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

Felipe Benguria[†]

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Abstract

This paper 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. I test this theory by studying the response of exporting and importing firms to the recent Colombia-U.S. free trade agreement. This evidence illustrates a novel mechanism of adjustment of U.S. firms to trade liberalization.

[†]Department of Economics, Gatton College of Business and Economics, University of Kentucky. Email: fbe225@uky.edu. Website: felipebenguria.weebly.com.

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1 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 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. This theory is guided by new findings drawn from a matched exporter-importer dataset that characterizes exporting and importing firms. The model is used to derive the implications of the matching and sorting of exporters and importers for global trade flows and for welfare. I test this theory by studying the response of exporting and importing firms to the recent Colombia-U.S. free trade agreement.

To motivate the model’s assumptions, Section 2 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 3 develops a 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]

[1]The result on the positive sorting between exporters and importers rests upon the complementarity (or in mathematical terms the supermodularity) in the production function that combines the activities of exporters (manufacturers) and importers (distributors) and is consistent with the empirical findings. This

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. These subjects have been highlighted by recent surveys of this literature as areas open for further research.[2] Current understanding of fixed costs is limited: a recent survey by Bernard et al. (2012) describes them as a black box. My theory proposes that the 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.[3] 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.

To acknowledge search frictions when studying the matching between exporters and importers is a natural choice. In fact, Tinbergen (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.[4] 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, Jacquemin and Petit (1980). 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 U.K. exporters.

To test the model, I study the response of exporting and importing firms to trade liberalization in section 4, using the recent free trade agreement between Colombia and the U.S as a natural experiment. 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. According to the model, tariff concessions faced by U.S. exporters would induce them to switch to trading with more productive importers and consequently sell more (in addition to the direct effect of tariff cuts on firms' exports). The higher profitability of the export market will lead the U.S. exporters to optimally incur in a higher search effort in order to find a more productive Colombian partner. In other words, while the marginal cost of search remains constant, its marginal benefit increases. Finding a more productive importer is more valuable in a more profitable market and trade liberaliza-

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]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."

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

[4]As Rauch (1999) argues, 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.

tion makes paying a higher fixed cost (search cost) worth it. 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. U.S. exporters that switch their importing partners in response to tariff cuts switch to larger importers, as the model suggests. Put together, these findings illustrate a new mechanism at work in the response of firms to trade liberalization.

Section 5 concludes, proposing ideas for future research.

1.1 Related Literature

This work is closely related to a set of contemporaneous papers that study the matching between individual buyers and individual sellers across borders.

Closest to my paper, Bernard, Moxnes and Ulltveit-Moe (2018) and Carballo, Ottaviano and Volpe Martincus (2018) build models that deliver predictions 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).[5,6] 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, which is essential to understand the sorting of exporters and importers.

In other work, Eaton et al. (2014), Monarch (2015), Monarch and Schmidt-Eisenlohr (2016) and Bernard, Bøler and Dhingra (2018) examine the dynamics of the relationships between buyers and sellers. Kramarz, Martin and Mejean (2015) study the role of customer related shocks in the volatility of french exporters. Blum, Claro and Horstmann (2012) study the role of import intermediaries (wholesalers). Kamal and Sundaram (2016) show that Bangladeshi exporters are more likely to sell to a given US importer if another firm in the same city has already done so. Sugita, Teshima and Seira (2015) develop a Becker-type matching model of exporters and importers motivated by findings from exporter-importer data on Mexican apparel exports to the U.S., while Dragusanu (2014) studies a subset of Indian exporters to the U.S. and shows that matching is driven by industry characteristics including the elasticity of demand. Meleshchuk (2017) studies non-linear pricing and its policy implications using Colombian data. Eaton et al. (2016) develop a model with random matching of exporters and importers. Differently than in Eaton et al. (2016), exporting firms in my model decide how much search effort to exert to find importers, resulting in non-random matching. Also closely related to this paper, Bernard and Dhingra (2015) study the impact of trade liberalization on contract choices of exporting and importing firms, also using the Colombia - U.S. FTA to test their theory, and focusing on the implications of changes in quantities and prices to infer the response of unobservable contract choices.

The theoretical model in this paper is related to Arkolakis (2010), which also features a cost of entry into export markets that is a choice variable of firms. As in my model, this mechanism allows small firms to export. The main differences of this paper with Arkolakis (2010) is that my model is focused on rationalizing exporter-importer matches and

[5]Differently than in these papers, I study the case of heterogeneous exporting firms and heterogeneous importing firms with free entry in both sides. In these other papers, importers are heterogeneous consumers, rather than profit maximizing firms subject to free entry. A model of importing firms allows one to understand the impact of trade liberalization on these firms.

[6]Differently from Bernard, Moxnes and Ulltveit-Moe (2018), my model converges to the Melitz (2003) heterogeneous firm model, adding minimal assumptions to incorporate heterogeneous importing firms.

understanding their implications for the response of trade flows to trade liberalization.

This paper contributes to a large empirical literature on exporting firms in international trade, surveyed by Bernard et al. (2012) and a growing literature on importer heterogeneity in trade including Bernard et al. (2007), Blaum, Lelarge and Peters (2018), and Antràs, Fort and Tintelnot (2017). Differently than all this work, my paper examines the interaction between heterogeneous exporters and importers. 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. (2012) and work on the role of reputation in international markets. Work in the literature on intermediaries in international trade includes Antràs and Costinot (2011), Blum, Claro and Horstmann (2010), Blum, Claro and Horstmann (2012), Bernard, Grazzi and Tomasi (2011), Felbermayr and Jung (2011), Akerman (2018) and Ahn, Khandelwal and Wei (2011) among others. Macchiavello (2010) and Macchiavello and Morjaria (2015) study the importance of reputation in buyer-seller relationship in the context of wine exports from Chile and flower exports from Kenya.

Finally, empirical work regarding search frictions in international trade has been scarce. An exception is Allen (2014) who introduces information frictions in the context of 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.

2 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 3.

2.1 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.[7] I merge these 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.[8] A key advantage of studying the exports of France to Colombia is that French firms export a large variety of differentiated

[7]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. These data are available from the official statistical agency of Colombia's government (DANE).

[8]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. Other sources reporting the same data on firms' revenue do not include include the address of every establishment of each firm, which is key for matching it to the Colombian customs data.

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.[9]

I define a firm in France by a "SIREN" number and a firm in Colombia by their tax ID number, "NIT". There are 963 exporting firms in France which I can identify and assign 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. Some results below are restricted to French exporters which report their revenue (89% of the initial 963 exporters). There are 950 Colombian importers in the data initially, and 74% of these report their revenue.

I can observe the industry affiliation of these French exporters and Colombian importers. These are tabulated in Appendix Tables 7.1 and 7.2. The largest category of French firms is manufacturing, while the largest category of Colombian importers is wholesalers and retailers. I can also observe which importers are multinational affiliates of French multinationals.[10]

2.2 Most French Exporters and Colombian Importers have a Single Partner

A first observation from this dataset is that the match between exporters and importers is mostly one-to-one. Table 2.1 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. This result is robust to restricting the sample to exclude trade involving multinational affiliates (as shown in Appendix Table 7.4) or to consider only trade with importers classified as distributors (retailers or wholesalers) (see Appendix Table 7.11).

Exporters and importers are even more likely to have a single trading partner within each product they trade. In Appendix Table 7.15 I report that within each HS 4-digit product, 88.6% of exporters-products are sold to a single importer while 92.0% of importers-products are bought from a single exporter.

It is also worth noting that French 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%. The share of aggregate French exports to Colombia associated to single-match exporters and single-match importers is 0.25 (as shown in Appendix Table 7.3). The share of trade from single-match exporters to multiple-match importers is 0.30, and from multiple-match exporters to single-match importers, 0.23. Finally, the share associated to multiple-match exporters and multiple-match importers is 0.22. The model describes the first two cases, which add up to 55.6 percent of aggregate trade. Analyzing these shares within HS 4-digit products, the share associated to single-match exporters and single-match importers increases to 0.53, and the share for single-match importers to multiple-match exporters is 0.23, adding up to 76.4 percent of aggregate trade.

[9]See Blum, Claro and Horstmann (2012), Eaton et al. (2012), Bernard, Moxnes and Ulltveit-Moe (2018), and Carballo, Ottaviano and Volpe Martincus (2018).

[10]Data on affiliates of multinational companies was provided by Dun and Bradstreet through the United Nations and WTO's International Trade Centre.

This within-product share is the relevant one to assess the relevance of the theoretical model below, which abstracts from analyzing multiproduct firms.

Finally, Appendix 7.9 complements these results by documenting a positive relationship between exporters' size and the number of importers they trade with, although even among the largest firms trading with a single importer is very common.

Table 2.1: 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		
	Number	%		Number	%
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	0.3	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).

2.3 Who Trades with Whom

The second observation is that there is a positive correlation between the productivity of French exporters and Colombian 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.[11] 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,

[11]Balance sheet data for Colombian firms is publicly available from the Colombian *Superintendencia de Sociedades.* The data includes firm's revenue, a code for its main activity, and a measure of labor costs.

and is defined as a within-industry (log) sales to labor costs ratio.[12]

I explore who trades with whom by estimating the following equation, where each observation i corresponds to a trading pair.

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

I include two sets of industry fixed effects (ϕ_p), for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification). I initially 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 3 (in other words, I restrict the exporter-importer pairs to one-to-one and many-to-one matches). Table 2.2 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.

Detecting positive assortative matching is challenging and I interpret these results as suggestive evidence. It is possible, for example, that for a given firm, trading with a high productivity partner generates productivity improvements if there is learning from that trading partner. This would artificially bias the results towards finding positive assortative matching. These results should be considered suggestive evidence and interpreted with caution.

The results indicate that there is positive assortative matching of exporters and importers. I find an economically large, positive and statistically significant coefficient with the three different measures of firm productivity. A one standard deviation increase in the exporter's productivity is associated with a 0.09 to 0.14 standard deviations increase in the productivity of the exporter's trading partner. These results are robust to not restricting the sample to exporters' top partners (see Appendix Table 7.7) and to excluding exporters with multiple trading partners (see Appendix Table 7.9). The results are also robust to excluding trade involving importers that are affiliates of French multinationals (see Appendix Table 7.5) and to restricting the sample to importers that are distributors (i.e. retailers or wholesalers) as shown in Appendix Table 7.12.

2.4 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.

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

[12] Lileeva and Trefler (2010) use a measure of labor productivity when estimating the response of plants to trade liberalization, and discuss its limitations. Verhoogen (2008) and Bustos (2011) use different measures of firm revenue or employment as proxies for productivity. Marin and Voigtländer (2013) compare different measures of plant productivity in the context of international trade. Ideally one would estimate productivity accounting for simultaneity and selection biases as, in the context of international trade, Pavcnik (2002). Data required for that type of estimation is not available in this case.

Table 2.2: 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	0.137***	0.128***	0.089**
	(0.044)	(0.043)	(0.040)
Observations	665	665	545

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Each observation i corresponds to an exporter-importer pair. As before, I initially consider only one relationship per exporter, but present similar results in the Appendix using the unrestricted sample. The independent variable is the total value traded between these firms. I include two sets of industry fixed effects (ϕ_p), for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . I use the same three proxies for productivity as in the previous estimation. Table 2.3 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 magnitudes of these coefficients are economically significant. A one standard deviation in the productivity of an exporter leads to a 0.23 to 0.34 standard deviations increase in exporter-importer trade depending on the measure used. An exporter's productivity has a larger impact on trade than the importer's productivity. A one standard deviation in the productivity of the importer leads to a 0.11 to 0.12 standard deviations increase in exporter-importer trade depending on the measure used. As before, the results are robust to not restricting the sample to exporters' top partners, to excluding exporters with multiple partners, to excluding trade involving importers that are affiliates of French multinationals and to restricting the sample to importers that are distributors (i.e. retailers or wholesalers) as shown in Appendix Tables 7.8, 7.10, 7.6, and 7.13. These results highlight the importance of considering not only exporter but also importer heterogeneity in trade models.

3 Theory

I consider a model of a continuum of producers of differentiated varieties selling them both domestically and to foreign destinations in a world composed of a set of symmetric countries. Selling to final consumers requires distribution services performed by a continuum of distrib-

Table 2.3: The Value Traded Depends on the Productivity of Both Exporters and Importers

Dependent Variable: (log) Traded Value

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.335***	0.331***	0.230***
	(0.039)	(0.039)	(0.033)
Importer's Productivity	0.118***	0.105**	0.124**
	(0.044)	(0.045)	(0.057)
Observations	665	665	545

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

utors located in each country. Both producers and distributors are heterogeneous in their productivities, as in Melitz (2003). Producers must search for and choose a distributor in each market. Search is costly and is modeled as in Stigler (1961). The model features search costs as an additional barrier to trade besides the standard iceberg 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 first analyze a closed economy version of this model, and subsequently introduce the open-economy case.

3.1 Consumption

Consumers demand the differentiated varieties (ω) manufactured by producers. Preferences are represented by the following utility function:

$$U = \left(\int_{\omega \, \epsilon \, \Omega} q(\omega)^{\rho} d\omega \right)^{1/\rho} ,$$

with constant elasticity of substitution $\sigma = \frac{1}{(1-\rho)}$, where Ω is the set of varieties consumed. The demand for a producer's variety is:

$$q(\omega) = \frac{E}{P^{1-\sigma}} \cdot p_F(\omega)^{-\sigma} = A \cdot p_F(\omega)^{-\sigma} \ , \tag{3.1}$$

where p_F is the price paid by final consumers, and the term A, a measure of the demand level, combines aggregate expenditure and the price index: $A = \frac{E}{P^{1-\sigma}}$. The price index is

$$P = \left(\int_{\omega \, \epsilon \, \Omega} p_F(\omega)^{1-\sigma} d\omega \right)^{1/(1-\sigma)} .$$

3.2 Production, Distribution and Matching

Selling to final consumers requires production and distribution. Producers must search for a distributor in each market. Both producers and distributors are heterogeneous in their productivities, which they draw upon entry from a probability distribution after paying an entry cost.[13] 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. Within this sample, producers choose the most productive distributor. Since distributors are not constrained in their capacity, a producer only needs a single 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.[14] Distributors are passive in terms of the search process: they simply wait to be found by producers.[15]

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 tractability I assume the productivities of distributors are drawn from a Fréchet distribution with shape parameter γ_I.[16] Mathematically, the probability of meeting and choosing a distributor of productivity φ_I is given by the following density function:[17,18]

$$f^n_{max}(\varphi_I) = \frac{dF^n_{max}(\varphi_I)}{d\varphi_I} = n \cdot \gamma_I \cdot \varphi_I^{-\gamma_I - 1} \cdot e^{-n \cdot \varphi_I^{-\gamma_I}} . \quad (3.2)$$

Producers manufacture differentiated varieties and operate in a context of monopolistic com-

[13]The free entry equilibrium is described in Section 3.4.

[14]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 higher search effort leads to a better expected outcome (in this case, finding a more productive distributor).

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

[16]I use a Fréchet distribution for distributors' productivities to be able to obtain a closed form solution to the producers' optimization problem. In Appendix 8.6.1 I show that a solution to the producers' optimization problem exists when distributors' productivities are drawn from a Pareto distribution. In this case the model can be solved computationally.

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

[18]In terms of notation, I use subscript I for variables that refer to distributors (also importers in the open economy version) and subscript E for variables that refer to producers (also exporters in the open economy version).

petition. 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_E 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.[19] Since distributors market these already differentiated varities, they also operate under monopolistic competition.

Distributors use labor to produce an amount of distribution services q_I using labor according to $q_I = \varphi_I \cdot l_I$. To sell goods to final consumers they combine the manufactured goods with distribution services according to the following production function:

$$q_F = q_E^{\nu} \cdot q_I^{1-\nu} \ , \tag{3.3}$$

where q_E is the quantity of the good manufactured by the producer. The unit cost of distributors is:

$$cost_F = \kappa_1 \cdot p_E^{\nu} \cdot \left(\frac{w}{\varphi_I}\right)^{1-\nu} \ , \tag{3.4}$$

with the wage w normalized to 1 from here onwards.[20] The input demands of distributors for the output of producers and for their own distribution services are:

$$q_E = \kappa_2 \cdot q_F \cdot p_E^{\nu-1} \cdot \left(\frac{1}{\varphi_I}\right)^{1-\nu} \tag{3.5}$$

and

$$q_I = \kappa_3 \cdot q_F \cdot p_E^{\nu} \cdot \left(\frac{1}{\varphi_I}\right)^{-\nu} \ , \tag{3.6}$$

where $\kappa_2 = \left(\frac{\nu}{1-\nu}\right)^{1-\nu}$ and $\kappa_3 = \left(\frac{1-\nu}{\nu}\right)^{\nu}$.

