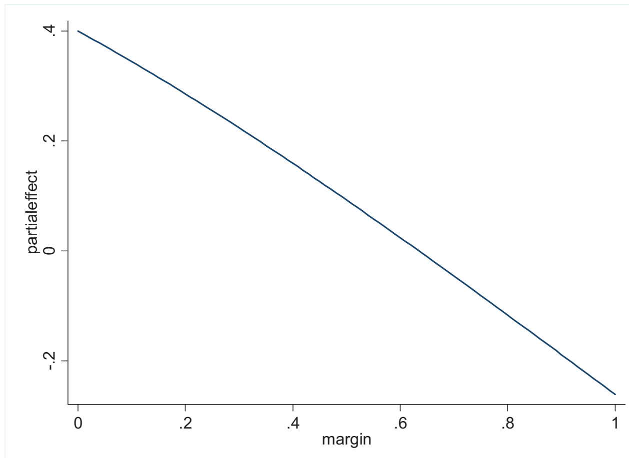
In table III.1 I report the estimated coefficients for the second stage including the inverse Mills ratio from the first stage. I calculate the derivative of (log) exported value with respect to (log) distance for positive trade flows and evaluate it across all values of distribution margins in my sample. I evaluate the other variables at their means. I show graphically in figure III.1 how this partial effect varies with distribution margins. The two-stage estimation shows results of the same nature than the OLS estimation: there is a relevant interaction between distance and distribution margins, which I interpret as evidence of search costs.

Table III.1: The effect of distance on exported value depends negatively on distribution margins. Estimation of equations 3.1 and 3.2.

	OLS		Heckman Second Stage		Heckman First Stage Probit	
Log Transport Cost	-0.3581	***	-0.3565	***		
	0.08129		0.08064			
Log Distance	0.39707	*	0.39583	*	0.01667	
	0.24209		0.23907		0.03795	
Log GDP	0.071	*	0.04148		0.07306	***
	0.03983		0.18733		0.00197	
Log GDP per capita	0.08999	*	0.09951		-0.015	***
	0.05426		0.09139		0.00319	
Log Remoteness	0.03276		0.06893		-0.0677	***
	0.08715		0.26708		0.00643	
Landlockedness	-0.2203		-0.2108		-0.0355	**
	0.14831		0.15356		0.0169	
Distribution Margin	2.8914		1.43647		4.00891	***
	5.48923		10.0959		0.80699	
Distribution Margin x Log Distance	-0.5981		-0.4149		-0.4952	***
	0.62325		1.26188		0.08712	
Inverse Mills Ratio			-0.1115			
			0.64774			
Firm Fixed Effects	Yes		Yes		No	
					Pseudo R-squared	
R-squared within	0.0532		0.0532		0.3918	
Observations	272061		272061		1282989	

*Notes: The first column on the left shows the estimation of equation 3.1 using OLS. The second column shows the estimation of the second stage of the two-stage Heckman procedure, which is equation 3.2 augmented with the estimated inverse Mills ratio from the first stage. The third column shows the results of the estimation of the first stage probit (equation 3.2), reporting marginal effects. Standard errors are reported under the estimated coefficients. Errors are clustered by firm, destination, and product using the original product categories of the input-output table used to calculate distribution margins. The calculation of these clustered standard errors takes into account that the dimensions by which I cluster are non-nested, as explained by Cameron, Gelbach and Miller (2011). ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.*

Figure III.1: The effect of distance on trade flows depends negatively on distribution margins.



Notes: This graph shows the partial effect of distance on exported value for different values of the distribution margins, as calculated in equation 3.3. In the data, distribution margins go from 0.14 to 0.75 so this figure includes some out of sample values on both ends. Following the recommendation of Greene (2010) on how to report interaction effects in non-linear models, I compute the standard errors for the estimated coefficients, but not for this partial effect of distance on exports.

III.E Results Based on U.S. Product Level Export Data

In this subsection I include an additional test, using product level data on U.S. exports. The data is described in the Appendix. I estimate a first stage selection equation for the probability that the U.S. exports product p to destination d:

$$Pr(value_{pd} > 0) = \gamma_0 + \gamma_1 \cdot distance_d + \gamma_2 \cdot GDP_d + \gamma_3 \cdot GDPPC_d + \gamma_4 \cdot margin_p$$

$$+\gamma_5 \cdot distance_d \cdot margin_p + \gamma_6 \cdot remoteness_d + \gamma_7 \cdot landlocked_d + \epsilon_{pd} \qquad (3.4)$$

I use the inverse Mills ratio $\hat{\lambda_{pd}}$ from the first stage to estimate the following second stage equation:

$$log(value)_{pd} = \beta_1 \cdot transport\,costs_{pd} + \beta_2 \cdot distance_d + \beta_3 \cdot GDP_d + \beta_4 \cdot GDPPC_d +$$

$$\beta_5 \cdot margin_p + \beta_6 \cdot distance_d \cdot margin_p + \beta_7 \cdot remoteness_d + \beta_8 \cdot landlocked_d + + \beta_\lambda \cdot \hat{\lambda_{pd}} + \epsilon_{pfd} \quad (3.5)$$

The results of the estimation of equations (3.4) and (3.5) are reported in table III.2. As in subsection III.D, I am interested in the second derivative of $E[log(value)_{pd}|value_(pd) > 0]$ with respect to *distance* and *margin*. This derivative is reported in table III.3. The negative sign indicates that the elasticity of trade flows to distance is more negative in industries which are distribution-intensive, confirming the earlier findings obtained from the firm-level estimation.

Table III.2: Estimation of equations 3.4 and 3.5.

	OLS		Heckman Second Stage		Heckman First Stage Probit	
Log Distance	-0.33038	*	-0.95567	***	-0.0864	***
	0.17062		0.11448		0.003044	
Log GDP	0.452774	***	1.030859	***	0.068963	***
	0.03981		0.08803		0.00017	
Log GDP per capita	0.023264		0.285066	***	0.02809	***
	0.03187		0.05397		0.000284	
Log Remoteness	0.235442	***	0.934082	***	0.085911	***
	0.09024		0.12923		0.000615	
Landlockedness	-0.20544	*	-0.98569	***	-0.06616	**
	0.12105		0.13752		0.001055	
Distribution Margin	1.704481		3.976228	*	0.445884	***
	1.6191		2.36361		0.059846	
Distribution Margin x Log Distance	-0.39361	**	-0.48016	*	-0.031	***
	0.18461		0.24882		0.006723	
Inverse Mills Ratio			2.87615	***		
			0.39226			
					Pseudo R-squared	
R-squared	0.165		0.1749		0.2361	
Observations	264433		264433		1227776	

*Notes: The first column on the left shows the estimation of equation 3.5 using OLS. The second column shows the estimation of the second stage of the two-stage Heckman procedure, which is equation 3.5 augmented with the estimated inverse Mills ratio from the first stage. The third column shows the results of the estimation of the first stage probit (equation 3.4), reporting marginal effects. Standard errors are reported under the estimated coefficients. Errors are clustered by firm, destination, and product using the original product categories of the input-output table used to calculate distribution margins. The calculation of these clustered standard errors takes into account that the dimensions by which I cluster are non-nested, as explained by Cameron, Gelbach and Miller (2011). ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.*

Table III.3: Second Derivative of $E[log(value)_{pd}|value_(pd) > 0]$ with respect to Distance and Distribution Margins. .

Second Derivative	-0.2416 **
Std Error	0.11696

*Notes: This table shows the value of of the second derivative of $E[log(value)_{pd}|value_(pd) > 0]$ wiith respect to log(distance) and margin, evaluated at the means. The standard error is bootstrapped using 100 repetitions and clustered using the original product categories of the input-output table used to calculate distribution margins. . ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.*

IV. Conclusions

Trade frictions influence the matching and sorting of exporting and importing firms. This is a previously unexplored mechanism through which geography impacts trade flows.

The model developed in chapter 1 was put to work in this chapter to quantify these effects. Section II shows how the parameters of the model, including search costs between countries, can be estimated using either matched exporter-importer data or more standard firm-level export data. The estimated model is used to quantify the response of firms to trade liberalization. As ad-valorem trade costs fall firms increase their exports both due to the direct effect of a higher demand and because of their higher expenditure in search that allows them to find more productive importers. The estimation procedure also allows the estimated search costs to be a function of geographic characteristics, such as distance and linguistic differences between countries. I find search costs to be increasing in distance and larger when destination countries speak a different language than the source country. The estimated search costs are large: I compare them with transport costs observed in the data and find them to be on average three times as large as a fraction of exporters' revenue. I also find evidence, consistent with the model, that the effect of search costs on trade flows varies across industries. This effect is stronger for industries in which distribution is relatively more important compared to production.

References

AHN, J., KHANDELWAL, A. AND S. WEI (2011): "The role of intermediaries in facilitating trade," Journal of International Economics, 84(1), 73-85.

ALLEN, T. (2012): "Information Frictions in Trade," Working paper.

ANDERSON, J., AND E. VAN WINCOOP (2004): "Trade costs," Journal of Economic Literature, 42(3), 691-751.

ANTRAS, P. AND A. COSTINOT (2011): "Intermediated Trade,' 'Quarterly Journal of Economics, 126, 1319-1374.

ARKOLAKIS, C. (2010): "Market Penetration Costs and the New Consumers Margin in International Trade," Journal of Political Economy, 118 (6), 1151-1199.

BERGER, D., FAUST, J., ROGERS, J., AND STEVERSON, K. (2012), "Border Prices and Retail Prices," Journal of International Economics, 88, 62-73.

BERNARD, A., AND JENSEN, B. (1995), "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987," Brookings Papers on Economic Activity. Microeconomics, Vol. 1995 (1995), pp.67-119

BERNARD, A., JENSEN, B., REDDING, S., AND SCHOTT, P., (2007): "Firms in International Trade," Journal of Economic Perspectives. 21(3): 105-30.

BERNARD, A., B. JENSEN, S. REDDING AND P. SCHOTT. (2011): "The Empirics of Firm Heterogeneity and International Trade," Working paper.

BERNARD, A., M. GRAZZI, AND C. TOMASI. (2011): "Intermediaries in International Trade: Direct versus Indirect Modes of Export,' 'Working paper.

BERNARD, A., A. MOXNES, AND K. ULLTVEIT-MOE. (2013): "Two-Sided Heterogeneity and Trade," Working paper.