Distributors maximize their profits by setting their final price p_F (the price charged to final consumers) equal to a constant markup over cost: $p_F = \frac{\sigma}{\sigma-1} \cdot cost_F$. The quantity sold is $q_F = A \cdot p_F^{-\sigma}$. Given the behavior of distributors, producers face a demand curve given by distributors' input demand (equation 3.5), which is a function of the wholesale price p_E.

Producers use labor to manufacture goods. In addition they must pay a fixed cost f (measured in units of labor) to sell in the domestic market. Producers maximize their profits by choosing a wholesale price $p_E = \kappa_4 \cdot cost_E$, where $cost_E = \frac{1}{\varphi_E}$ is the unit cost for

[19] This generates "double marginalization". See Tirole (1988) (section 4.1) and Joskow (2005) for a discussion of the literature on vertical relationships. This setup implies that distributors hold all the bargaining power in their transactions with final consumers, and producers hold all the bargaining power in their transactions with distributors. Alternative settings include bargaining between producers and the distributors, two-part tariffs, vertical integration or vertical restraints. As Joskow (2005) points out, double marginalization is more likely to occur when the downstream firm is uncertain of the costs of the upstream firm. Arguably, this is more likely in international transactions. Ultimately, the nature of the contracts between exporters and importers or more in general between manufacturers and retailers is an empirical matter. The only evidence on the nature of price setting by exporting firms, by Gopinath and Rigobon (2008) and based on the BLS International Price Program microdata, indicates that for most U.S. exporters prices are not specific to foreign importers. Further, for 90% of U.S. exporters prices are not a function of quantities ordered. This suggests that the model's assumptions fit well international transactions.

[20] In this expression $\kappa_1 = \left(\frac{\nu}{1-\nu}\right)^{1-\nu} \cdot \frac{1}{\nu}$.

a producer of productivity φ_E.[21] This yields operating profits:

$$\pi_E(\varphi_E, \varphi_I) = \kappa_5 \cdot A \cdot \varphi_E^{\nu \cdot(\sigma-1)} \cdot \varphi_I^{(\sigma-1)\cdot(1-\nu)} \tag{3.7}$$

and revenue $r_E = \kappa_6 \cdot A \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot \varphi_I^{(\sigma-1)\cdot(1-\nu)}$ for producers.[22]

Knowing their operating profits $\pi_E(\varphi_E, \varphi_I)$ from any potential relationship with a distributor of productivity φ_I, producers choose their optimal search effort n^*, solving:

$$\max_n \int_0^\infty f_{max}^n(\varphi_I) \cdot \pi_E(\varphi_E, \varphi_I) d\varphi_I - \lambda \cdot n - f \ . \tag{3.8}$$

The first term in equation (3.8) represents the expected operating profits for the producer obtained from a trading relationship with a distributor of productivity φ_I, 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 effort of a producer is:

$$n^* = \kappa_7 \cdot \left(\frac{A \cdot \varphi_E^{\nu\cdot(\sigma-1)}}{\lambda} \right)^\phi \ , \tag{3.9}$$

where $\phi = \frac{\gamma_I}{\gamma_I - (\sigma-1)(1-\nu)}$.[23,24]

3.3 Open Economy

I now analyze the open-economy case with costly trade between a set of $N+1 >= 2$ identical countries. Producers (exporters) shipping to foreign destinations face a per-unit 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 (importers) abroad. Producers face identical search costs when selling to all countries, including the domestic market. As in Melitz (2003), firms face identical iceberg trade costs when shipping to all foreign markets excluding the domestic market. To export, firms face a fixed cost f_X (measured in units of labor). I assume this exporting fixed cost is larger than the fixed cost required to serve the domestic market ($f_X > f$).

In this context, the optimal search effort of a producer for a distributor abroad depends on the bilateral iceberg trade costs:

$$n_X^* = \kappa_7 \cdot \left(\frac{A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)}}{\lambda} \right)^\phi \ . \tag{3.10}$$

[21]The markup for exporters is $\kappa_4 = \frac{1+\nu(\sigma-1)}{\nu(\sigma-1)}$.

[22]$\kappa_5 = \kappa_1^{1-\sigma} \cdot \kappa_4^{-\nu\cdot\sigma+\nu-1} \cdot \left(\frac{1}{\sigma-1}\right) \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}$ and $\kappa_6 = \nu \cdot (\sigma-1) \cdot \kappa_5$.

[23]Refer to Appendix 8.1 for the derivation. It is necessary to impose a large enough shape parameter $\gamma_I > (\sigma-1)\cdot(1-\nu)$ for this integral to converge. Further, for producers' expected revenue and for the expected productivity of producers' partners to be well defined, I impose $\gamma_I > \max[(\sigma-1)\cdot(1-\nu)\, , \, (\sigma-1)\cdot\nu\, , \, 1]$.

[24]In this expression $\kappa_7 = \left(\kappa_5 \cdot \frac{\phi-1}{\phi} \cdot \Gamma\left[\frac{1}{\phi}\right]\right)^\phi$

3.4 Free Entry Equilibrium

Producers There is a large (unbounded) set of prospective entrants. Firms must pay a sunk entry cost F_e to enter. Upon entry, producers draw a productivity parameter φ_E from the productivity distribution $G(\varphi_E)$. I assume this is a Pareto distribution with shape parameter γ_E, a scale parameter equal to 1 and support over $[1, \infty)$.[25] Define the equilibrium productivity distribution of producers in the domestic and export markets as:

$$\mu(\varphi_E) = \begin{cases} \frac{g(\varphi_E)}{1-G(\underline{\varphi}_E)} & \text{if } \varphi_E \geq \underline{\varphi}_E \\ 0 & \text{otherwise} \end{cases} \tag{3.11}$$

and

$$\mu_X(\varphi_E) = \begin{cases} \frac{g(\varphi_E)}{1-G(\underline{\varphi}_E^X)} & \text{if } \varphi_E \geq \underline{\varphi}_E^X \\ 0 & \text{otherwise} \end{cases} \tag{3.12}$$

Define expected profits (condititonal on succesful entry) for producers in the domestic and export markets as:

$$\bar{\pi}_E = \int_{\underline{\varphi}_E}^{\infty} E[\pi_E|\varphi_E] \cdot \mu(\varphi_E) d\varphi_E \tag{3.13}$$

and expected profits in each foreign market as:

$$\bar{\pi}_{E_X} = \int_{\underline{\varphi}_E^X}^{\infty} E[\pi_{E_X}|\varphi_E] \cdot \mu_X(\varphi_E) d\varphi_E \tag{3.14}$$

The free entry condition equates the entry cost to the value of entry:

$$(1 - G(\underline{\varphi}_E)) \cdot (\bar{\pi}_E + \chi \cdot N \cdot \bar{\pi}_{E_X}) = F_e \tag{3.15}$$

where $\chi = \frac{1-G(\underline{\varphi}_E^X)}{1-G(\underline{\varphi}_E)}$ is the probability of exporting (condititonal on succesful entry) .

The fixed cost f required to serve the domestic market generates a productivity cutoff $\underline{\varphi}_E$ such that firms that draw a productivity below this cutoff choose to exit.[26] The fixed cost f_X required to export generates an additional productivity cutoff $\underline{\varphi}_E^X$ that divides firms into domestic producers and exporters.[27]

Distributors For distributors, the structure of entry is similar to the case of producers. There is a large (unbounded) set of prospective entrants. Firms must pay a sunk entry

[25] The cumulative distribution function is $G(\varphi_E) = 1 - \varphi^{-\gamma_E}$ and the probability density function is $g(\varphi_E) = \gamma_E \cdot \varphi_E^{-(\gamma_E+1)}$.

[26] The cutoff is such that conditional on productivity expected profits obtained from selling to the domestic market are zero. This cutoff is $\underline{\varphi}_E = \kappa_8 \cdot \left(\frac{f^{\frac{1}{\phi}} \cdot \lambda^{\frac{\phi-1}{\phi}}}{A} \right)^{\frac{1}{\nu \cdot (\sigma-1)}}$. In this expression $\kappa_8 = \left(\kappa_5^{\phi} \cdot (\Gamma[\frac{1}{\phi}])^{\phi} \cdot \left(\frac{\phi-1}{\phi} \right)^{\phi} \cdot \frac{1}{\phi-1} \right)^{\frac{-1}{\phi \cdot \nu \cdot (\sigma-1)}}$

[27] The export productivity cutoff is such that conditional on productivity expected profits are zero. This cutoff is $\underline{\varphi}_E^X = \kappa_8 \cdot \tau \cdot \left(\frac{f_X^{\frac{1}{\phi}} \cdot \lambda^{\frac{\phi-1}{\phi}}}{A} \right)^{\frac{1}{\nu \cdot (\sigma-1)}}$.

cost F_e to enter.[28] Upon entry, distributors draw a productivity parameter φ_I from the productivity distribution $F(\varphi_I)$. As discussed earlier, I assume this is a Fréchet distribution with shape parameter γ_I, scale parameter 1, location parameter 0 and support over $[0, \infty)$.[29] The free entry condition is analogous to that for producers.

3.5 Sorting of Exporters and Importers

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

Proposition I. Exporters with a higher productivity φ_E:

i. Have a higher search effort in the domestic and foreign markets.

ii. Have a higher expected productivity of their trading partner in the domestic and foreign markets.

iii. Obtain larger expected revenue in the domestic and foreign markets.

(See Appendix 8.2 for proof.)

More productive producers search more and thus enter partnerships with more productive distributors on average. 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 production function of importers (equation 3.3).

3.6 Effect of Trade Costs and Search Costs on Sorting, Trade Flows, and Welfare

The second key result concerns the effect of per-unit iceberg trade costs on the sorting between exporters and importers and on trade flows.

Proposition II. A decline in trade costs (τ):

i. Leads exporting firms to increase their search effort in foreign markets.

ii. Leads exporting firms to find and choose partners of higher expected productivity in foreign markets.

iii. Leads exporting firms to obtain a larger expected revenue in foreign markets.

[28] The entry cost for distributors could be allowed to differ from that for producers. For simplicity and without loss of generality, I set them equal.

[29] The distribution function is $F(\varphi_I) = e^{-\varphi_I^{-\gamma_I}}$ and the probability density function is $f(\varphi_I) = \gamma_I \cdot \varphi_I^{-\gamma_I - 1} \cdot e^{-\varphi_I^{-\gamma_I}}$.

(See Appendix 8.2 for proof.)

As trade costs fall, the marginal benefit of search increases, as lower trade costs increase the profitability of the destination market. The optimal search effort increases, which leads to, on average, matches with importers of higher productivity. Exports increase due to a standard 'direct' effect of trade costs lowering exporters' marginal cost of serving the foreign market. This is present in Melitz (2003). Additionally, exports increase due to an 'indirect effect' of exporters selling more due to their more productive importing partners. The third key result concerns the effect of search costs (λ) on the sorting between exporters and importers and on trade flows.

Proposition III. A decline in search costs (λ):

i. Leads exporting firms to increase their search effort in the domestic and foreign markets.

ii. Leads exporting firms to find and choose partners of higher expected productivity in the domestic and foreign markets.

iii. Has no impact on exporting firms' expected revenue in the domestic and foreign markets.[30]

(See Appendix 8.2 for proof.)

As the search for importing firms becomes less expensive, exporters increase their search effort, and are matched on average to more productive importers. The fourth key result concerns trade flows between firms, which depend on the productivity of both the exporter and the importer. In contrast, in models based on Melitz (2003) trade flows depend on the characteristics (typically productivity) of exporting firms only.

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

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

ii. Negatively on trade costs.

(See Appendix 8.2 for proof.)

The last proposition describes the impact of reductions in trade costs or search costs on welfare.

Proposition V. Welfare increases as a consequece of reductions in trade costs (τ) or in search costs (λ). In addition, the impact of changes in trade costs (τ) on welfare occurs only through their impact on the share of expenditure in domestic goods.

(See Appendix 8.2 and 8.4 for proof.)

[30] As search costs fall a partial equilibrium result increases search effort, leading an increase in the expected productivity of trading partners and an increase in expected revenue. This effect on expected revenue is cancelled out, however, by a general equilibrium effect in the opposite direction.

In this sense, the model belongs to a wide class of models for which changes in welfare in response to trade liberalization depend only on changes in the share of expenditure in domestic goods, as shown by Arkolakis, Costinot and Rodríguez-Clare (2012).

Convergence to Melitz (2003) Finally, note that this model converges to the canonical Melitz (2003) model as $\nu \to 1$, as shown in Appendix 8.5.

4 Exporter-Importer Matches and Trade Liberalization: the U.S. - Colombia Free Trade Agreement

The U.S.-Colombia Free Trade Agreement (FTA) provides an ideal quasinatural experiment to test the theory of exporter-importer sorting described by the model. The model predicts that by making the Colombian market more profitable. U.S. exporters find it optimal to incur in a higher search effort in order to find more productive importing partners in Colombia. This reorganization of exporter-importer matches is a novel dimension on the response of firms to trade liberalization. I take advantage of the substantial cross-industry variation in tariff cuts favoring U.S. exporters to Colombia.

From Theory to Empirics. Tariff cuts for U.S. exports to Colombia as a consequence of the FTA are interpreted as a decline in the per-unit iceberg trade cost in the model. As discussed in proposition II in the theory section, this leads U.S. exporters to optimally increase their search effort, which increases the expected productivity of their importing partner and their expected revenue. In other words, the marginal benefit of search increases as lower tariffs increase the profitability of the Colombian market for U.S. exporters.

In the data, not all exporters switch importing partners. While the model does not describe the dynamics in the transition from high to low tariffs, one can compare the gain in switching trading partners to its cost, and predict that exporters would switch partners if the gain from switching (the difference in expected profits (excluding search costs) is larger than the cost of switching (the search cost incurred).[31]

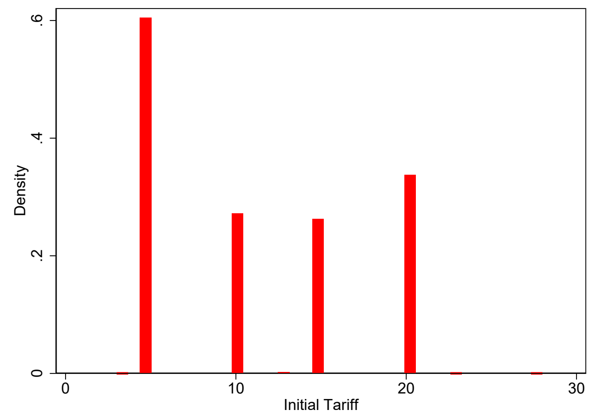
The U.S. - Colombia Free Trade Agreement. This section briefly describes the trade agreement and shows it led to an increase in U.S. exports to Colombia. The FTA reduced tariffs starting on May 15th 2012. U.S. exporters to Colombia faced large tariff cuts in many industries. Most of these were effective immediately and reduced tariffs to zero. Due to the short span of the post-liberalization period, I focus exclusively on these industries in the empirical design described below in Section 4.1. 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.

Figure 4.1 illustrates the density of the tariff cuts faced by U.S. exporters. Descriptive statistics on these tariffs faced by U.S. exporters in Colombia before and after the agreement are reported in Table 4.1. A first essential observation is that initial pre-FTA tariffs were large in many industries, and the reduction was also large as many of these were fully eliminated.

[31] In addition, the outcome of search in the model is stochastic. An exporter could search to find a new partner, find only worse partners than the existing one, and consequently mantain their relationship with their existing partner.

A second important point is that there was substantial variation across industries, as shown in the figure.

Figure 4.1: 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.