BLUM, B., S. CLARO, AND I. HORSTMANN (2010): "Facts and figures on intermediated trade," The American Economic Review Papers & Proceedings, 100 (2), 419 - 423.

BLUM, B., S. CLARO, AND I.HORSTMANN (2012): "Intermediation and the nature of trade costs," Working paper.

BRICOUT, J. (1991): "Exporter : une question de taille," Economie et statistique, N244, pp. 25-33.

BUSTOS, P. (2011):"Trade Liberalization, Exports, and Technology Upgrading:Evidence on

the Impact of MERCOSUR on Argentinian Firms," American Economic Review 101:304-340.
CAMERON, C., J. GELBACH, AND D. MILLER (2011):"Robust Inference with Multi-way Clustering," Journal of Business and Economic Statistics, 29 (2), 238-249.
CARBALLO, J., G. OTTAVIANO, AND C. VOLPE-MARTINCUS (2013): "The buyer margins of firms' exports," Working Paper.
CHANEY, T. (2011a):"The gravity equation in international trade: An explanation," Working paper.
CHANEY, T. (2011b):"The network structure of international trade," Working paper.
EATON, J. AND S. KORTUM (2002):"Technology, geography, and trade," Econometrica, 70(5),1741-1779.
EATON, J., M. ESLAVA, C. KRIZAN, M.KUGLER, AND J.TYBOUT (2011):"A search and learning model of export dynamics," Working paper.
FELBERMAYR, B. AND JUNG, B. (2011): "Home Market Effects and the Single-Sector Melitz Model," Working Paper.
FRONDEL, M. AND C. VANCE (2012): "On Interaction Effects: The case of Heckit and Two Part Models," Working Paper.
GOLDBERG, L. AND CAMPA, J. (2010): "The Sensitivity of the CPI to Exchange Rates: Distribution Margins, Imported Inputs, and Trade Exposure," The Review of Economics and Statistics, 92(2), 392407.
GLEJSER, H., JACQUEMIN, A., PETIT, J., (1980): "Exports in an Imperfect Competition Framework: An Analysis of 1,446 Exporters," The Quarterly Journal of Economics, Vol. 94, No. 3 (May, 1980), pp. 507-524
GREENE, W. (2010): "Testing Hypotheses about Interaction Terms in Nonlinear Models," Economic Letters, 107, 291-296.
GROSSMAN, G., AND MAGGI, G., (2000), "Diversity and Trade", American Economic Review, 90(5), 1255-1275.
HELPMAN, E., MELITZ, M., AND RUBINSTEIN, Y., (2008), "Estimating Trade Flows: Trading Partners and Trading Volumes, Quarterly Journal of Economics, 123(2), 441-487.
KNELLER, R., AND M.PISU (2011): "Barriers to Exporting: What are they and who do they matter to?," The World Economy, 34(6), 893-930.
KREMER, M. AND MASKIN, E. (2006), "Globalization and Inequality," Working Paper.
KRUGMAN, P. New York Times blog: http://krugman.blogs.nytimes.com/2013/02/10/the-death-of-protectionism/
MELITZ, M., (2003):"The Impact of Trade on Intra-Industry Reallocations and Aggregate

Industry Productivity," Econometrica, 71(6), 1695-1725.
MELITZ, M., AND OTTAVIANO, G., (2008): "Market Size, Trade and Productivity," Review of Economic Studies, 75(1), 295-316.
MILGROM, P. AND ROBERTS, J., (1990): "The Economics of Modern Manufacturing: Technology, Strategy and Organization," American Economic Review, 80(3), 511-528.
MORALES, E., SHEU, G., AND ZAHLER, A., (2011), "Gravity and Extended Gravity: Estimating a Structural Model of Export Entry," Working Paper.
OHLIN, B., (1933), "Interregional and international trade," (Harvard University Press).
RAUCH, J. (1996): "Trade and Search: Social Capital, Sogo Shosha, and Spillovers,' 'Working paper.
RAUCH, J. (1999): "Networks versus markets in international trade," Journal of International Economics, 48(1), 7-35.
REDDING, S., (2011), "Theories of Heterogeneous Firms and Trade," Annual Review of Economics, 3, 77-105.
STIGLER, G. (1961): "The Economics of Information," The Journal of Political Economy, 69(3), 213-225.
TINBERGEN, J. (1962) "Shaping the World Economy: Suggestions for an International Economic Policy, New York.
TIROLE, J, (1988) "The Theory of Industrial Organization, The MIT PRESS.
WOOLDRIDGE, J. (2010):"Econometric Analysis of Cross Section and Panel Data," MIT Press, Second Edition.

A. Empirical Appendix

A.1 Descriptive Statistics for Matched Exporter-Importer Data used in Section II of Chapter One

The following table presents descriptive statistics for the dataset used in section II.

Table A.1: Descriptive Statistics for the data on French exporters and Colombian importers.

	Mean	Standard Deviation	Min	Max
(log) Traded Value	10.24	2.223	0.336	17.17
(log) Revenue Exporter	17.41	2.046	10.3	24.19
(log) Revenue Importer	17.56	1.941	11.74	22.74

A.2 Descriptive Statistics for Section IV of Chapter One.