Table 4.1: Descriptive Statistics for Colombian Tariffs on U.S. Exports

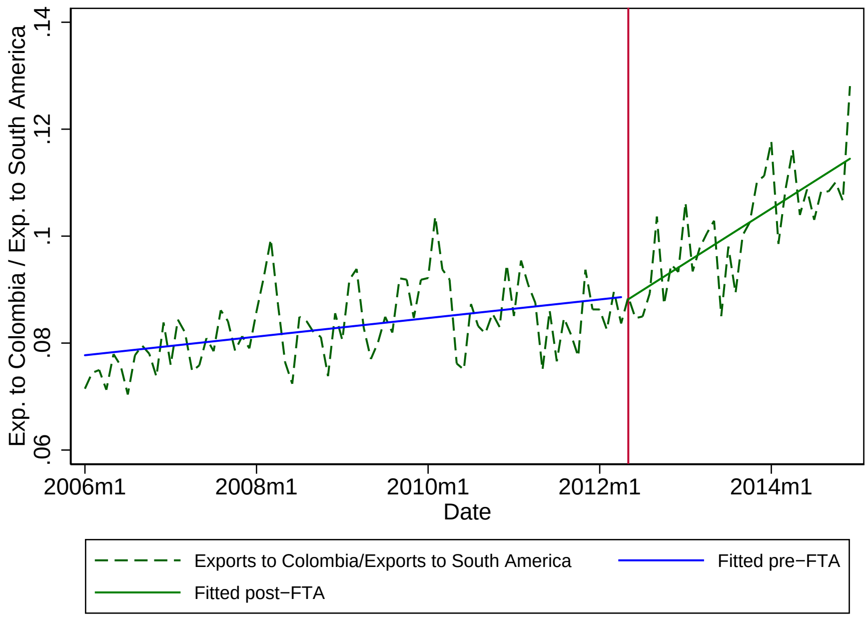
	PRE	POST
Mean Tariff across HS10 products	12.11	3.14
Median Tariff across HS10 products	10	0
Maximum Tariff across HS10 products	80	43.85
Standard Deviation of Tariff across HS10 products	6.72	6.18
Number of HS10 products with zero tariff	160	5275

Notes: This table reports descriptive statistics for Colombian tariffs on U.S. exported before and after the FTA starts in May 2012 (the POST data corresponds to one year after the start of the FTA). The data is obtained from the FTA's website: http://trade.gov/fta/colombia/ and http://www.tlc.gov.co/publicaciones.php?id=727.

The trade data show an increase in U.S. exports to Colombia immediately after the agreement. A first observation, shown in Figure 4.2, is that the ratio of U.S. exports to Colombia over U.S. exports to other South American markets that did not implement these tariff cuts rose substantially. While this pattern is evident at plain sight, the figure illustrates a change in the slope of a line fitted to the trade data before and after the agreement. To further establish the causality of the impact of the FTA on U.S. exports to Colombia, in Appendix 9.1 I show that U.S. exports in liberalized sectors (relative to non-liberalized sectors) to Colombia (relative to other Southamerican countries) increase following the FTA.

Data on U.S. Exporters and Colombian Importers. I use the information on import transactions collected by Colombian customs described in Section 2.1. These records contain

Figure 4.2: The Effect of the FTA on U.S. Exports to Colombia



Notes: This figure shows the evolution of U.S. exports to Colombia as a fraction of U.S. exports to South America at a monthly frequency during January 2006- May 2014 (dashed line). The blue sold lines correspond to the fitted linear prediction estimated separately before May 2012 and after May 2012. Data is obtained from the U.S. Census Bureau.

the name and tax ID of each Colombian importer, and I define importers based on their tax ID as is standard. The data also report the name of each U.S. exporter in each transaction. The procedure to standardize names of U.S. exporters is discussed in detail in Appendix 11.[32,33] Table 4.2 presents descriptive statistics on U.S. exporters to Colombia. Additionally I use balance sheet data on these Colombian importers to observe their size as domestic sales. These data were introduced in Section 2. Given that the model describes trade in final goods between producers and distributors, in the analysis below I restrict the sample to trade in final consumer goods.[34]

4.1 The Free Trade Agreement and Exporter-Importer Matches.

I investigate the effect of the trade liberalization on the reorganization of U.S. exporter - Colombian importer relationships in several steps. First, and to provide context to the

[32] The data also the address, city and telephone number or email address of U.S. exporters. Since I will be interested in identifying firms rather than plants, I use the names of these U.S. firms but not their address to define a firm in my preferred results. Alternative definitions of U.S. exporters in the Appendix do use the address in addition to the firm name.

[33] Appendix 11 also shows that the results in this section are robust to different procedures of standardizing exporters' names.

[34] Final consumer goods are defined by the "Stages Of Processing" (SOP) classification by UNCTAD. This classification divides goods into raw materials, intermediate inputs, capital goods, and consumer goods. This classification is obtained from the World Bank's WITS.

Table 4.2: Descriptive Statistics for U.S. Exporters to Colombia.

Exporters in consumer good industries in PRE and POST	3026
In immediately liberalized industries	1698
Share finding new trading partner	31.27%
Mean Value Exported - PRE (USD million)	1.138
Mean Value Exported - POST (USD million)	1.966

Notes: This table reports descriptive statistics for U.S. exporters to Colombia before and after the FTA starts in May 2012 (PRE corresponds to 2011/5 to 2012/6 and POST to 2013/5 to 2014/6). The first row reports the number of U.S. firms exporting to Colombia in both periods, exporting consumer goods. The second row reports the share of those firms in industries liberalized immediately and completely, which are the ones I consider in the analysis. The third column shows the share of those finding new partners in the second period. The last two rows show the mean value exported by these U.S. exporters in each period.

following results, I show that tariff concessions made by Colombia to U.S. exporters raised the sales of these exporters in this market.[35] Second, U.S. exporters respond to tariff cuts by finding new importing partners. Finally, I show that U.S. exporters that switched importing partners in response to the tariff cuts chose larger importing partners.

Tariff Cuts lead to an Increase in U.S. Firms' Exports. First, I show that tariff cuts in favor of U.S. exporters to Colombia led to an increase in the value exported by these U.S. firms, as would be predicted by any standard model of firms in international trade. I follow a difference in differences approach, comparing the exports of U.S. firms to Colombia before and after the agreement and across industries facing different degrees of liberalization.

I measure the exposure of U.S. exporters to trade liberalization computing the change in tariffs for each HS 6-digit level code. I restrict the analysis to firms in sectors liberalized immediately and completely, which represent the large majority of U.S. exports to Colombia. I assign firms to HS 6- digit industries based on firms' largest value exported in the pre-FTA period (the results are very similar when defining tariffs at the HS 4-digit level).[36]

I estimate the following equation, with the change in (log) exports of exporting firm f as the dependent variable. The independent variable of interest is the change in tariffs associated to that firm. I define the pre-liberalization period as June 2011-May 2012 and the post-liberalization period as June 2013 - May 2014. I restrict the sample to a balanced panel of firms which export to Colombia both before and after the agreement.

$$\Delta \textsc{Exports}_{fs} = \beta \cdot \Delta \textsc{Tariff}_s^{COL} + \epsilon_{fs} \tag{4.1}$$

I include a set of firm-level and industry-level controls. First, I include sector-level fixed effects at the HS-2 digit level. This means I am comparing different industries within sectors; for instance, manufacturers of photographic cameras to manufacturers of video recorders,

[35] Additionally, in Appendix 9.6 I show that the FTA induces net entry into exporting among U.S. firms in industries facing larger tariff cuts for U.S. exports to Colombia.

[36] I obtain the tariff data directly from the customs records of Colombia's imports. These tariffs are not yet available in the World Bank's TRAINS dataset. They are available in the FTA website of the Office of the U.S. Trade Representative but are reported in the Colombian classification of 2004, which is difficult to map into more recent HS codes. In the customs data, transactions report the ad-valorem tariff paid.

rather than to producers of pharmaceuticals. I cluster standard errors by sector at the HS 2-digit level, based on firms main sector in the initial period. Second, I control for the change in the tariff imposed by Colombia to the rest of the world (excluding the U.S.) during this period. Third, I control for exporting firms' level of exports in the pre-FTA period. I also control for Colombian importers which also export to the U.S. (using a dummy for exporters) and control for the change in industry-level (at the HS 6-digit level) U.S. tariff cuts for Colombian exports to the U.S.

I find that U.S. exporters facing larger tariff cuts did increase their exports to Colombia by more. The results are reported in Table 4.3, and descriptive statistics are found in Appendix Table 9.2. A one standard deviation larger tariff reduction is associated with a 0.142 standard deviations higher revenue (in column 2, including firm and industry controls). These results are robust to excluding exporters selling to Colombian multinational affiliates as shown in Appendix Table 9.3.

Table 4.3: Tariff Cuts Lead to an Increase in U.S. Firms' Exports.

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

	(1)	(2)
$\Delta\text{Tariff}_s^{COL}$	-0.124***	-0.142**
	(0.041)	(0.057)
Firm and Industry Controls	No	Yes
Sector F.E.	Yes	Yes
Observations	1698	1698

Notes: This table shows the results of the estimation of equation (4.1). All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Tariff Cuts Lead to Finding New Importing Partners. Next, I ask whether firms facing larger tariff concessions were more likely to switch or add new importing partners. I estimate the following equation. The dependent variable New Partner_{fs} takes a value of one for exporters with new importing partners in the post-FTA period. The independent variable of interest is again the change in tariffs associated to each firm. I estimate this regression using both a probit and a linear probability model. In this regression with fixed effects the probit model has the disadvantage of generating biased coefficients due to the incidental parameters problem, but the results indicate that the difference between the two methods is small.

$$\text{New Partner}_{fs} = \beta \cdot \Delta\text{Tariff}_s^{COL} + \epsilon_{fs} \tag{4.2}$$

One concern is distinguishing between the choice of trading partners within existing importers, and the entry of new importers into the economy as a consequence of the FTA.[37] I

[37] Appendix 9.6 shows that there is some evidence that the FTA induced entry into importing in Colombia, even though the relationship found is not statistically significant.

focus on exporters' new partners within the set of existing importers here, but report results including all new partners in the Appendix. Another important point is distinguishing between exporters that add new partners and drop old partners (they completely switch trading partners) and exporters that simply add new partners. For this reason I also report in the Appendix results from estimating equation (4.2) in a sample of exporters with a single trading partner in both periods (such that NEW PARTNER represents fully switching importing partners).

I find that firms in industries facing larger tariff cuts were more likely to find new trading partners, as shown in Table 4.4. I report standardized average effects. A one standard deviation larger tariff reduction is associated with a 0.1 standard deviations higher probability of finding new importing partners (in column 2, including firm and industry controls). Estimates using a probit model or a linear probability model barely differ. Appendix Table 9.6 reports additional results considering all new partners of an exporter (not only those already active in the pre-FTA period), while Appendix Table 9.7 reports the results for exporters with a single partner in both periods. In the Appendix, I also report the estimation of this equation excluding trade involving Colombian multinational affiliates (Appendix Table 9.4) or using tariffs at the HS 4-digit level, to reduce the cases of exporters switching industries in the data as a response to trade liberalization (Appendix Table 9.8).

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 4.4: Tariff Cuts Lead to Finding New Importing Partners

DEPENDENT VARIABLE: NEW PARTNER$_{fs}$

	(1)	(2)	(3)	(4)
ΔTARIFF$_s^{COL}$	-0.111***	-0.100**	-0.111***	-0.100**
	(0.030)	(0.048)	(0.030)	(0.048)
FIRM AND INDUSTRY CONTROLS	NO	YES	NO	YES
SECTOR F.E.	YES	YES	YES	YES
OBSERVATIONS	1698	1698	1698	1698

Notes: This table shows the results of the estimation of equation (4.2). Columns 1 and 2 report the estimates of a probit model. Columns 3 and 4 report the estimates of a linear probability model. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Exporters that Switch their Importing Partner in Response to the Tariff Cuts Switch to Larger Importers. Finally, I find that that U.S. exporters respond to tariff cuts switching to larger importing partners. The model predicts that lower trade costs increase exporters' search effort and exporters match on average with more productive importing partners. While the model characterizes firms in terms of their productivity, I characterize importing partners in terms of size, measured as total imports from the world or alternatively by domestic sales.[38]

Once again, I rely on the variation across industries in the extent of tariff cuts and estimate the following equation (4.3). The dependent variable $\Delta\text{PARTNER-SIZE}_{fs}$ is the change in the average size of all importing firms (i) trading with a given U.S. exporter (f) before and after the liberalization. The independent variable is the exporter's exposure to the trade liberalization, captured by the tariff cuts relevant to each exporter.

$$\Delta\text{PARTNER-SIZE}_{fs} = \beta \cdot \Delta\text{TARIFF}_s^{COL} + \epsilon_{fs} \tag{4.3}$$

The size of exporters' partners in both periods is always measured as their pre-FTA size, to prevent the concern that the size of exporters' post-FTA importing partners are influenced directly by the tariff change. The average size of an exporter's partners is measured as the weighted average of the importing partners' size (weighted by exporter's sales to each importing partner v_{fi}). (This is relevant for a minority of cases with exporters with more than one trading partner.) Changes over time in the average size of exporters' partners are thus driven by changes in the matching of exporters to importers, but not by changes in the size of these importers.

$$\text{PARTNER-SIZE}_{fs}^{t} = \frac{\sum_i v_{fi}^t \cdot \text{SIZE}_i^{PRE}}{\sum_i v_{fi}^t} \tag{4.4}$$

I estimate equation (4.3) both on the sample of exporters switching trading partners as well as on the full sample.[39] The results are reported in Table 4.5.[40] Exporters that find new importing partners in response to the tariff cuts choose larger importing partners. For the sample of switchers, the estimated coefficient indicates that a one standard deviation larger tariff reduction is associated with 0.21 standard deviations larger average partner size when measuring importers according to their (log) world imports or 0.27 standard deviations when measuring importer size according to their (log) domestic sales.[41] Appendix Table 9.5 shows that these results are robust to excluding exporters that trade with Colombian multinational affiliates. Appendix Table 9.9 documents these results are robust to excluding exporters trading with multiple importers.

To summarize, bringing together all the findings presented earlier, these results indicate that tariff reductions to U.S. exporters lead them to increase their export sales. Tariff cuts induce exporters to switch partners, and exporters who switch partners typically find larger importers than before. Overall, this set of results is consistent with the theoretical model developed in this paper and illustrates a new mechanism of adjustment of firms to

[38] Measuring productivity accurately is econometrically challenging, and demanding in terms of data. Further, the literature reports a high correlation between firm productivity and various measures of firm size.

[39] The results restricting the sample to switchers are robust to estimating a two-stage procedure to correct the potential sample selection problem. The first stage is equation (4.2), measuring the impact of tariff cuts on the probability of finding new trading partners and the inverse Mills ratio predicted from the first stage is included in the second stage (4.3).

[40] The number of observations corresponding to the full sample estimates in Table 4.5 are lower than those in the previous tables because the sample is restricted to exporters for which post-FTA trading partners were also present in the pre-FTA period.

[41] The coefficients based on the full sample, in which a majority of exporters do not switch partners, are such that a one standard deviation larger tariff reduction is associated with 0.12 standard deviations larger average partner size when measuring importers according to their world imports or 0.15 standard deviations when measuring importer size according to their domestic sales.

trade liberalization, which highlights the importance of understanding exporter-importer relationships.

Table 4.5: Exporters that Switch their Importing Partner in Response to the Tariff Cuts Switch to Larger Importers

Dependent Variable: ΔPartner-Size$_{fs}$

	(1)	(2)	(3)	(4)
Partner Size Based on:	World Imports		Domestic Sales	
Sample:	Switchers	Full Sample	Switchers	Full Sample
ΔTariff$_s^{COL}$	-0.213**	-0.121**	-0.266**	-0.153**
	(0.097)	(0.053)	(0.128)	(0.068)
Firm and Industry Controls	Yes	Yes	Yes	Yes
Sector F.E.	Yes	Yes	Yes	Yes
Observations	430	1442	237	886

Notes: This table shows the results of the estimation of equation (4.3). Columns 1 and 2 use world imports as a measure of importing firm size. Columns 3 and 4 use domestic sales as a measure of importing firm size. Columns 1 and 3 are restricted to the sample of exporters switching importing partners. Columns 2 and 4 are estimated on the full sample. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

5 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 an influence on the pattern of trade. This represents a departure from existing models of international trade in which entry into export markets is a black box and the role of importing firms is ignored.

This paper has also provided empirical evidence in support of this theory. In the cross-section, I establish three new observations using matched exporter-importer data: i) most exporters trade with a single importer, ii) there is positive assortative matching between exporters and importers in terms of their productivity, and iii) the value traded is positively correlated with the productivity of both exporters and importers. Then, using the Colombia-US Free Trade Agreement as an exogenous shock I provide the first evidence on the reallocation of exporter-importer matches in response to trade liberalization. As predicted by the model, U.S. exporters facing larger tariff cuts in the Colombian market adjust by switching to more larger Colombian importers.

It has been recently stressed that 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 moves in that direction by incorporating importing firms into the canonical heterogeneous-firms trade model.

6 References

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7 Appendix to Section 2

This appendix includes:

7.1] The industry affiliation of French exporters and Colombian importers.

7.2] Shares of Value Traded by number of Connections of Exporters and Importers.

7.3] A version of Tables 2.1, 2.2, and 2.3 that excludes trade involving Colombia importers that are multinational affiliates of French firms.

7.4] A version of Tables 2.2 and 2.3 that is not restricted to exporters' top trading partner.