The following table presents descriptive statistics for the dataset used in section IV.

Table A.2: Descriptive Statistics for the data on US exporters and Colombian importers.

	Mean	Standard Deviation	Min	Max
Change in Exports	0.01	2.124	-11.08	13.82
Switch	0.392	0.488	0	1
Change in Tariff	8.034	4.97	0.0002	20
(log) Exports f,t-1	9.85	2.131	0.693	17.81
Interaction	77.84	50.48	0.003	318.6

Notes: This table shows descriptive statistics for the data used in the estimation of equations 4.1 and 4.2.

A.3 Firm-level Export Transactions from Chile

The dataset of exports of Chilean firms contains the identity of the exporter, the country of destination, an 8-digit HS code identifying the product exported, and the value exported in each transaction. This data has been used, for example, by Morales, Zahler and Sheu (2011). This dataset also includes the transport cost paid to deliver a shipment to a destination country.

Table A.3: Descriptive Statistics for the dataset on Chilean wine exporters

Destination	Number of exporters	Log Revenue Mean	Log Revenue Min	Log Revenue Max	Distance	Language
United States	179	12.198	5.148	17.820	0.827	0
China	178	11.821	6.957	16.820	1.908	0
United Kingdom	152	12.246	6.857	17.637	1.169	0
Brazil	151	11.641	7.172	16.325	0.259	0
Germany	146	11.580	7.737	16.262	1.210	0
Canada	135	11.375	5.704	16.566	0.863	0
Japan	117	12.175	5.318	16.470	1.725	0
South Korea	116	11.073	7.313	15.025	1.838	0
Denmark	115	11.447	6.735	16.104	1.264	0
Netherlands	112	11.798	6.620	15.907	1.203	0
Mexico	110	10.976	5.822	16.285	0.662	1
Belgium	108	11.190	5.317	15.753	1.190	0
Hong Kong	99	10.783	7.714	14.086	1.870	0
Vietnam	82	10.866	7.090	13.457	1.860	0
France	79	11.212	7.194	15.625	1.166	0
Colombia	79	10.961	8.086	14.924	0.427	1
Ireland	79	11.882	8.189	16.235	1.148	0
Russia	77	11.807	6.985	15.858	1.415	0
Poland	69	10.918	6.888	14.797	1.300	0
Singapore	68	10.399	7.003	13.797	1.640	0
Finland	60	11.630	3.246	15.714	1.350	0
Sweden	58	11.379	7.237	16.024	1.310	0
Switzerland	53	11.093	8.191	14.445	1.187	0
Costa Rica	53	10.187	7.977	15.384	0.504	1
Czech Republic	52	10.427	7.190	14.269	1.249	0
Thailand	51	10.290	7.202	12.759	1.766	0
Peru	49	10.317	2.303	14.914	0.247	1
Uruguay	46	10.823	7.730	15.177	0.134	1
Venezuela	46	11.379	8.124	14.656	0.492	1
Malaysia	40	10.411	8.455	13.471	1.656	0

Notes: This table shows descriptive statistics for the data used in the estimation of the parameters of the model in section IVB. The second column shows the number of wine exporters that exported a positive amount to each of the 30 destinations in 2010. The third, fourth and fifth column show the average, minimum and maximum of log revenue across firms and within destinations. The last two columns show the distance from Chile to each destination in (kilometers/10000) and the language dummy which is positive for Spanish speaking countries.

The following table shows descriptive statistics for the estimation of equations 3.1 and 3.2 in section III of Chapter Two.

Table A.4: Descriptive Statistics for the dataset on Chilean firms' export transactions.

	Mean	Standard Deviation	Min	Max
Log Distance	8.819	0.807	7.028	9.856
Log GDP	6.580	2.128	-1.952	9.584
Log GDP per capita	9.586	1.109	5.225	11.567
Log Remoteness	-2.814	0.620	-4.093	-1.698
Landlockedness	0.067	0.249	0.000	1.000
Log Transport Cost	-2.453	1.322	-10.219	0.000
Distribution Margin	0.407	0.062	0.145	0.751
Log Exported Value	8.631	1.880	-1.609	14.505

A.4 U.S. Product-level Exports.

These are the descriptive statistics for the data on U.S. product level exports used in section VII. The data correspond to 2005 and were obtained from Peter Schott's website.

Table A.5: Descriptive Statistics for the dataset on U.S. product level exports.

	Mean	Standard Deviation	Min	Max
Log Distance	8.79157	0.64257	6.307	9.69155
Log GDP	4.76859	2.06881	-3.8167	8.42768
Log GDP per capita	8.99693	1.38049	5.00495	11.3042
Log Remoteness	-2.1715	0.76233	-3.8578	-1.0475
Landlockedness	0.06387	0.24453	0	1
Distribution Margin	0.44817	0.09024	0.14512	0.75131
Log Exported Value	11.2944	2.22688	7.82445	22.2315

A.5 Distribution margins.

I measured distribution margins following Campa and Goldberg (2010) (who study exchange rate pass-through) and a BEA document. A distribution margin at purchaser prices for a product is 0.6 means that for each dollar spent by consumers in this product, 60 cents go to distribution (retailing and wholesaling) of the finished product. I measure this for 198 sectors that according to the IO table are destined for final consumers. The BEA has a concordance between IO codes and HS codes. Table X.3 shows an example of distribution margins measured at purchaser prices for various well known sectors.