7.5] A version of Tables 2.2 and 2.3 that excludes exporters with multiple trading partners.

7.6] A version of Tables 2.1, 2.2, and 2.3 that are restricted to trade involving Colombian importers classified as distributors (retailers or wholesalers).

7.7] Summary statistics for the variables in regressions (2.1) and (2.2).

7.8] A version of Table 2.1 that includes number of matches per importer-product and per exporter-product.

7.9] Evidence on the relationship between exporters' size and number of trading partners.

7.1 Industry affiliation of French exporters and Colombian importers

Table 7.1: Industry Affiliation of French Exporters

Sector	Number of Exporters	Percent
Manufacturing	600	62.8
Wholesale and Retail Trade	219	22.9
Professional, scientfic and technical activities	52	5.4
Information and communication	20	2.1
Financial intermediation	17	1.8
Agriculture, hunting, and forestry	11	1.2
Transportation and storage	10	1.0
Construction	8	0.8
Administrative and support service activities	8	0.8
Real estate, renting, and business activities	3	0.3
Water supply; sewerage, waste management, etc.	3	0.3
Mining and quarrying	3	0.3
Arts, entertainment and recreation	1	0.1

Notes: This table reports the number and percent of French exporters in each two digit industry according to the French NAF industrial classification.

Table 7.2: Industry Affiliation of Colombian Importers

Sector	Number of Importers	Percent
Wholesale and retail trade	317	45.5
Manufacturing	308	44.2
Real estate, renting and business activities	14	2.0
Transport, storage and communications	13	1.9
Mining and quarrying	13	1.9
Construction	11	1.6
Agriculture, hunting and forestry	9	1.3
Hotels and restaurants	3	0.4
Other community, social and personal service activities	3	0.4
Health and social work	2	0.3
Electricity, gas and water supply	2	0.3
Fishing	1	0.1
Financial intermediation	1	0.1

Notes: This table reports the number and percent of Colombian importers in each two digit industry according to the ISIC industrial classification.

7.2 Shares of Value Traded by Number of Connections of Exporters and Importers

Table 7.3: Shares of Value Traded by Number of Connections of Exporters and Importers

Exporter-Importer Connections	Value (%) Overall	Value (%) Within-Industries
one-to-one	25.3	53.1
many-to-one	30.3	23.3
one-to-many	22.5	14.9
many-to-many	21.9	8.7

Notes: This table reports the share of value traded from France to Colombia depending on the number of connections of both the exporter and the importer(one-to-one, many-to-one, one-to-many, and many-to-many connections). The first column reports the percentages for each case overall, and the second case, within HS 4-digit products. This result excludes trade with multinational affiliates.

7.3 Tables 2.1, 2.2, and 2.3 excluding multinational affiliates

Table 7.4: Distribution of the Number of Importers with which an Exporter Trades, and of the Number of Exporters with which an Importer Trades. (Equivalent to Table 2.1 in the main text.)

Number of Exporters	906				
Number of Importers	929				
Importers per Exporter			Exporters per Importer		
	Number	%		Number	%
Exporters matched to one importer	690	76.2	Importers matched to one exporter	716	77.1
Exporters matched to two importers	138	15.2	Importers matched to two exporters	140	15.1
3	37	4.1	3	30	3.2
4	16	1.8	4	19	2.0
5	8	0.9	5	11	1.2
6	5	0.6	6	7	0.8
7	3	0.3	8	1	0.1
8	2	0.2	9	1	0.1
10	1	0.1	12	1	0.1
11	1	0.1	15	1	0.1
13	1	0.1	21	2	0.2
14	1	0.1			
15	1	0.1			
16	1	0.1			
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).

Table 7.5: The Productivities of Exporters and Importers in a Trading Relationship are Positively Correlated. (Equivalent to Table 2.2 in the main text.)

Dependent Variable: Importer's Productivity

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.119***	0.111***	0.091**
	(0.042)	(0.042)	(0.045)
Observations	612	612	500

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 7.6: The Value Traded Depends on the Productivity of Both Exporters and Importers. (Equivalent to Table 2.3 in the main text.)

Dependent Variable: (log) Traded Value

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.324***	0.319***	0.240***
	(0.041)	(0.041)	(0.035)
Importer's Productivity	0.136***	0.125**	0.107*
	(0.050)	(0.051)	(0.061)
Observations	612	612	500

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

7.4 Tables 2.2 and 2.3 not restricted to exporters' top trading partner

Table 7.7: The Productivities of Exporters and Importers in a Trading Relationship are Positively Correlated. (Equivalent to Table 2.2 in the main text.)

Dependent Variable: Importer's Productivity

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.088**	0.083**	0.073*
	(0.037)	(0.037)	(0.042)
Observations	995	995	782

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 7.8: The Value Traded Depends on the Productivity of Both Exporters and Importers. (Equivalent to Table 2.3 in the main text.)

Dependent Variable: (log) Traded Value

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.196***	0.194***	0.145***
	(0.036)	(0.036)	(0.031)
Importer's Productivity	0.140***	0.129***	0.089*
	(0.035)	(0.036)	(0.046)
Observations	995	995	782

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

7.5 Tables 2.2 and 2.3 excluding exporters' with multiple trading partners

Table 7.9: The Productivities of Exporters and Importers in a Trading Relationship are Positively Correlated. (Equivalent to Table 2.2 in the main text.)

Dependent Variable: Importer's Productivity

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.148***	0.140***	0.062
	(0.047)	(0.046)	(0.047)
Observations	510	510	422

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 7.10: The Value Traded Depends on the Productivity of Both Exporters and Importers. (Equivalent to Table 2.3 in the main text.)

Dependent Variable: (log) Traded Value

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.256***	0.253***	0.239***
	(0.057)	(0.057)	(0.041)
Importer's Productivity	0.098*	0.087	0.141**
	(0.054)	(0.055)	(0.063)
Observations	510	510	422

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

7.6 Tables 2.1, 2.2, and 2.3 for importers that are distributors (retailers or wholesalers)

Table 7.11: Distribution of the Number of Importers with which an Exporter Trades, and of the Number of Exporters with which an Importer Trades. (Equivalent to Table 2.1 in the main text.)

Number of Exporters	360				
Number of Importers	317				
Importers per Exporter			Exporters per Importer		
	Number	%		Number	%
Exporters matched to one importer	313	86.9	Importers matched to one exporter	250	78.9
Exporters matched to two importers	33	9.2	Importers matched to two exporters	42	13.2
3	5	1.4	3	9	2.8
4	6	1.7	4	9	2.8
5	1	0.3	5	3	0.9
8	2	0.6	6	2	0.6
			7	1	0.3
			8	1	0.3

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).

Table 7.12: The Productivities of Exporters and Importers in a Trading Relationship are Positively Correlated. (Equivalent to Table 2.2 in the main text.)

Dependent Variable: Importer's Productivity

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.274***	0.260***	0.178***
	(0.061)	(0.060)	(0.048)
Observations	325	325	266

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 7.13: The Value Traded Depends on the Productivity of Both Exporters and Importers. (Equivalent to Table 2.3 in the main text.)

Dependent Variable: (log) Traded Value

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.265***	0.268***	0.172***
	(0.070)	(0.070)	(0.053)
Importer's Productivity	0.100*	0.083	0.161*
	(0.053)	(0.054)	(0.085)
Observations	325	325	266

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. All columns include two sets of industry fixed effects, for the exporter's industry (based on the French industrial classification) and the importer's industry (based on the Colombian industrial classification) . All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by exporter and importer industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

7.7 Summary statistics for the variables in regressions (2.1) and (2.2)

The following table presents descriptive statistics for the dataset used in Section 2. These are descriptive statistics for the non-standardized variables. Coefficients in Tables 2.2 and 2.3 are based on these variables standardized to have mean 0 and standard deviation 1.

Table 7.14: Summary Statistics for the data on French exporters and Colombian importers

	Exporters' Top Partner		All Partners	
	Mean	Std. Deviation	Mean	Std. Deviation
Traded Value	10.25	2.19	10.03	2.16
Exporter - Revenue	17.38	2.04	17.68	2.09
Importer - Revenue	17.56	1.94	17.46	1.91
Exporter - Revenue minus bilateral trade	17.66	2.05	17.95	2.00
Importer - Revenue minus bilateral trade	16.89	1.96	16.80	1.93
Exporter - Productivity Measure		0.60		0.59
Importer - Productivity Measure		0.81		0.83

7.8 Table 2.1 including distribution of matches by importer-product and by exporter-product

Table 7.15: Distribution of the Number of Importers with which an Exporter Trades (per product), and of the Number of Exporters with which an Importer Trades (per product). (Equivalent to Table 2.1 in the main text.)

Number of Exporters-Products	3368				
Number of Importers-Products	3696				
Importers per Exporter-Product			Exporters per Importer-Product		
	Number	%		Number	%
Exporter-products matched to one importer	2983	88.6	Importer-products matched to one exporter	3401	92.0
Exporter-products matched to two importers	275	8.2	Importer-products matched to two exporters	246	6.7
3	47	1.4	3	29	0.8
4	22	0.7	4	9	0.2
5	11	0.3	5	7	0.2
6	12	0.4	6	1	0.0
7	2	0.1	7	1	0.0
8	1	0.0	11	1	0.0
9	4	0.1	14	1	0.0
10	3	0.1			
12	3	0.1			
14	1	0.0			
15	3	0.1			
17	1	0.0			

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

7.9 Evidence on the relationship between exporters' size and number of trading partners.

In this section, I provide evidence on the relationship between exporters' size (and productivity) and the number of importers they trade with. I use the data on French exporters and Colombian importers described in Section 2.

First, I estimate the following equation in which the dependent variable is the number of importing partners of an exporting firm and the explanatory variable is a measure of the productivity of each exporter. I include industry fixed effects (at the two-digit level according to the French industrial classification) and cluster standard errors by industry. Each observation corresponds to an exporting firm.

$$(number\,of\,partners)_e = \beta_1 (exporter's\,productivity)_e + \phi_{ind} + \epsilon_e \tag{7.1}$$

Table 7.16 shows the results. In the first, column, the explanatory variable is exporter size (total revenue) as a proxy for productivity. In the second column, I use total revenue minus exports to Colombia. In the third column, I measure productivity as a within-industry (log) sales to labor costs ratio, as described in Section 2. A one standard deviation increase in exporters' productivity is associated with a 0.124 to 0.165 standard deviations increase in the number of importers that exporters trade with depending on the measure used.

To complement this result, Figure 7.1 groups French exporters based on the number of importing partners. For each group of exporters, it shows the size of each exporting firm, measured by total revenue. (Note that differently than this figure, the regression results discussed earlier reflect a within-industry pattern.) The figure shows that while some large exporters have several trading partners, a majority have a single one.

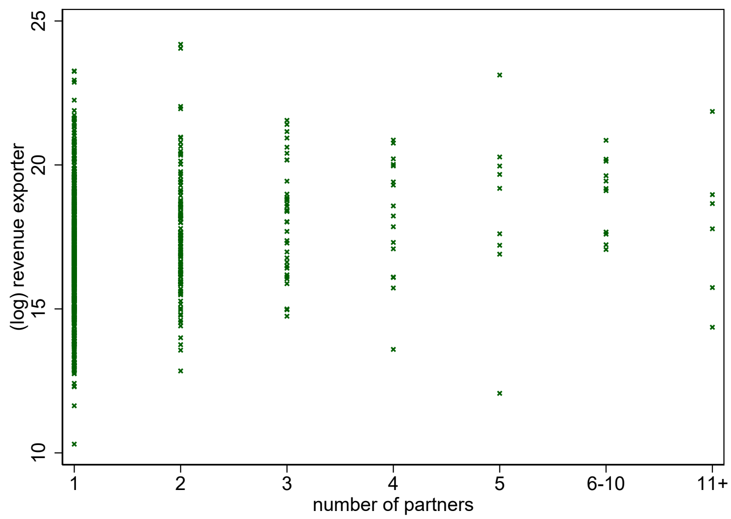
Table 7.16: Exporter Productivity and Number of Trading Partners.

Dependent Variable: Exporter's Number of Trading Partners

	Measure of Productivity		
	Revenue	Revenue minus bilateral trade	Estimated Productivity
Exporter's Productivity	0.165***	0.155**	0.124**
	(0.061)	(0.064)	(0.062)
Observations	866	866	735

Notes: The first column on the left shows the results for the estimation of equation 7.1 using exporters' (log) revenue as a proxy for their productivity. The second column shows the results using exporters' revenue minus their exports to Colombia. The third column uses the measure of productivity described in the text. All columns include industry fixed effects (based on the French industrial classification). All variables are standardized. Standard errors are reported under the estimated coefficients and are clustered by industry. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Figure 7.1: Exporter Size and Number of Trading Partners



Notes: Each observation corresponds to an exporter in France. The vertical axis shows the (log) total revenue of each exporter. The horizontal axis corresponds to the number of importing partners of each exporter. The horizontal axis groups exporters into those with one, two, three, four, five, six to ten, and eleven or more trading partners.

8 Appendix to Section 3

This appendix includes:

8.1 Detailed Solution to the Exporters' Problem

This section describes in detail the solution to an exporter's problem of choosing an importing partner abroad.[42] Exporters maximize their expected profits choosing an optimal search effort n_X. The maximization problem is the following:

$$\max_{n_X} \int_0^\infty f^n_{\max}(\varphi_I) \cdot \pi_{E_X}(\varphi_E, \varphi_I) d\varphi_I - \lambda \cdot n_X - f_X \tag{8.1}$$

The first term in this equation represents the expected operating profits for the exporter obtained from a trading relationship with an importer of productivity φ_I, given a search effort n_X. 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.

Exporters' operating profits in a relationship with a importer of productivity φ_I are:

$$\pi_{E_X}(\varphi_E, \varphi_I) = \kappa_5 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot \varphi_I^{(\sigma-1)\cdot(1-\nu)} \ . \tag{8.2}$$

The maximization problem can then be written as:

$$\max_{n_X} \ \kappa_5 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot \int_0^\infty n_X \cdot \gamma_I \cdot \varphi_I^{(1-\nu)\cdot(\sigma-1)-\gamma_I-1} \cdot e^{-n_X\cdot\varphi_I^{-\gamma_I}} d\varphi_I - \lambda \cdot n_X - f_X \tag{8.3}$$

To evaluate the integral, define $t = n_X \cdot \varphi_I^{-\gamma_I}$ and integrate in terms of t. The maximization problem is:

$$\max_{n_X} \ \kappa_5 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n_X^{\frac{\phi-1}{\phi}} \cdot \int_0^\infty t^{-\frac{\phi-1}{\phi}} \cdot e^{-t} dt - \lambda \cdot n_X - f_X \tag{8.4}$$

with $\phi = \frac{\gamma_I}{\gamma_I-(\sigma-1)(1-\nu)}$. Note that the integral is a gamma function.[43] In general:

$$\int_0^\infty t^{-\alpha} \cdot e^{-t} \cdot dt = \Gamma(1-\alpha) \ . \tag{8.5}$$

The maximization problem can then be written as:

$$\max_{n_X} \ \kappa_9 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n_X^{\frac{\phi-1}{\phi}} - \lambda \cdot n_X - f_X \tag{8.6}$$

with $\kappa_9 = \kappa_5 \cdot \Gamma(\frac{1}{\phi})$. The first order condition is:

$$\frac{\phi-1}{\phi} \cdot \kappa_9 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n_X^{*\,\frac{-1}{\phi}} - \lambda = 0 \tag{8.7}$$

[42] The problem of a producer of finding a distributor in the domestic market is analogous, excluding trade costs τ and replacing the exporting fixed cost f_X by the domestic fixed cost f.

[43] It is necessary to impose a shape parameter γ_I of the Fréchet distribution of importer productivities large enough such that $\gamma_I > (1-\nu)\cdot(\sigma-1)$.

The optimal search effort is:

$$n_X^* = \kappa_7 \cdot \left(\frac{A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma - 1)}}{\lambda} \right)^{\phi} \tag{8.8}$$

with $\kappa_7 = \left(\frac{\phi - 1}{\phi} \cdot \kappa_5 \cdot \Gamma(\frac{1}{\phi}) \right)^{\phi}$ as was defined in Section 3.

8.2 Comparative Statics

This section includes the proofs to the comparative statics in propositions I, II, III, IV and V in the main text.

Proposition I. Exporters with a higher productivity φ_E:

i. Have a higher search effort in the domestic and foreign markets.

ii. Have a higher expected productivity of their trading partner in the domestic and foreign markets.

iii. Obtain larger expected revenue in the domestic and foreign markets.

Proof:

• i) Consider the case of exporters' matches in foreign markets. (The case of the domestic market is analogous). Exporters' optimal search effort is:

$$n_X^* = \kappa_7 \cdot \left(\frac{A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma-1)}}{\lambda} \right)^{\phi} . \tag{8.9}$$

with $\phi = \frac{\gamma_I}{\gamma_I - (\sigma-1)\cdot(1-\nu)}$. The derivative of exporters' optimal search effort with respect to exporters' productivity is:

$$\frac{dn_X^*}{d\varphi_E} = \phi \cdot \nu \cdot (\sigma - 1) \cdot \frac{n_X^*}{\varphi_E} > 0 \tag{8.10}$$

• ii) The expected productivity of an exporters' match (conditional on exporter productivity) is:

$$E[\varphi_I|\varphi_E] = {n_X^*}^{\frac{1}{\gamma_I}} \cdot \Gamma\left[\frac{\gamma_I - 1}{\gamma_I}\right] . \tag{8.11}$$

(Note that it is necessary to impose a shape parameter γ_I of the Fréchet distribution of importer productivities large enough such that $\gamma_I > 1$.) Its derivative with respect to the exporter's productivity is:

$$\frac{dE[\varphi_I|\varphi_E]}{d\varphi_E} = \frac{dE[\varphi_I|\varphi_E]}{dn_X^*} \cdot \frac{dn_X^*}{d\varphi_E} . \tag{8.12}$$

The derivative of this expected productivity $E[\varphi_I|\varphi_E]$ with respect to n_X^* is:

$$\frac{dE[\varphi_I|\varphi_E]}{dn_X^*} = \frac{1}{\gamma_I} \cdot {n_X^*}^{\frac{1-\gamma_I}{\gamma_I}} \cdot \Gamma[\frac{\gamma_I - 1}{\gamma_I}] = \frac{E[\varphi_I|\varphi_E]}{\gamma_I \cdot n_X^*} , \tag{8.13}$$

such that:

$$\frac{dE[\varphi_I|\varphi_E]}{d\varphi_E} = \frac{\phi \cdot \nu \cdot (\sigma - 1) \cdot E[\varphi_I|\varphi_E]}{\gamma_I \cdot \varphi_E} > 0 . \tag{8.14}$$

• iii) The expected revenue of an exporter (conditional on its own productivity) can be written as:

$$E[r_{E_X}|\varphi_E] = \kappa_{10} \cdot \kappa_7^{\frac{\phi-1}{\phi}} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot \lambda^{-(\phi-1)} \quad , \tag{8.15}$$

with $\kappa_{10} = \kappa_6 \cdot \Gamma(\frac{1}{\phi})$. Its derivative with respect to φ_E is:

$$\frac{dE[r_{E_X}|\varphi_E]}{d\varphi_E} = \frac{\phi \cdot \nu \cdot (\sigma-1) \cdot E[r_{E_X}|\varphi_E]}{\varphi_E} > 0 \tag{8.16}$$

Proposition II. A decline in trade costs (τ):

i. Leads exporting firms to increase their search effort in foreign markets.

ii. Leads exporting firms to find and choose partners of higher expected productivity in foreign markets.

iii. Leads exporting firms to obtain a larger expected revenue in foreign markets.

Proof:

• i) Consider the case of exporters' matches in foreign markets. (Firms do not face trade costs in the domestic market). The derivative of exporters' optimal search effort with respect to the trade cost τ is:

$$\frac{dn_X^*}{d\tau} = \frac{\partial n_X^*}{\partial \tau} + \frac{\partial n_X^*}{\partial A} \cdot \frac{dA}{d\tau} \tag{8.17}$$

The partial derivative of exporters' search effort (in equation (8.9)) with respect to τ is:

$$\frac{\partial n_X^*}{\partial \tau} = \phi \cdot \nu \cdot (1-\sigma) \cdot \frac{n_X^*}{\tau} < 0 \tag{8.18}$$

The partial derivative of exporters' search effort with respect to A is:

$$\frac{\partial n_X^*}{\partial A} = \phi \cdot \frac{n_X^*}{A} > 0 \tag{8.19}$$

To compute the derivative of A with respect to τ I use the free entry condition (equation (3.15)), which equates the value of entry to the sunk entry cost. Expected profits in the domestic market (conditional on successful entry) are:

$$\bar{\pi}_E = \int_{\underline{\varphi}_E}^{\infty} E[\pi_E|\varphi_E] \cdot \frac{g(\varphi_E)}{1-G(\underline{\varphi}_E)} d\varphi_E \tag{8.20}$$

and expected profits in each foreign market (conditional on exporting) are:

$$\bar{\pi}_{E_X} = \int_{\underline{\varphi}_E^X}^{\infty} E[\pi_{E_X}|\varphi_E] \cdot \frac{g(\varphi_E)}{1-G(\underline{\varphi}_E^X)} d\varphi_E \tag{8.21}$$

Note that it is necessary to impose that the shape parameter γ_E is large enough such that $\gamma_E > \phi \cdot \nu \cdot (\sigma-1)$. Expected profits conditional on exporters' productivity in the domestic and foreign markets are:

$$E[\pi_E|\varphi_E] = \kappa_9 \cdot A \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n^{*\frac{\phi-1}{\phi}} - \lambda \cdot n^* - f = \kappa_{11} \cdot A^\phi \cdot \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot \lambda^{-(\phi-1)} - f \quad (8.22)$$

and

$$\begin{aligned} E[\pi_{E_X}|\varphi_E] &= \kappa_9 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n_X^{*\frac{\phi-1}{\phi}} - \lambda \cdot n_X^* - f_X \\ &= \kappa_{11} \cdot A^\phi \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot \lambda^{-(\phi-1)} - f_X \quad (8.23) \end{aligned}$$

where $\kappa_{11} = \kappa_9 \cdot \kappa_7^{\frac{\phi-1}{\phi}} - \kappa_7$. It is convenient to define a function $H(A, \tau)$ which is equal to zero given the free entry condition. Replacing expected profits in (8.20) and (8.21) in the free entry condition and simplifying:

$$\begin{aligned} H(A,\tau) = \kappa_{11} \cdot A^\phi \cdot \lambda^{-(\phi-1)} \cdot \int_{\underline{\varphi}_E}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) d\varphi_E - f \int_{\underline{\varphi}_E}^{\infty} g(\varphi_E) d\varphi_E + \\ N \cdot \kappa_{11} \cdot A^\phi \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)} \int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E \\ - N \cdot f_X \cdot \int_{\underline{\varphi}_E^X}^{\infty} g(\varphi_E) \cdot d\varphi_E - F_e = 0 \quad (8.24) \end{aligned}$$

Implicitly differentiating, the derivative of A with respect to τ is:

$$\frac{dA}{d\tau} = \frac{-\frac{\partial H}{\partial \tau}}{\frac{\partial H}{\partial A}} \quad (8.25)$$

Replacing (8.18), (8.19) and (8.25) in (8.17) I can write the total derivative:

$$\frac{dn_X^*}{d\tau} = \phi \cdot n_X^* \cdot \left(\frac{\nu \cdot (1-\sigma) \cdot A \cdot \frac{\partial H}{\partial A} - \tau \cdot \frac{\partial H}{\partial \tau}}{\tau \cdot A \cdot \frac{\partial H}{\partial A}} \right) \quad (8.26)$$

Using Leibniz' rule,

$$\begin{aligned} \frac{\partial H}{\partial A} = \frac{\phi \cdot \kappa_{11} \cdot A^\phi \cdot \lambda^{-(\phi-1)}}{A} \cdot \left(\int_{\underline{\varphi}_E}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) d\varphi_E \right) \\ - \frac{d\underline{\varphi}_E}{dA} \cdot g(\underline{\varphi}_E) \cdot \left(\kappa_{11} \cdot A^\phi \cdot \lambda^{-(\phi-1)} (\underline{\varphi}_E)^{\phi\cdot\nu\cdot(\sigma-1)} - f \right) \\ + \frac{\phi \cdot N \cdot \kappa_{11} \cdot A^\phi \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)}}{A} \cdot \left(\int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E \right) \\ - \frac{d\underline{\varphi}_E^X}{dA} \cdot g(\underline{\varphi}_E^X) \cdot N \cdot \left(\kappa_{11} \cdot A^\phi \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)} (\underline{\varphi}_E^X)^{\phi\cdot\nu\cdot(\sigma-1)} - f_X \right) \quad (8.27) \end{aligned}$$

In the expression above, the second term is equal to zero given the definition of the domestic productivity cutoff $\underline{\varphi}_E$. The fourth term is equal to zero given the definition of the export productivity cutoff $\underline{\varphi}_E^X$. This means:

$$\frac{\partial H}{\partial A} = \frac{\phi \cdot \kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)}}{A} \cdot \left(\int_{\underline{\varphi}_E}^{\infty} \varphi_E^{\phi \cdot \nu \cdot (\sigma-1)} \cdot g(\varphi_E) d\varphi_E \right)$$
$$+ \frac{\phi \cdot N \cdot \kappa_{11} \cdot A^{\phi} \cdot \tau^{\phi \cdot \nu \cdot (1-\sigma)} \cdot \lambda^{-(\phi-1)}}{A} \cdot \left(\int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi \cdot \nu \cdot (\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E \right) \quad (8.28)$$

These two terms are positive. This means the denominator in equation (8.26) is positive. Next, I show below the numerator in equation (8.26) is positive. Using once again Leibniz' rule:

$$\frac{\partial H}{\partial \tau} = \frac{N \cdot \phi \cdot \nu \cdot (1-\sigma) \cdot \kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)} \cdot \tau^{\phi \cdot \nu \cdot (1-\sigma)}}{\tau} \cdot \left(\int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi \cdot \nu \cdot (\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E \right)$$
$$- \frac{d\underline{\varphi}_E^X}{d\tau} \cdot g(\underline{\varphi}_E^X) \cdot N \cdot \left(\kappa_{11} \cdot A^{\phi} \cdot \tau^{\phi \cdot \nu \cdot (1-\sigma)} \cdot \lambda^{-(\phi-1)} (\underline{\varphi}_E)^{\phi \cdot \nu \cdot (\sigma-1)} - f_X \right) \quad (8.29)$$

In the expression above, the second term is equal to zero given the definition of the exporting productivity cutoff $\underline{\varphi}_E^X$. This means:

$$\frac{\partial H}{\partial \tau} = \frac{N \cdot \phi \cdot \nu \cdot (1-\sigma) \cdot \kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)} \cdot \tau^{\phi \cdot \nu \cdot (1-\sigma)}}{\tau} \cdot \left(\int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi \cdot \nu \cdot (\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E \right) \quad (8.30)$$

Replacing in the numerator of the term in parenthesis in (8.26) and simplifying (several terms cancel out):

$$\nu \cdot (1-\sigma) \cdot A \cdot \frac{\partial H}{\partial A} - \tau \cdot \frac{\partial H}{\partial \tau} = \nu \cdot (1-\sigma) \cdot \phi \cdot \kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)} \cdot \int_{\underline{\varphi}_E}^{\infty} \varphi_E^{\phi \cdot \nu \cdot (\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E < 0 \quad (8.31)$$

This means the numerator of equation (8.26) is negative. This implies $\frac{dn_X^*}{d\tau} < 0$.

• ii) The derivative of the expected productivity of an exporters' match (conditional on exporters' productivity) with respect to τ is:

$$\frac{dE[\varphi_I|\varphi_E]}{d\tau} = \frac{dE[\varphi_I|\varphi_E]}{dn_X^*} \cdot \frac{dn_X^*}{d\tau} \quad (8.32)$$

The first term is positive (see equation (8.13)) and the second term is negative, so $\frac{dE[\varphi_I|\varphi_E]}{d\tau} < 0$.

• iii) The derivative of exporters' expected revenue (conditional on exporter productivity) (in equation (8.15)) with respect to τ is:

$$\frac{dE[r_{E_X}|\varphi_E]}{d\tau} = \frac{\partial E[r_{E_X}|\varphi_E]}{\partial \tau} + \frac{\partial E[r_{E_X}|\varphi_E]}{\partial A} \cdot \frac{dA}{d\tau} \tag{8.33}$$

The partial derivative with respect to τ is:

$$\frac{\partial E[r_{E_X}|\varphi_E]}{\partial \tau} = \frac{\phi \cdot \nu \cdot (1-\sigma) \cdot E[r_{E_X}|\varphi_E]}{\tau} \tag{8.34}$$

The partial derivative with respect to A is:

$$\frac{\partial E[r_{E_X}|\varphi_E]}{\partial A} = \frac{\phi \cdot E[r_{E_X}|\varphi_E]}{A} \tag{8.35}$$

Combining (8.34), (8.35), and (8.25):

$$\frac{dE[r_{E_X}|\varphi_E]}{d\tau} = \phi \cdot E[r_{E_X}|\varphi_E] \cdot \left(\frac{\nu \cdot (1-\sigma) \cdot A \cdot \frac{\partial H}{\partial A} - \tau \cdot \frac{\partial H}{\partial \tau}}{\tau \cdot A \cdot \frac{\partial H}{\partial A}} \right) < 0 \tag{8.36}$$

Note that the numerator of the term in parenthesis was found to be negative in equation (8.31) and that $\frac{\partial H}{\partial A} > 0$ as shown earlier.

Proposition III. A decline in search costs:

i. Leads exporting firms to increase their search effort in the domestic and foreign markets.

ii. Leads exporting firms to find and choose partners of higher expected productivity in the domestic and foreign markets.

iii. Has no impact on exporting firms' expected revenue in the domestic and foreign markets.

PROOF:

• i) Consider the case of exporters' matches in foreign markets. (The case of the domestic market is analogous). The derivative of exporters' optimal search effort with respect to the search cost λ is:

$$\frac{dn_X^*}{d\lambda} = \frac{\partial n_X^*}{\partial \lambda} + \frac{\partial n_X^*}{\partial A} \cdot \frac{dA}{d\lambda} \tag{8.37}$$

The partial derivative of exporters' search effort (in equation (8.9)) with respect to λ is:

$$\frac{\partial n_X^*}{\partial \lambda} = -\phi \cdot \frac{n_X^*}{\lambda} < 0 \tag{8.38}$$

The partial derivative of exporters' search effort with respect to A is:

$$\frac{\partial n_X^*}{\partial A} = \phi \cdot \frac{n_X^*}{A} > 0 \tag{8.39}$$

To compute the derivative of A with respect to λ I use the free entry condition. The definition of expected profits, used in the free entry condition, are described in detail in the proof to proposition II earlier. As in the case of proposition II, it is convenient to define a function $H(A, \lambda)$ which is equal to zero given the free entry condition.

$$H(A,\lambda) = \kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)} \cdot \int_{\underline{\varphi}_E}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) d\varphi_E - f \int_{\underline{\varphi}_E}^{\infty} g(\varphi_E) d\varphi_E + N \cdot \kappa_{11} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)} \int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E - N \cdot f_X \cdot \int_{\underline{\varphi}_E^X}^{\infty} g(\varphi_E) \cdot d\varphi_E - F_e = 0 \quad (8.40)$$

Implicitly differentiating, the derivative of A with respect to λ is:

$$\frac{dA}{d\lambda} = \frac{-\frac{\partial H}{\partial \lambda}}{\frac{\partial H}{\partial A}} \quad (8.41)$$

Replacing (8.38), (8.39) and (8.41) in (8.37) I can write the total derivative:

$$\frac{dn_X^*}{d\lambda} = \phi \cdot n_X^* \cdot \left(\frac{-A \cdot \frac{\partial H}{\partial A} - \lambda \cdot \frac{\partial H}{\partial \lambda}}{\lambda \cdot A \cdot \frac{\partial H}{\partial A}} \right) \quad (8.42)$$

It was already shown in the proof to proposition II above that $\frac{\partial H}{\partial A}$ is positive, so the denominator in this expression is positive. Using Leibniz' rule,

$$\frac{\partial H}{\partial \lambda} = -\frac{(\phi-1) \cdot \kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)}}{\lambda} \cdot \left(\int_{\underline{\varphi}_E}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) d\varphi_E \right) - \frac{d\underline{\varphi}_E}{d\lambda} \cdot g(\underline{\varphi}_E) \cdot \left(\kappa_{11} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)} (\underline{\varphi}_E)^{\phi\cdot\nu\cdot(\sigma-1)} - f \right) - \frac{(\phi-1) \cdot N \cdot \kappa_{11} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)}}{\lambda} \cdot \left(\int_{\underline{\varphi}_E^X}^{\infty} \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot g(\varphi_E) \cdot d\varphi_E \right) - \frac{d\underline{\varphi}_E^X}{d\lambda} \cdot g(\underline{\varphi}_E^X) \cdot N \cdot \left(\kappa_{11} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)} (\underline{\varphi}_E^X)^{\phi\cdot\nu\cdot(\sigma-1)} - f_X \right) \quad (8.43)$$

In the expression above, the second term is equal to zero given the definition of the domestic productivity cutoff $\underline{\varphi}_E$. The fourth term is equal to zero given the definition of the export productivity cutoff $\underline{\varphi}_E^X$. This means:

$$\frac{\partial H}{\partial \lambda} = -\frac{(\phi-1)\cdot\kappa_{11}\cdot A^{\phi}\cdot\lambda^{-(\phi-1)}}{\lambda}\cdot\left(\int_{\underline{\varphi}_E}^{\infty}\varphi_E^{\phi\cdot\nu\cdot(\sigma-1)}\cdot g(\varphi_E)d\varphi_E\right)$$
$$-\frac{(\phi-1)\cdot N\cdot\kappa_{11}\cdot A^{\phi}\cdot\tau^{\phi\cdot\nu\cdot(1-\sigma)}\cdot\lambda^{-(\phi-1)}}{\lambda}\cdot\left(\int_{\underline{\varphi}_E^X}^{\infty}\varphi_E^{\phi\cdot\nu\cdot(\sigma-1)}\cdot g(\varphi_E)\cdot d\varphi_E\right) \quad (8.44)$$

Replacing in the numerator of the term in parenthesis in (8.42) and simplifying,

$$-A\cdot\frac{\partial H}{\partial A}-\lambda\cdot\frac{\partial H}{\partial \lambda} = -\kappa_{11}\cdot A^{\phi}\cdot\lambda^{-(\phi-1)}\cdot\int_{\underline{\varphi}_E}^{\infty}\varphi_E^{\phi\cdot\nu\cdot(\sigma-1)}\cdot g(\varphi_E)\cdot d\varphi_E$$
$$-N\cdot\kappa_{11}\cdot A^{\phi}\cdot\tau^{\phi\cdot\nu\cdot(1-\sigma)}\cdot\lambda^{-(\phi-1)}\cdot\int_{\underline{\varphi}_E^X}^{\infty}\varphi_E^{\phi\cdot\nu\cdot(\sigma-1)}\cdot g(\varphi_E)\cdot d\varphi_E < 0 \quad (8.45)$$

Both the first and the second terms in this expression are negative. This means the numerator of equation (8.42) is negative. This implies $\frac{dn_X^*}{d\lambda} < 0$.