Table A.6: Some Examples of Distribution Margins.

Industry	Distribution Margin
Motor home manufacturing	0.23
Flavoring syrup and concentrate manufacturing	0.27
Automobile manufacturing	0.29
Breakfast cereal manufacturing	0.35
Chocolate and confectionery manufacturing from cacao beans	0.35
Cookie, cracker, and pasta manufacturing	0.37
Book publishers	0.39
Wineries	0.44
Pharmaceutical preparation manufacturing	0.45
Coffee and tea manufacturing	0.46
Men's and boys' cut and sew apparel manufacturing	0.49
Sporting and athletic goods manufacturing	0.54
Footwear manufacturing	0.58
Telephone apparatus manufacturing	0.62

B. Theory Appendix

B.1 Solution to the Producer's Problem

Producers maximize their expected profits choosing an optimal search intensity n. Consider the case of a producer in Home of productivity θ_{PH} searching for a distributor in Foreign. The maximization problem is the following:

$$max_n \int_0^\infty f_{max}^n(\theta_{DF})\pi_{PH}^{Hf}(\theta_{PH},\theta_{DF})d\theta_{DF} - w_H \cdot \lambda \cdot n$$

The first term in this equation represents the expected operating profits for the producer obtained from a trading relationship with a distributor of productivity θ_{DF}, given a search effort n. The integrand is the probability of being matched with a certain distributor times the operating profits that the producer obtains from the relationship. The second term is the cost of the search effort.

I can rewrite the maximization problem after replacing these terms as:

$$max_n \; Z^{Hf} \cdot \theta_{PH}^{\epsilon \cdot v-1} \cdot \int_0^\infty \gamma \cdot n \cdot \theta_{DF}^{-\gamma-1} \cdot e^{-n \cdot \theta_{DF}^{-\gamma}} \cdot \theta_{DF}^{\epsilon \cdot (1-v)} \cdot d\theta_{DF} - w_H \cdot \lambda \cdot n$$

To evaluate the integral, define $t = n \cdot \theta_{DF}^{-\gamma}$ and integrate in terms of t. The maximization problem is:

$$max_n \; Z^{Hf} \cdot \theta_{PH}^{\epsilon \cdot v-1} \cdot \int_0^\infty n^b \cdot t^{-b} \cdot e^{-t} \cdot dt - w_H \cdot \lambda \cdot n$$

Note that

$$\int_0^\infty n^b \cdot t^{-b} \cdot e^{-t} \cdot dt = n^b \cdot \int_0^\infty t^{-b} \cdot e^{-t} \cdot dt = n^b \cdot R$$

with $R = \Gamma(1-b)$ and $b = \frac{\epsilon \cdot (1-v)}{\gamma}$.

The maximization problem is then

$$max_n \; (Z^{Hf} \cdot \theta_{PH}^{\epsilon \cdot v-1} \cdot R \cdot n^b - \lambda \, w_H \, n)$$

the solution of which is

$$n^*(\theta_{PH}, Z^{Hf}, \lambda) = k \cdot \left(\frac{Z_{Hf} \cdot \theta_{PH}^{\epsilon \cdot v-1}}{\lambda \cdot w_H} \right)^{\gamma/(\gamma - \epsilon \cdot (1-v))},$$

where $k = \left(\frac{\epsilon \cdot (1-v) \cdot \Gamma\left(\frac{\gamma - \epsilon \cdot (1-v)}{\gamma}\right)}{\gamma} \right)^{\gamma/(\gamma - \epsilon \cdot (1-v))}$

B.2 The Case with Nash-Bargaining between Exporters and Importers

In the model discussed in section III, producers set the wholesale price at which they sell to distributors. Based on this price, distributors choose the optimal final price. An alternative way of modeling the interaction between producers and distributors is such that these firms jointly set the final price and bargain over the surplus generated by the trading partnership. This case is briefly discussed below. The results described in section III still hold in this case. In the model below I assume all outside options are zero, so the share of surplus obtained by exporters is always the same. This is unrealistic, but accounting for the selection of firms into trading pairs and the existence of outside options at the same time is a difficult issue beyond the scope of this paper.

Selling to consumers in Foreign requires production and distribution. Exporters must search for a distributor in Foreign. Once an exporter has found and chosen a distributor, the relationship generates profits $\pi_E(\theta_E, \theta_I)$ by producing and distributing the good to the consumers. These profits are split between both parties through Nash bargaining. The exporter receives a share $\beta \cdot \pi_E(\theta_E, \theta_I)$.

Exporters produce differentiated varieties and operate in a context of monopolistic competition. Consumers in Foreign have preferences over the set of varieties described by a utility function with constant elasticity of substitution α. The demand for a firm's variety is then

$$y = A \cdot p_f^{-\epsilon},$$

where $\epsilon = \frac{1}{1-\alpha} > 1$ and the term $A = \frac{I_F}{P_F^{1-\epsilon}}$ determined in equilibrium, combines income and the price index in Foreign.