- ii) The derivative of the expected productivity of an exporters' match (conditional on exporters' productivity) with respect to λ is:

$$\frac{dE[\varphi_I|\varphi_E]}{d\lambda} = \frac{dE[\varphi_I|\varphi_E]}{dn_X^*}\cdot\frac{dn_X^*}{d\lambda} \quad (8.46)$$

The first term is positive (see equation (8.13)) and the second term is negative, so $\frac{dE[\varphi_I|\varphi_E]}{d\lambda} < 0$.

- iii) The derivative of exporters' expected revenue (conditional on exporter productivity) (in equation (8.15)) with respect to λ is:

$$\frac{dE[r_{E_X}|\varphi_E]}{d\lambda} = \frac{\partial E[r_{E_X}|\varphi_E]}{\partial\lambda}+\frac{\partial E[r_{E_X}|\varphi_E]}{\partial A}\cdot\frac{dA}{d\lambda} \quad (8.47)$$

The partial derivative with respect to λ is:

$$\frac{\partial E[r_{E_X}|\varphi_E]}{\partial\lambda} = -(\phi-1)\cdot\frac{E[r_{E_X}|\varphi_E]}{\lambda} \quad (8.48)$$

Combining (8.48), (8.35), and (8.41):

$$\frac{dE[r_{E_X}|\varphi_E]}{d\lambda} = E[r_{E_X}|\varphi_E]\cdot\left(\frac{-(\phi-1)\cdot A\cdot\frac{\partial H}{\partial A}-\phi\cdot\lambda\cdot\frac{\partial H}{\partial\lambda}}{\lambda\cdot A\cdot\frac{\partial H}{\partial A}}\right) \quad (8.49)$$

Replacing (8.28) and (8.44), the numerator in the term in parenthesis is equal to zero. As search costs fall a partial equilibrium result increases search effort, leading an increase in the expected productivity of trading partners and an increase in expected revenue. This effect on expected revenue is cancelled out, however, by a general equilibrium effect in the opposite direction.

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

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

ii. Negatively on trade costs.

PROOF:

• i) Consider the case of exporters' sales to a foreign market (the case of sales to the domestic market is analogous). An exporters' revenue from its sales to an importer in a foreign market is:

$$r_{E_X}(\varphi_E, \varphi_I) = \kappa_6 \cdot A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma-1)} \cdot \varphi_I^{(\sigma-1) \cdot (1-\nu)} \; . \tag{8.50}$$

It is immediate to see that:

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\varphi_E} = \nu \cdot (\sigma - 1) \cdot \frac{r_{E_X}(\varphi_E, \varphi_I)}{\varphi_E} > 0 \tag{8.51}$$

and

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\varphi_I} = (1 - \nu) \cdot (\sigma - 1) \cdot \frac{r_{E_X}(\varphi_E, \varphi_I)}{\varphi_I} > 0 \; . \tag{8.52}$$

• ii) The derivative of exporters' revenue in a relationship $r_E(\varphi_E, \varphi_I)$, with respect to the trade cost τ is:

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\tau} = \frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial \tau} + \frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial A} \cdot \frac{dA}{d\tau} \tag{8.53}$$

The partial derivative of exporters' revenue in a relationship $r_{E_X}(\varphi_E, \varphi_I)$ with respect to τ is:

$$\frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial \tau} = \nu \cdot (1 - \sigma) \cdot \frac{r_{E_X}(\varphi_E, \varphi_I)}{\tau} < 0 \tag{8.54}$$

The partial derivative of exporters' revenue in a relationship $r_{E_X}(\varphi_E, \varphi_I)$ with respect to A is:

$$\frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial A} = \frac{r_{E_X}(\varphi_E, \varphi_I)}{A} > 0 \tag{8.55}$$

The derivative $\frac{dA}{d\tau}$ has been obtained using the free entry condition in the proof to proposition II above and was expressed as:

$$\frac{dA}{d\tau} = \frac{-\frac{\partial H}{\partial \tau}}{\frac{\partial H}{\partial A}} \tag{8.56}$$

Replacing (8.54), (8.55) and (8.56) in (8.34) I can write the total derivative:

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\tau} = \frac{r_{E_X}(\varphi_E, \varphi_I)}{\tau \cdot A \cdot \frac{\partial H}{\partial A}} \cdot \left(\nu \cdot (1 - \sigma) \cdot A \cdot \frac{\partial H}{\partial A} - \tau \cdot \frac{\partial H}{\partial \tau} \right) \tag{8.57}$$

It was already shown in the proof to proposition II that the term in parenthesis is negative. This means $\frac{dr_{E_X}}{d\tau} < 0$.

Proposition V. Reductions in trade costs (τ) or in search costs (λ) increase welfare.

PROOF:

Note: The second part of Proposition V is proved in section 8.4.

Welfare per worker is the ratio of wages (normalized to one) to the price level. Using the definition $A = \frac{E}{P^{1-\sigma}} = L \cdot P^{\sigma-1}$, welfare per worker can be written as:

$$W = \frac{1}{P} = A^{\frac{1}{1-\sigma}} \cdot L^{\frac{1}{\sigma-1}} \tag{8.58}$$

• The derivative of welfare per worker with respect to trade costs (τ) is:

$$\frac{dW}{d\tau} = \frac{dW}{dA} \cdot \frac{dA}{d\tau} \tag{8.59}$$

where

$$\frac{dW}{dA} = \frac{1}{1-\sigma} \cdot \frac{W}{A} < 0 \tag{8.60}$$

and

$$\frac{dA}{d\tau} = \frac{-\frac{\partial H}{\partial \tau}}{\frac{\partial H}{\partial A}} \tag{8.61}$$

The term $\frac{\partial H}{\partial \tau}$ is negative (see equation (8.30)) while the term $\frac{\partial H}{\partial A}$ is positive (see equation (8.28)), so $\frac{dA}{d\tau} > 0$. This means that welfare increases in response to a decline in trade costs.

• The derivative of welfare per worker with respect to search costs (λ) is:

$$\frac{dW}{d\lambda} = \frac{dW}{dA} \cdot \frac{dA}{d\lambda} \tag{8.62}$$

where

$$\frac{dA}{d\lambda} = \frac{-\frac{\partial H}{\partial d\lambda}}{\frac{\partial H}{\partial A}} \tag{8.63}$$

The term $\frac{\partial H}{\partial d\lambda}$ is negative (see equation (8.44)) while the term $\frac{\partial H}{\partial A}$ is positive (see equation (8.28)), so $\frac{dA}{dd\lambda} > 0$. This means that welfare increases in response to a decline in search costs.

8.3 Comparative Statics

This section includes the proofs to the comparative statics in propositions I, II, III, IV and V in the main text.

Proposition I. Exporters with a higher productivity φ_E:

i. Have a higher search effort in the domestic and foreign markets.

ii. Have a higher expected productivity of their trading partner in the domestic and foreign markets.

iii. Obtain larger expected revenue in the domestic and foreign markets.

PROOF:

• i) Consider the case of exporters' matches in foreign markets. (The case of the domestic market is analogous). Exporters' optimal search effort is:

$$n_X^* = \kappa_7 \cdot \left(\frac{A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma - 1)}}{\lambda} \right)^{\phi} . \tag{8.64}$$

with $\phi = \frac{\gamma_I}{\gamma_I - (\sigma-1)\cdot(1-\nu)}$. The derivative of exporters' optimal search effort with respect to exporters' productivity is:

$$\frac{dn_X^*}{d\varphi_E} = \phi \cdot \nu \cdot (\sigma - 1) \cdot \frac{n_X^*}{\varphi_E} > 0 \tag{8.65}$$

• ii) The expected productivity of an exporters' match (conditional on exporter productivity) is:

$$E[\varphi_I|\varphi_E] = {n_X^*}^{\frac{1}{\gamma_I}} \cdot \Gamma\left[\frac{\gamma_I - 1}{\gamma_I}\right] . \tag{8.66}$$

(Note that it is necessary to impose a shape parameter γ_I of the Fréchet distribution of importer productivities large enough such that $\gamma_I > 1$.) Its derivative with respect to the exporter's productivity is:

$$\frac{dE[\varphi_I|\varphi_E]}{d\varphi_E} = \frac{dE[\varphi_I|\varphi_E]}{dn_X^*} \cdot \frac{dn_X^*}{d\varphi_E} . \tag{8.67}$$

The derivative of this expected productivity $E[\varphi_I|\varphi_E]$ with respect to n_X^* is:

$$\frac{dE[\varphi_I|\varphi_E]}{dn_X^*} = \frac{1}{\gamma_I} \cdot {n_X^*}^{\frac{1-\gamma_I}{\gamma_I}} \cdot \Gamma[\frac{\gamma_I - 1}{\gamma_I}] = \frac{E[\varphi_I|\varphi_E]}{\gamma_I \cdot n_X^*} , \tag{8.68}$$

such that:

$$\frac{dE[\varphi_I|\varphi_E]}{d\varphi_E} = \frac{\phi \cdot \nu \cdot (\sigma - 1) \cdot E[\varphi_I|\varphi_E]}{\gamma_I \cdot \varphi_E} > 0 . \tag{8.69}$$

• iii) The expected revenue of an exporter (conditional on its own productivity) can be written as:

$$E[r_{E_X}|\varphi_E] = \kappa_{10} \cdot \kappa_7^{\frac{\phi-1}{\phi}} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot \lambda^{-(\phi-1)} \quad , \tag{8.70}$$

with $\kappa_{10} = \kappa_6 \cdot \Gamma(\frac{1}{\phi})$. Its derivative with respect to φ_E is:

$$\frac{dE[r_{E_X}|\varphi_E]}{d\varphi_E} = \frac{\phi \cdot \nu \cdot (\sigma - 1) \cdot E[r_{E_X}|\varphi_E]}{\varphi_E} > 0 \tag{8.71}$$

Proposition II. A decline in trade costs (τ):

i. Leads exporting firms to increase their search effort in foreign markets.

ii. Leads exporting firms to find and choose partners of higher expected productivity in foreign markets.

iii. Leads exporting firms to obtain a larger expected revenue in foreign markets.

PROOF:

• i) Consider the case of exporters' matches in foreign markets. (Firms do not face trade costs when selling to the domestic market). The derivative of exporters' optimal search effort with respect to the trade cost τ is:

$$\frac{dn_X^*}{d\tau} = \frac{\partial n_X^*}{\partial \tau} + \frac{\partial n_X^*}{\partial A} \cdot \frac{dA}{d\tau} \tag{8.72}$$

The partial derivative of exporters' search effort (in equation (8.64)) with respect to τ is:

$$\frac{\partial n_X^*}{\partial \tau} = \phi \cdot \nu \cdot (1 - \sigma) \cdot \frac{n_X^*}{\tau} < 0 \tag{8.73}$$

The partial derivative of exporters' search effort with respect to A is:

$$\frac{\partial n_X^*}{\partial A} = \phi \cdot \frac{n_X^*}{A} > 0 \tag{8.74}$$

To compute the derivative of A with respect to τ I use the free entry condition (equation (3.15)), which equates the value of entry to the sunk entry cost. Expected profits in the domestic market (conditional on successful entry) are:

$$\bar{\pi}_E = \int_{\underline{\varphi}_E}^{\infty} E[\pi_E|\varphi_E] \cdot \frac{g(\varphi_E)}{1 - G(\underline{\varphi}_E)} d\varphi_E \tag{8.75}$$

and expected profits in each foreign market (conditional on exporting) are:

$$\bar{\pi}_{E_X} = \int_{\underline{\varphi}_E^X}^{\infty} E[\pi_{E_X}|\varphi_E] \cdot \frac{g(\varphi_E)}{1 - G(\underline{\varphi}_E^X)} d\varphi_E \tag{8.76}$$

Expected profits conditional on exporters' productivity in the domestic and foreign markets are:

$$E[\pi_E|\varphi_E] = \kappa_9 \cdot A \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n^{*\,\frac{\phi-1}{\phi}} - \lambda \cdot n^* - f = \kappa_{11} \cdot A^{\phi} \cdot \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot \lambda^{-(\phi-1)} - f \quad (8.77)$$

and

$$\begin{aligned} E[\pi_{E_X}|\varphi_E] &= \kappa_9 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot n_X^{*\,\frac{\phi-1}{\phi}} - \lambda \cdot n_X^* - f_X \\ &= \kappa_{11} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \varphi_E^{\phi\cdot\nu\cdot(\sigma-1)} \cdot \lambda^{-(\phi-1)} - f_X \quad (8.78) \end{aligned}$$

where $\kappa_{11} = \kappa_9 \cdot \kappa_7^{\frac{\phi-1}{\phi}} - \kappa_7$. Expected profits (before drawing a productivity parameter) in the domestic and foreign markets are such that:

$$(1 - G(\underline{\varphi}_E)) \cdot \bar{\pi}_E = \kappa_{12} \cdot A^{\phi} \cdot \lambda^{-(\phi-1)} \cdot \underline{\varphi}_E^{\phi\cdot\nu\cdot(\sigma-1)-\gamma_E} - f \cdot \underline{\varphi}_E^{-\gamma_E} \quad (8.79)$$

and

$$(1 - G(\underline{\varphi}_E^X)) \cdot \bar{\pi}_{E_X} = \kappa_{12} \cdot A^{\phi} \cdot \tau^{\phi\cdot\nu\cdot(1-\sigma)} \cdot \lambda^{-(\phi-1)} \cdot (\underline{\varphi}_E^X)^{\phi\cdot\nu\cdot(\sigma-1)-\gamma_E} - f_X \cdot (\underline{\varphi}_E^X)^{-\gamma_E} \quad (8.80)$$

where $\kappa_{12} = \frac{\gamma_E\cdot\kappa_{11}}{\gamma_E-\phi\cdot\nu\cdot(\sigma-1)}$. Note that it is necessary to impose that the shape parameter γ_E is large enough such that $\gamma_E > \phi \cdot \nu \cdot (\sigma - 1)$. The productivity cutoffs for the domestic and export markets are:

$$\underline{\varphi}_E = \kappa_8 \cdot \left(\frac{f^{\frac{1}{\phi}} \cdot \lambda^{\frac{\phi-1}{\phi}}}{A} \right)^{\frac{1}{\nu\cdot(\sigma-1)}} \quad (8.81)$$

and

$$\underline{\varphi}_E^X = \kappa_8 \cdot \tau \cdot \left(\frac{f_X^{\frac{1}{\phi}} \cdot \lambda^{\frac{\phi-1}{\phi}}}{A} \right)^{\frac{1}{\nu\cdot(\sigma-1)}} \quad (8.82)$$

with $\kappa_8 = \kappa_{11}^{\frac{-1}{\phi\cdot\nu\cdot(\sigma-1)}}$. Replacing these expected profits in the free entry condition I write A as a function of the domestic and exporting fixed costs, the entry cost, the search cost and the iceberg trade cost.

$$A = \kappa_{13} \cdot \frac{F_e^{\frac{\nu\cdot(\sigma-1)}{\gamma_E}} \cdot \lambda^{\frac{\phi-1}{\phi}}}{\left(f^{\frac{-\gamma_E+\phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E+\phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} \right)^{\frac{\nu\cdot(\sigma-1)}{\gamma_E}}} \quad (8.83)$$

where $\kappa_{13} = \left(\kappa_{12} \cdot \kappa_8^{-b} - \kappa_8^{-\gamma_E}\right)^{\frac{\nu}{\gamma_E}} = \kappa_{11}^{\frac{-1}{\phi\cdot\nu\cdot(\sigma-1)}} \cdot \left(\frac{\phi\cdot\nu\cdot(\sigma-1)}{\gamma_E-\phi\cdot\nu\cdot(\sigma-1)}\right)^{\frac{-\nu\cdot(\sigma-1)}{\gamma_E}}$. This means:

$$\frac{dA}{d\tau} = \frac{\nu \cdot (\sigma - 1) \cdot A \cdot N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E+\phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}}}{\tau \cdot \left(f^{\frac{-\gamma_E+\phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E+\phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} \right)} . \quad (8.84)$$

Combining (8.73), (8.74), and (8.84):

$$\frac{dn_X^*}{d\tau} = \frac{\phi \cdot \nu \cdot (1-\sigma) \cdot n_X^* \cdot f^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}}}{\tau \cdot \left(f^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}} \right)} < 0 \tag{8.85}$$

- ii) The derivative of the expected productivity of an exporters' match (conditional on exporters' productivity) with respect to τ is:

$$\frac{dE[\varphi_I | \varphi_E]}{d\tau} = \frac{dE[\varphi_I | \varphi_E]}{dn_X^*} \cdot \frac{dn_X^*}{d\tau} \tag{8.86}$$

Combining (8.68) and (8.85):

$$\frac{dE[\varphi_I | \varphi_E]}{d\tau} = \frac{\phi \cdot \nu \cdot (1-\sigma) \cdot E[\varphi_I | \varphi_E] \cdot f^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}}}{\gamma_I \cdot \tau \cdot \left(f^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}} \right)} < 0 \tag{8.87}$$

- iii) The derivative of exporters' expected revenue (conditional on exporter productivity) (in equation (8.70)) with respect to τ is:

$$\frac{dE[r_{E_X} | \varphi_E]}{d\tau} = \frac{\partial E[r_{E_X} | \varphi_E]}{\partial \tau} + \frac{\partial E[r_{E_X} | \varphi_E]}{\partial A} \cdot \frac{dA}{d\tau} \tag{8.88}$$

The partial derivative with respect to τ is:

$$\frac{\partial E[r_{E_X} | \varphi_E]}{\partial \tau} = \frac{\phi \cdot \nu \cdot (1-\sigma) \cdot E[r_{E_X} | \varphi_E]}{\tau} \tag{8.89}$$

The partial derivative with respect to A is:

$$\frac{\partial E[r_{E_X} | \varphi_E]}{\partial A} = \frac{\phi \cdot E[r_{E_X} | \varphi_E]}{A} \tag{8.90}$$

Combining (8.89), (8.90), and (8.84):

$$\frac{dE[r_{E_X} | \varphi_E]}{d\tau} = \frac{\phi \cdot \nu \cdot (1-\sigma) \cdot E[r_{E_X} | \varphi_E] \cdot f^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}}}{\tau \cdot \left(f^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E + \phi \cdot \nu \cdot (\sigma-1)}{\phi \cdot \nu \cdot (\sigma-1)}} \right)} < 0 \tag{8.91}$$

Proposition III. A decline in search costs (λ):

i. Leads exporting firms to increase their search effort in the domestic and foreign markets.

ii. Leads exporting firms to find and choose partners of higher expected productivity in the domestic and foreign markets.

iii. Has no impact on exporting firms' expected revenue in the domestic and foreign markets.

PROOF:

- i) Consider the case of exporters' matches in foreign markets. (The case of the domestic market is analogous). The derivative of exporters' optimal search effort with respect to the search cost λ is:

$$\frac{dn_X^*}{d\lambda} = \frac{\partial n_X^*}{\partial \lambda} + \frac{\partial n_X^*}{\partial A} \cdot \frac{dA}{d\lambda} \tag{8.92}$$

The partial derivative of exporters' search effort (in equation (8.64)) with respect to λ is:

$$\frac{\partial n_X^*}{\partial \lambda} = -\phi \cdot \frac{n_X^*}{\lambda} < 0 \tag{8.93}$$

Using the expression for A in (8.83),

$$\frac{dA}{d\lambda} = \frac{(\phi - 1)}{\phi} \cdot \frac{A}{\lambda} \tag{8.94}$$

Combining (8.93), (8.74), and (8.94)

$$\frac{dn_X^*}{d\lambda} = \frac{-n_X^*}{\lambda} < 0 \tag{8.95}$$

- ii) The derivative of the expected productivity of an exporters' match (conditional on exporter productivity) with respect to λ is:

$$\frac{dE[\varphi_I|\varphi_E]}{d\lambda} = \frac{dE[\varphi_I|\varphi_E]}{dn_X^*} \cdot \frac{dn_X^*}{d\lambda} \tag{8.96}$$

Combining (8.68) and (8.95):

$$\frac{dE[\varphi_I|\varphi_E]}{d\lambda} = \frac{-E[\varphi_I|\varphi_E]}{\gamma_I \cdot \lambda} < 0\ . \tag{8.97}$$

- iii) The derivative of exporters' expected revenue (conditional on exporter productivity) (in equation (8.70)) with respect to λ is:

$$\frac{dE[r_{E_X}|\varphi_E]}{d\lambda} = \frac{\partial E[r_{E_X}|\varphi_E]}{\partial \lambda} + \frac{\partial E[r_{E_X}|\varphi_E]}{\partial A} \cdot \frac{dA}{d\lambda} \tag{8.98}$$

The partial derivative with respect to λ is:

$$\frac{\partial E[r_{E_X}|\varphi_E]}{\partial \lambda} = -(\phi - 1) \cdot \frac{E[r_{E_X}|\varphi_E]}{\lambda} \tag{8.99}$$

Combining (8.99), (8.90), and (8.94):

$$\frac{dE[r_{E_X}|\varphi_E]}{d\lambda} = 0 \tag{8.100}$$

As search costs fall a partial equilibrium result increases search effort, leading an increase in the expected productivity of trading partners and an increase in expected revenue. This effect on expected revenue is cancelled out, however, by a general equilibrium effect in the opposite direction.

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

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

ii. Negatively on trade costs.

PROOF:

• i) Consider the case of exporters' sales to a foreign market (the case of sales to the domestic market is analogous). An exporters' revenue from its sales to an importer in a foreign market is:

$$r_{E_X}(\varphi_E, \varphi_I) = \kappa_6 \cdot A \cdot \tau^{\nu\cdot(1-\sigma)} \cdot \varphi_E^{\nu\cdot(\sigma-1)} \cdot \varphi_I^{(\sigma-1)\cdot(1-\nu)} \ . \tag{8.101}$$

It is immediate to see that:

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\varphi_E} = \nu \cdot (\sigma - 1) \cdot \frac{r_{E_X}(\varphi_E, \varphi_I)}{\varphi_E} > 0 \tag{8.102}$$

and

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\varphi_I} = (1-\nu) \cdot (\sigma - 1) \cdot \frac{r_{E_X}(\varphi_E, \varphi_I)}{\varphi_I} > 0 \ . \tag{8.103}$$

• ii) The derivative of exporters' revenue in a relationship $r_E(\varphi_E, \varphi_I)$, with respect to the trade cost τ is:

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\tau} = \frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial \tau} + \frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial A} \cdot \frac{dA}{d\tau} \tag{8.104}$$

The partial derivative of exporters' revenue in a relationship $r_{E_X}(\varphi_E, \varphi_I)$ with respect to τ is:

$$\frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial \tau} = \nu \cdot (1-\sigma) \cdot \frac{r_{E_X}(\varphi_E, \varphi_I)}{\tau} < 0 \tag{8.105}$$

The partial derivative of exporters' revenue in a relationship $r_{E_X}(\varphi_E, \varphi_I)$ with respect to A is:

$$\frac{\partial r_{E_X}(\varphi_E, \varphi_I)}{\partial A} = \frac{r_{E_X}(\varphi_E, \varphi_I)}{A} > 0 \tag{8.106}$$

Combining (8.105), (8.106), and (8.84):

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\tau} = \frac{\nu \cdot (1-\sigma) \cdot r_{E_X}(\varphi_E, \varphi_I) \cdot f^{\frac{-\gamma_E + \phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}}}{\tau \cdot \left(f^{\frac{-\gamma_E + \phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E + \phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} \right)} < 0 \tag{8.107}$$

Proposition V. Reductions in trade costs (τ) or in search costs (λ) increase welfare.

PROOF:

Note: The second part of Proposition V is proved in section 8.4.

Welfare per worker is the ratio of wages (normalized to one) to the price level. Using the definition $A = \frac{E}{P^{1-\sigma}} = L \cdot P^{\sigma-1}$, welfare per worker can be written as:

$$W = \frac{1}{P} = A^{\frac{1}{1-\sigma}} \cdot L^{\frac{1}{\sigma-1}} \tag{8.108}$$

• The derivative of welfare per worker with respect to trade costs (τ) is:

$$\frac{dW}{d\tau} = \frac{dW}{dA} \cdot \frac{dA}{d\tau} \tag{8.109}$$

where

$$\frac{dW}{dA} = \frac{1}{1-\sigma} \cdot \frac{W}{A} < 0 \ . \tag{8.110}$$

Combining (8.110) and (8.84) :

$$\frac{dW}{d\tau} = \frac{-\nu \cdot W \cdot N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E + \phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}}}{\tau \cdot \left(f^{\frac{-\gamma_E + \phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} + N \cdot \tau^{-\gamma_E} \cdot f_X^{\frac{-\gamma_E + \phi\cdot\nu\cdot(\sigma-1)}{\phi\cdot\nu\cdot(\sigma-1)}} \right)} < 0 \tag{8.111}$$

• The derivative of welfare per worker with respect to search costs (λ) is:

$$\frac{dW}{d\lambda} = \frac{dW}{dA} \cdot \frac{dA}{d\lambda} \tag{8.112}$$

Combining (8.110) and (8.94):

$$\frac{dW}{d\lambda} = \frac{1}{1-\sigma} \cdot \frac{(\phi-1)}{\phi} \cdot \frac{W}{\lambda} < 0 \tag{8.113}$$

8.4 Welfare

Welfare can be written as a function of the domestic expenditure share as shown below. Arkolakis, Costinot and Rodríguez-Clare (2012) show this is the case in a wide class of models including Melitz (2003). For comparison purposes, I include the Melitz (2003) case.

Welfare and the Domestic Expenditure Share.

The domestic expenditure share can be written as:

$$\psi = \frac{f^{\frac{\phi\cdot\nu\cdot(\sigma-1)-\gamma_E}{\phi\cdot\nu\cdot(\sigma-1)}}}{f^{\frac{\phi\cdot\nu\cdot(\sigma-1)-\gamma_E}{\phi\cdot\nu\cdot(\sigma-1)}} + N\cdot\tau^{-\gamma_E}\cdot f_X^{\frac{\phi\cdot\nu\cdot(\sigma-1)-\gamma_E}{\phi\cdot\nu\cdot(\sigma-1)}}} \tag{8.114}$$

Welfare per capita (the real wage) can be written as:

$$W = \frac{1}{P} = L^{\frac{1}{\sigma-1}}\cdot A^{\frac{1}{1-\sigma}} \tag{8.115}$$

The term $A = L\cdot P^{\sigma-1}$ was found in the previous section (equation (8.83)) using the free entry condition. Using this and the expression for the domestic expenditure share (8.114):

$$W = \frac{1}{P} = \kappa_{14}\cdot\frac{L^{\frac{1}{\sigma-1}}\cdot f^{\frac{\phi\cdot\nu\cdot(\sigma-1)-\gamma_E}{\gamma_E\cdot\phi\cdot(\sigma-1)}}\lambda^{\frac{-(\phi-1)}{\phi\cdot(\sigma-1)}}}{F_e^{\frac{\nu}{\gamma_E}}}\cdot\psi^{\frac{-\nu}{\gamma_E}} \tag{8.116}$$

where $\kappa_{14} = \kappa_{11}^{\frac{1}{\phi\cdot(\sigma-1)}}\cdot\left(\frac{\phi\cdot\nu\cdot(\sigma-1)}{\gamma_E-\phi\cdot\nu\cdot(\sigma-1)}\right)^{\frac{\nu}{\gamma_E}}$.

Comparison: Welfare and the Domestic Expenditure Share in Melitz (2003).

In a standard Melitz (2003) model with symmetric countries and frictions, welfare per capita (the real wage) can be written as:

$$W = \frac{1}{P} = \kappa_{15}\cdot\frac{L^{\frac{1}{\sigma-1}}\cdot f^{\frac{-\gamma_E+\sigma-1}{\gamma_E\cdot(\sigma-1)}}}{F_e^{\frac{1}{\gamma_E}}}\cdot\psi^{\frac{-1}{\gamma_E}} \tag{8.117}$$

where ψ is the domestic expenditure share and $\kappa_{15} = \left(\frac{1}{\gamma_E-\sigma+1}\right)^{\frac{1}{\gamma_E}}\cdot(\sigma-1)^{\frac{1-\gamma_E}{\gamma_E}}\cdot\sigma^{\frac{-\sigma}{\sigma-1}}$. This expression is derived in Arkolakis et al. (2008).

8.5 Convergence to a Melitz (2003) Model

The model converges to a Melitz (2003) model of heterogeneous exporters. In the limit as the shape parameter of the distribution of importers γ_I goes to infinity, the distribution becomes degenerate and all importers share the same productivity $\varphi_I = 1$. In this case importer heterogeneity plays no role. In addition allowing ν to go to 1 the model becomes a standard Melitz (2003) model of heterogeneous exporters.[44,45] Note that in the version of the model discussed in Section 3 in the main text, there will still be double marginalization (so the model will differ in this regard from Melitz (2003)). In the case discussed in Section 8.6.2 in which I assume that exporters and importers split profits through Nash-bargaining the model will converge exactly to Melitz (2003). This is regardless of the value of the bargaining parameter β_E.

Case with Double Marginalization (corresponds to Section 3 in main text). In the limit as $\gamma_I \to \infty$ and $\nu \to 1$:

1. The price charged to domestic consumers converges to: $p_F = \left(\frac{\sigma}{\sigma-1}\right)^2 \cdot \frac{1}{\varphi_E}$. The price charged to consumers in export markets converges to $p_F^X = \left(\frac{\sigma}{\sigma-1}\right)^2 \cdot \frac{\tau}{\varphi_E}$
2. Optimal search effort in domestic (n^*) and export (n_X^*) markets converges to zero.[46]
3. The domestic productivity cutoff converges to $\underline{\varphi}_E = \kappa_8^{\text{LIM}} \cdot f^{\sigma-1} \cdot A^{1-\sigma}$.[47]
4. The export productivity cutoff converges to $\underline{\varphi}_E^X = \kappa_8^{\text{LIM}} \cdot \tau \cdot f_X^{\sigma-1} \cdot A^{1-\sigma}$.
5. Producers' expected profits (conditional on their own productivity) in the domestic market converge to: $E[\pi_E|\varphi_E] = \kappa_{11}^{LIM} \cdot A \cdot \varphi_E^{(\sigma-1)} - f$. [48]
6. Producers' expected profits (conditional on their own productivity) in each export market converge to: $E[\pi_{E_X}|\varphi_E] = \kappa_{11}^{LIM} \cdot A \cdot \tau^{(1-\sigma)} \cdot \varphi_E^{(\sigma-1)} - f_X$.
7. The constants defined throughout converge to: $\kappa_1 \to 1$, $\kappa_2 \to 1$, $\kappa_3 \to 0$, $\kappa_4 \to \frac{\sigma}{\sigma-1}$, $\kappa_5 \to \frac{1}{\sigma} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-2\cdot\sigma} = \kappa_5^{\text{LIM}}$, $\kappa_6 \to (\sigma-1) \cdot \kappa_5^{\text{LIM}}$, $\kappa_7 \to 0$, $\kappa_8 \to \kappa_5^{\text{LIM}\,\frac{1}{1-\sigma}}$, $\kappa_9 \to \kappa_5^{\text{LIM}}$, $\kappa_{10} \to (\sigma-1) \cdot \kappa_5^{\text{LIM}}$, $\kappa_{11} \to \kappa_5^{\text{LIM}}$, $\kappa_{12} \to \frac{\gamma_E \cdot \kappa_5^{\text{LIM}}}{\gamma-\sigma+1}$, $\kappa_{13} \to \kappa_5^{\text{LIM}\,\frac{1}{1-\sigma}} \cdot \left(\frac{\sigma-1}{\gamma_E-\sigma+1}\right)^{\frac{1-\sigma}{\gamma_E}}$, $\kappa_{14} \to \kappa_5^{\text{LIM}\,\frac{1}{\sigma-1}} \cdot \left(\frac{\sigma-1}{\gamma_E-\sigma+1}\right)^{\frac{1}{\gamma_E}}$ $\phi \to 1$.