Production and distribution are necessary to sell a variety to final consumers and are combined in Cobb-Douglas form. The joint cost of these activities is

$$cost = \left(\frac{w_E}{\theta_E}\right)^v \cdot \left(\frac{w_I}{\theta_I}\right)^{1-v}$$

Wages are w_E at Home and w_I at Foreign. Under this framework, the price charged to consumers is a constant markup over the cost, $p = cost/\alpha$. The maximized operating profits of the exporter - distributor relationship are

$$\pi_E(\theta_E, \theta_I) = A \cdot (1-\alpha) \cdot \left(\frac{1}{\alpha} \cdot \left(\frac{w_E}{\theta_E}\right)^v \cdot \left(\frac{w_I}{\theta_I}\right)^{1-v}\right)^{1-\epsilon}$$

Anticipating this, exporters choose their optimal search effort n, solving:

$$max_n \int_0^\infty f_{max}^n(\theta_I) \cdot \beta \cdot \pi_E(\theta_E, \theta_I) d\theta_I - w_E \cdot \lambda \cdot n$$

The first term in this equation represents the expected surplus for the exporter of a trading relationship with an importer θ_I, given a search effort n. The integrand is the probability of being matched with a certain importer times the operating profits that the exporter obtains from the relationship. The second term is the cost of the search effort.

B.3 Solution to the General Equilibrium

Consider first the zero profit conditions for producers in Home. In what follows θ_E represents the productivity of an exporter (producer) and θ_I the productivity of an importer (distributor). For notational simplicity I omit some of the subindices present in the main text.

$$\int_0^\infty \int_0^\infty \left(Z^{HH} \theta_E^{\epsilon v-1} \theta_I^{\epsilon(1-v)} - \lambda w_H n^*(\theta_E, Z^{HH}, \lambda w_H)\right) f_{max}^{n^*(\theta_E, Z^{HH}, \lambda w_H)}(\theta_I) f(\theta_E)\, d\theta_I\, d\theta_E +$$
$$\int_0^\infty \int_0^\infty \left(Z^{HF} \cdot \theta_E^{\epsilon v-1} \theta_I^{\epsilon(1-v)} - \lambda w_H n^*(\theta_E, Z^{HF}, \lambda w_H)\right) f_{max}^{n^*(\theta_E, Z^{HF}, \lambda w_H)}(\theta_I)\, f(\theta_E)\, d\theta_I\, d\theta_E$$
$$= w_H\ F_H \quad (1)$$

and for producers in Foreign:

$$\int_0^\infty \int_0^\infty \Big(Z^{FF}\, \theta_E^{\epsilon\, v-1} \cdot \theta_I^{\epsilon\,(1-v)} - \lambda\, w_F\, n^*(\theta_E, Z^{FF}, \lambda\, w_F)\Big)\; f_{max}^{n^*(\theta_E, Z^{FF}, \lambda\, w_F)}(\theta_I)\, f(\theta_E)\, d\theta_I\, d\theta_E +$$

$$\int_0^\infty \int_0^\infty \Big(Z^{FH}\, \theta_E^{\epsilon\, v-1} \cdot \theta_I^{\epsilon\,(1-v)} - \lambda\, w_F \cdot n^*(\theta_E, Z^{FH}, \lambda\, w_F)\Big) \cdot f_{max}^{n^*(\theta_E, Z^{FH}, \lambda\, w_F)}(\theta_I)\, f(\theta_E)\, d\theta_I\, d\theta_E$$

$$= w_F\; F_F \quad (2)$$

where

$$Z^{HH} = \frac{w_H \cdot L_H \cdot \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1}\right)^{-\epsilon \cdot v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right) \cdot w_H^{1-\epsilon \cdot v} \cdot w_H^{-\epsilon \cdot (1-v)}}{P_H^{1-\epsilon}}$$

$$Z^{HF} = \frac{w_F \cdot L_F \cdot \tau^{1-\epsilon v} \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1}\right)^{-\epsilon \cdot v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right) \cdot w_H^{1-\epsilon \cdot v} \cdot w_F^{-\epsilon \cdot (1-v)}}{P_F^{1-\epsilon}}$$

$$Z^{FH} = \frac{w_H \cdot L_H \cdot \tau^{1-\epsilon v} \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1}\right)^{-\epsilon \cdot v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right) \cdot w_F^{1-\epsilon \cdot v} \cdot w_H^{-\epsilon \cdot (1-v)}}{P_H^{1-\epsilon}}$$

$$Z^{FF} = \frac{w_F \cdot L_F \cdot \left(\frac{\epsilon \cdot v}{\epsilon \cdot v - 1}\right)^{-\epsilon \cdot v} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right)^{-\epsilon} \cdot \left(\frac{\epsilon}{\epsilon - 1}\right) \cdot w_F^{1-\epsilon \cdot v} \cdot w_F^{-\epsilon \cdot (1-v)}}{P_F^{1-\epsilon}}$$

After some algebra, the zero profit conditions for producers in Home and Foreign can be written as:

$$Z^{HH^\delta} \cdot \int_0^\infty \int_0^\infty S \cdot \theta_E^{\delta \cdot (\epsilon \cdot v - 1)} \cdot \lambda^{\delta - 1} \cdot f(\theta_E) \cdot d\theta_E +$$

$$Z^{HF^\delta} \cdot \int_0^\infty \int_0^\infty S \cdot \theta_E^{\delta \cdot (\epsilon \cdot v - 1)} \cdot \lambda^{\delta - 1} \cdot f(\theta_E) \cdot d\theta_E = w_H \cdot F_H \quad (3)$$

and for producers in Foreign:

$$Z^{FF^\delta} \cdot \int_0^\infty \int_0^\infty S \cdot \theta_E^{\delta \cdot (\epsilon \cdot v - 1)} \cdot \lambda^{\delta - 1} \cdot f(\theta_E) \cdot d\theta_E +$$

$$Z^{FH^\delta} \cdot \int_0^\infty \int_0^\infty S \cdot \theta_E^{\delta \cdot (\epsilon \cdot v - 1)} \cdot \lambda^{\delta - 1} \cdot f(\theta_E) \cdot d\theta_E = w_F \cdot F_F \quad (4)$$

This is a linear system for $P_H^{\delta \cdot (\epsilon - 1)}$ and $P_F^{\delta \cdot (\epsilon - 1)}$. I obtain expressions for these price indices as functions of the wages. The terms S and δ group a number of parameters.

Next consider the equations for the price indices in Home and Foreign.

In Home:

$$P_H^{1-\epsilon} = M_H \cdot K \cdot w_H^v \cdot w_H^{1-v} \cdot \int_0^\infty \int_0^\infty \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot f_{max}^{n^*(\theta_E, Z^{HH}, \lambda\cdot w_H)}(\theta_I) \cdot f(\theta_E) \cdot d\theta_I \cdot d\theta_E + \\ M_F \cdot K \cdot w_F^v \cdot w_H^{1-v} \cdot \int_0^\infty \int_0^\infty \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot f_{max}^{n^*(\theta_E, Z^{FH}, \lambda\cdot w_F)}(\theta_I) \cdot f(\theta_E) \cdot d\theta_I \cdot d\theta_E \quad (5)$$

In Foreign:

$$P_F^{1-\epsilon} = M_H \cdot K \cdot w_H^v \cdot w_F^{1-v} \cdot \int_0^\infty \int_0^\infty \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot f_{max}^{n^*(\theta_E, Z^{HF}, \lambda\cdot w_H)}(\theta_I) \cdot f(\theta_E) \cdot d\theta_I \cdot d\theta_E + \\ M_F \cdot K \cdot w_F^v \cdot w_F^{1-v} \cdot \int_0^\infty \int_0^\infty \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot f_{max}^{n^*(\theta_E, Z^{FF}, \lambda\cdot w_F)}(\theta_I) \cdot f(\theta_E) \cdot d\theta_I \cdot d\theta_E, \quad (6)$$

where I have used $K = \frac{\epsilon}{\epsilon-1} \cdot \left(\frac{\epsilon v}{\epsilon v-1}\right)^v$.

The equations for the price index in Home and Foreign are a linear system in terms of the mass of producers in Home and Foreign, M_H and M_F. Given that I can find the price indices as functions of the wages from the zero profit conditions, I obtain also expressions for the mass of producers as functions of the wages.Since this is a linear system, this is solved analytically.

Next, I replace these terms in the balanced trade condition, set one wage as the numeraire and solve for the other one. The balanced trade condition is the following.

$$M_H \cdot \int_0^\infty \int_0^\infty Z^{HF} \cdot \epsilon \cdot v \cdot \theta_E^{\epsilon\cdot v-1} \cdot \theta_I^{\epsilon\cdot(1-v)} \cdot f_{max}^{n^*(\theta_E, Z^{HF}, \lambda\cdot w_H)}(\theta_I) \cdot f(\theta_E) \cdot d\theta_I \cdot d\theta_E = \\ M_F \cdot \int_0^\infty \int_0^\infty Z^{FH} \cdot \epsilon \cdot v \cdot \theta_E^{\epsilon\cdot v-1} \cdot \theta_I^{\epsilon\cdot(1-v)} \cdot f_{max}^{n^*(\theta_E, Z^{FH}, \lambda\cdot w_F)}(\theta_I) \cdot f(\theta_E) \cdot d\theta_I \cdot d\theta_E \quad (7)$$

Finally the mass of importers in each country, N_H and N_F is obtained by replacing the solution into the zero profit condition of importers. A useful property of the model is that the mass of importers does not affect the other equilibrium variables.If search were modeled differently, this would not hold.

The zero profit condition for importers in Home is the following. J denotes the cost of entry into importing.

$$\int_0^\infty \int_0^\infty f_{max}^{n^*(\theta_E, Z^{HH}, \lambda\cdot w_H)}(\theta_I)\cdot \frac{1}{N_H \cdot f(\theta_I)} \cdot B_{HH} \cdot \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot M_H \cdot f(\theta_E) \cdot f(\theta_I) \cdot d\theta_I \cdot d\theta_E +$$
$$\int_0^\infty \int_0^\infty f_{max}^{n^*(\theta_E, Z^{FH}, \lambda\cdot w_F)}(\theta_I)\cdot \frac{1}{N_H \cdot f(\theta_I)} \cdot B_{FH} \cdot \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot M_F \cdot f(\theta_E) \cdot f(\theta_I) \cdot d\theta_I \cdot d\theta_E = w_H \cdot J_H \tag{8}$$

In Foreign:

$$\int_0^\infty \int_0^\infty f_{max}^{n^*(\theta_E, Z^{HF}, \lambda\cdot w_H)}(\theta_I)\cdot \frac{1}{N_F \cdot f(\theta_I)} \cdot B_{HF} \cdot \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot M_H \cdot f(\theta_E) \cdot f(\theta_I) \cdot d\theta_I \cdot d\theta_E +$$
$$\int_0^\infty \int_0^\infty f_{max}^{n^*(\theta_E, Z^{FF}, \lambda\cdot w_F)}(\theta_I)\cdot \frac{1}{N_F \cdot f(\theta_I)} \cdot B_{FF} \cdot \theta_E^{(\epsilon-1)\cdot v} \cdot \theta_I^{(\epsilon-1)\cdot(1-v)} \cdot M_F \cdot f(\theta_E) \cdot f(\theta_I) \cdot d\theta_I \cdot d\theta_E = w_F \cdot J_F \tag{9}$$

In these equations,

$$B_{ij} = \frac{w_j \cdot L_j \cdot \left(\frac{\epsilon\cdot v}{\epsilon\cdot v-1}\right)^{1-\epsilon\cdot v} \cdot \left(\frac{\epsilon}{\epsilon-1}\right)^{-\epsilon} \cdot \left(\frac{\epsilon}{\epsilon-1}\right) \cdot w_i^{1-\epsilon\cdot v} \cdot w_j^{1-\epsilon\cdot(1-v)}}{P_j^{1-\epsilon}}$$

The mass of importers in each country is obtained from these equations once the other equilibrium variables have been determined.. This can be done analytically.

This ends the solution to the general equilibrium.

B.4 Proofs to Propositions in section III of Chapter One.

Proof to Proposition I.

That more productive search more is seen by inspection of exporters' optimal search intensity (3.6). Under the restrictions imposed on the parameters, it is verified that the derivative of $n*$ with respect to θ_{PH} is positive.

Proof to Proposition II.

From the expression for an exporter's optimal search intensity, one can see that the search cost parameter λ impacts the exporter's decision both directly and through the price index. From the solution to the general equilibrium, as described in the previous section, one can write the price indices as functions of the wages and the search cost parameter.

Under symmetric trade costs (the case in which I focus), the search cost parameter does not affect the price indices through the wages, only through the direct effect. In this way one can directly calculate the derivative of the price index to the search cost parameter, which is then used to calculate the derivative of the exporter's optimal search intensity with respect to the search cost parameter.

From the explicit solution for P_F and P_H it follows that both P_H and P_F depend on λ as

$$P \approx \lambda^{\frac{1-\delta}{\delta(1-\epsilon)}},$$

where $\delta = \gamma_i/(\gamma_i - \epsilon(1-v))$. From the expression for n^* I know that $n^* \approx (Z/\lambda)^\delta$. Since Z depends on λ through the price indices I obtain that n^* is proportional to $1/\lambda$. Therefore $dn^*/d\lambda < 0$.

Proof to Proposition IV.

I can write the balanced trade condition as a relationship between the relative wage $y = \frac{w_F}{w_H}$ and relative country sizes L_H/L_F as

$$\frac{L_H}{L_F} = H(y)$$

where

$$H(y) = \frac{X(y)^{(1+\delta c)/\delta}}{y^{\delta c}} \frac{\left[1 + \frac{y^r(\tau y)^p}{X(y)}\right]}{\left[(\tau/y)^p + \frac{y^r}{X(y)}\right]}$$

with

$$X(y) = \frac{1 - \tau^\delta (y/\tau)^{\delta\epsilon v}}{1 - \tau^\delta (y\tau)^{-\delta\epsilon v}},$$

$$p = v(1-\epsilon) + \delta c(1 - \epsilon v)$$

and

$$r = \delta[(b-c) + \epsilon(2v-1)] - \delta(1-\epsilon).$$

I can prove that the relationship between relative country size and relative wages is monotonic, that identical countries have identical wages, and that the larger country will have a higher wage.

To prove this, I show that $H(y)$ is a decreasing function of y. The steps of the proof are the following:

First, by taking its derivative I prove that $X(y)$ decreases monotonically with y. Next verify that defining $\mathcal{Z} \equiv y^{(r+p)}/X(y)$ and $\mathcal{Q} \equiv (1+\tau^p \mathcal{Z})/(\tau^p + \mathcal{Z})$ $H(y)$ can be written as

$$H(y) = \frac{X(y)^{(1-\frac{b}{\epsilon})}}{y^{\delta\, v(\epsilon-1)}} \mathcal{Q} \tag{10}$$

where I used that

$$\frac{1+\delta c}{\delta} = 1 - \frac{b}{\epsilon}, \qquad \delta c - p = \delta\, v(\epsilon - 1).$$

Next, verify that $\mathcal{Z}$ increases with y, and that $\mathcal{Q}$ decreases with y.

Finally I see that the above implies that $H(y)$ decreases with y. Effectively, since $X(y), \mathcal{Q}$ and y are positive and, since $1 - b/\epsilon > 0$ the terms in the numerator of (10) decrease with y and the term in the denominator increases with y (because $\epsilon - 1 > 0$). Therefore $H(y)$ decreases with y.