Note that productivity cutoffs and expected profits converge to expressions that do not depend on the search cost (λ).

[44]Recall that ν is the parameter in the production function that combines manufactured goods with distribution services in equation (3.3).

[45]In fact allowing ν to go to 1 is enough for the model to converge to a Melitz (2003) model.

[46]Note that in this model n is continuous, which is a good approximation when the number of distributors is large.

[47]In this expression $\kappa_8^{\text{LIM}} = \sigma^{\frac{1}{\sigma-1}} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{\frac{2\cdot\sigma}{\sigma-1}}$.

[48]In this expression $\kappa_{11}^{\text{LIM}} = \frac{1}{\sigma} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-2\cdot\sigma}$.

Case with Nash-Bargaining (corresponds to Section 8.6.2). In the limit as $\gamma_I \to \infty$ and $\nu \to 1$:

1. The price charged to domestic consumers converges to: $p_F = \left(\frac{\sigma}{\sigma-1}\right) \cdot \frac{1}{\varphi_E}$. The price charged to consumers in export markets converges to $p_F^X = \left(\frac{\sigma}{\sigma-1}\right) \cdot \frac{\tau}{\varphi_E}$
2. Optimal search effort in domestic (n^*) and export (n_X^*) markets converges to zero.
3. The domestic productivity cutoff converges to $\underline{\varphi}_E = \kappa_{18}^{LIM} \cdot f^{\sigma-1} \cdot A^{1-\sigma}$.[49]
4. The export productivity cutoff converges to $\underline{\varphi}_E^X = \kappa_{18}^{LIM} \cdot \tau \cdot f_X^{\sigma-1} \cdot A^{1-\sigma}$.
5. Producers' expected profits (conditional on their own productivity) in the domestic market converge to: $E[\pi_E|\varphi_E] = \kappa_{19}^{LIM} \cdot A \cdot \varphi_E^{(\sigma-1)} - f$. [50]
6. Producers' expected profits (conditional on their own productivity) in each export market converge to: $E[\pi_{E_X}|\varphi_E] = \kappa_{19}^{LIM} \cdot A \cdot \tau^{(1-\sigma)} \cdot \varphi_E^{(\sigma-1)} - f_X$.
7. The constants used in Section 8.6.2 converge to: $\kappa_1 \to 1$, $\kappa_{16} \to \frac{1}{\sigma-1} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}$, $\kappa_{17} \to 0$.

Note that productivity cutoffs and expected profits converge to expressions that do not depend on the search cost (λ).

[49] In this expression, $\kappa_{18}^{LIM} = (\sigma-1)^{\frac{1}{\sigma-1}} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{\frac{\sigma}{\sigma-1}}$

[50] In this expression, $\kappa_{19}^{LIM} = \frac{1}{\sigma-1} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}$.

8.6 Alternative Assumptions

This section includes a discussion of versions of the model under the following different assumptions: i) a Pareto distribution for importers' productivities, ii) Nash-bargaining between exporters and importers instead of double marginalization, iii) a Leontief (instead of a Cobb-Douglas) production function, and iv) a CES production function,

8.6.1 Pareto Distribution of Importers' Productivities

Here I prove a solution exists for the exporters' problem when importers draw their productivity from a Pareto distribution. In this case the solution must be found computationally. I discuss the case of an exporter searching for an importer abroad. (The case for the domestic market is analogous). Assume distributors draw their productivity parameter from a Pareto distribution with scale parameter 1, shape parameter γ_I and support over $[1, \infty)$.[51] For an exporter, the probability of meeting and choosing a distributor of productivity φ_I is given by the following density function:[52]

$$F^n_{max}(\varphi_I) = \frac{df^{max}_n(\varphi_I)}{d\varphi_I} = n \cdot \gamma_I \cdot \varphi_I^{-\gamma_I - 1} \cdot (1 - \varphi_I^{-\gamma_I})^{n-1} \ . \tag{8.118}$$

Exporters' find an optimal search effort n_X solving:

$$\max_{n_X} \int_1^\infty f^n_{\max}(\varphi_I) \cdot \pi_{E_X}(\varphi_E, \varphi_I) d\varphi_I - \lambda \cdot n_X \tag{8.119}$$

Replacing $\pi_{E_X}(\varphi_E, \varphi_I)$ and $f^n_{\max}(\varphi_I)$ and calling $\delta = (1 - \nu) \cdot (\sigma - 1)$ this becomes:

$$\max_{n_X} \ \kappa_5 \cdot A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma - 1)} \cdot \int_1^\infty n_X \cdot \gamma_I \cdot \varphi_I^{\delta - \gamma_I - 1} \cdot (1 - \varphi_I^{-\gamma_I})^{n_X - 1} d\varphi_I - \lambda \cdot n_X \tag{8.120}$$

Call

$$I(n_X) = \int_1^\infty n_X \cdot \gamma_I \cdot \varphi_I^{\delta - \gamma_I - 1} \cdot (1 - \varphi_I^{-\gamma_I})^{n_X - 1} d\varphi_I \tag{8.121}$$

The maximization problem can be then written as:

$$\max_{n_X} \ \kappa_5 \cdot A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma - 1)} \cdot I(n_X) - \lambda \cdot n_X \tag{8.122}$$

The first order condition to this problem is:

$$\kappa_5 \cdot A \cdot \tau^{\nu \cdot (1-\sigma)} \cdot \varphi_E^{\nu \cdot (\sigma - 1)} \cdot \frac{dI(n_X)}{dn_X} = \lambda \tag{8.123}$$

Below I show that $\frac{dI}{dn_X} > 0$ and $\frac{d^2 I}{dn_X^2} < 0$, which implies there is a positive interior solution for n_X.

[51] The cumulative distribution function is $F(\varphi_I) = 1 - \varphi^{-\gamma_I}$ and the probability density function is $f(\varphi_I) = \gamma_I \cdot \varphi_I^{-(\gamma_I + 1)}$.

[52] The maximum out of a sample of size n drawn from a distribution $F(\varphi)$ is a random variable with distribution $F^n_{max}(\varphi) = \{F(\varphi)\}^n$. The density function of this order statistic is calculated by taking the derivative of $\{F(\varphi)\}^n$ with respect to φ.

- Sign of $\frac{dI}{dn_X}$ and $\frac{d^2I}{dn_X^2}$:

Define $u = \varphi^{-\gamma_I}$ to write:

$$I(n_X) = \int_0^1 n_X \cdot u^{-\frac{\delta}{\gamma_I}} \cdot (1-u)^{n_X-1} du \tag{8.124}$$

Do a second change of variables defining $1 - u = e^{-s}$ to write:

$$I(n_X) = \int_0^\infty n_X \cdot (1-e^{-s})^{-\frac{\delta}{\gamma_I}} \cdot e^{-n_X \cdot s} ds \tag{8.125}$$

The first order derivative is:

$$\frac{dI}{dn_X} = \int_0^\infty (1-e^{-s})^{-\frac{\delta}{\gamma_I}} \cdot e^{-n_X \cdot s} ds + \int_0^\infty n_X \cdot \frac{d}{dn_X}\left((1-e^{-s})^{-\frac{\delta}{\gamma_I}} \cdot e^{-n_X \cdot s}\right) ds \tag{8.126}$$

This can be written as:

$$\frac{dI}{dn} = \int_0^\infty (1-e^{-s})^{-\frac{\delta}{\gamma_I}} \cdot \left(\frac{d}{ds}\left(s \cdot e^{-n_X \cdot s}\right)\right) ds \tag{8.127}$$

Integrating by parts, this can be written as:

$$\frac{dI}{dn_X} = \frac{\delta}{\gamma_I} \cdot \int_0^\infty (1-e^{-s})^{-\frac{\delta}{\gamma_I}-1} \cdot s \cdot e^{-n_X \cdot s} ds \tag{8.128}$$

which is positive. The second order derivative is:

$$\frac{d^2I}{dn_X^2} = -\frac{\delta}{\gamma_I} \cdot \int_0^\infty (1-e^{-s})^{-\frac{\delta}{\gamma_I}-1} \cdot s^2 \cdot e^{-n_X \cdot s} ds \tag{8.129}$$

which is negative.

8.6.2 Nash-Bargaining

In the model discussed in section 3, 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 (in a closed economy setting). The results described in section 3 still hold in this case. In the model below I assume all outside options are zero, so the share of surplus obtained by producers is always the same. While this is unrealistic, 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. Here I discuss the closed economy case. The open economy case is analogous.

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:

$$cost_F = \kappa_1 \cdot \left(\frac{1}{\varphi_E}\right)^v \cdot \left(\frac{1}{\varphi_I}\right)^{1-v} \tag{8.130}$$

Under this framework, the price charged to consumers is a constant markup over the cost, $p_F = \frac{\sigma}{\sigma-1} \cdot cost_F$. The operating profits within a producer - distributor relationship are:

$$\pi(\varphi_E, \varphi_I) = \kappa_{16} \cdot A \cdot \varphi_E^{\nu \cdot (\sigma-1)} \cdot \varphi_I^{(1-\nu)\cdot(\sigma-1)} \tag{8.131}$$

where $\kappa_{16} = \kappa_1^{1-\sigma} \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-\sigma} \cdot \left(\frac{1}{\sigma-1}\right)$. Producers keep a fraction β_E of these profits. Producers choose their optimal search effort n^*, solving:

$$\max_n \int_0^\infty f_{max}^n(\varphi_I) \cdot \beta_E \cdot \pi(\varphi_E, \varphi_I) d\varphi_I - \lambda \cdot n - f \tag{8.132}$$

The first term in this equation represents the expected surplus for the producer of a trading relationship with a distributor of productivity φ_I, 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. Producers' optimal search effort is:

$$n^* = \kappa_{17} \cdot \left(\frac{\beta_E \cdot A \cdot \varphi_E^{\nu\cdot(\sigma-1)}}{\lambda} \right)^\phi \tag{8.133}$$

with $\kappa_{17} = \left(\frac{\phi-1}{\phi} \cdot \kappa_{16} \cdot \Gamma(\frac{1}{\phi}) \right)^\phi$. Finally, note that all the propositions stated in the paper apply in this case.

8.6.3 Leontief Production Function

In this case the production function of importers is:

$$q_F = min(q_E, q_I) \tag{8.134}$$

where q_E is the quantity of the good produced by the exporter and q_I the quantity of distribution services provided by the importer. Importers' input demand for the exporters' product is $q_E = q_F$. Importers' unit cost is $cost_F = p_E + \frac{1}{\varphi_I}$. Consider the case of an exporter trading with an importer abroad. Within a trading relationship, exporters' optimal price is:

$$p_{E_X}(\varphi_E, \varphi_I) = \frac{\sigma}{\sigma-1} \cdot \frac{\tau}{\varphi_E} + \frac{1}{\sigma-1} \cdot \frac{1}{\varphi_I} \tag{8.135}$$

Exporters sell a quantity

$$q_{E_X}(\varphi_E, \varphi_I) = A \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-2\cdot\sigma} \cdot \left(\frac{\tau}{\varphi_E} + \frac{1}{\varphi_I}\right)^{-\sigma} \tag{8.136}$$

and exporters' profits within a trading relationship are:

$$\pi_{E_X}(\varphi_E, \varphi_I) = A \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-2\cdot\sigma} \cdot \left(\frac{1}{\sigma-1}\right) \cdot \left(\frac{\tau}{\varphi_E} + \frac{1}{\varphi_I}\right)^{1-\sigma} \tag{8.137}$$

Differently than in the case with a Cobb-Douglas production function, exporters' optimal search effort must be solved computationally; obtaining a solution is not possible.

Computational analysis indicates that the results stated in propositions I through IV hold in the Leontief case.

The reason why the propositions hold in this case, similarly to the Cobb-Douglas case in the main text, is that the profits $\pi_{E_X}(\varphi_E, \varphi_I)$ are such that $\frac{d^2\pi_{E_X}}{d\varphi_E d\varphi_I} > 0$. This means 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.

Finally, I show analytically that exporters' revenue within a trading relationship, $r_{E_X}(\varphi_E, \varphi_I) = p_{E_X} \cdot q_{E_X}$, increases as trade costs fall. Exported quantity falls and export prices increase as trade costs fall. The derivative of exporters' revenue with respect to trade costs is:

$$\frac{dr_{E_X}(\varphi_E, \varphi_I)}{d\tau} = \frac{dp_{E_X}}{d\tau} \cdot q_{E_X} + \frac{dq_{E_X}}{dp_{E_X}} \cdot \frac{dp_{E_X}}{d\tau} \cdot p_{E_X} = \frac{dp_{E_X}}{d\tau} \cdot \left(q_{E_X} + \frac{dq_{E_X}}{dp_{E_X}} \cdot p_{E_X} \right) < 0 \quad (8.138)$$

where the derivative of exporters' price with respect to trade costs is $\frac{dp_{E_X}}{d\tau} = \frac{\sigma}{\sigma-1} \cdot \frac{1}{\varphi_E} > 0$

and $q_{E_X} + \frac{dq_{E_X}}{dp_{E_X}} \cdot p_{E_X} < 0$. The derivative of exporters' quantity with respect to trade costs is $\frac{dq_{E_X}}{d\tau} = \frac{dq_{E_X}}{dp_{E_X}} \cdot \frac{dp_{E_X}}{d\tau} = -\sigma \cdot q_{E_X} \cdot \left(\frac{1}{p_{E_X} + \frac{1}{\varphi_I}} \right) \cdot \left(\frac{\sigma}{\sigma-1}\right) \cdot \frac{1}{\varphi_E} < 0$.

8.6.4 CES Production Function

The production function of importers is:

$$q_F = (\lambda_1 \cdot q_E^{\rho} + \lambda_2 \cdot q_I^{\rho})^{\frac{1}{\rho}} \quad (8.139)$$

with $\lambda_1 + \lambda_2 = 1$ and $\rho <= 1$ and where q_E is the quantity of the good produced by the exporter and q_I the quantity of distribution services provided by the importer. Note that $\rho = -\infty$ corresponds to the Leontief production function, $\rho = 0$ corresponds to the Cobb-Douglas production function, and $\rho = 1$ corresponds to a case of perfect substitutes.

Importers' unit cost is

$$cost_F = (\lambda_1^{1-r} \cdot p_E^r + \lambda_2^{1-r} \cdot \left(\frac{1}{\varphi_I}\right)^r)^{\frac{1}{r}} \quad (8.140)$$

with $r = \frac{\rho}{\rho-1}$. Importers' input demand for the exporters' product is:

$$q_E = q_F \cdot \frac{dcost_F}{dp_E} = A \cdot \left(\frac{\sigma}{\sigma-1}\right)^{-\sigma} \cdot cost_F^{-\sigma} \cdot \frac{dcost_F}{dp_E} \quad (8.141)$$

Consider the case of an exporter trading with an importer abroad. Within a trading relationship, the price set by exporters is found from the first order condition to their maximization problem:

$$(p_{E_X} - cost_E \cdot \tau) \cdot \frac{dq_{E_X}}{dp_{E_X}} + q_{E_X} = 0 \quad (8.142)$$

Simplifying and replacing, this first order condition can be written as:

$$p_{E_X}\cdot\left(-\sigma\cdot cost_F^{1-r}\cdot\lambda_1^{1-r}\cdot p_{E_X}^{r-1}+cost_F\right)-cost_E\cdot\tau\cdot\left(-\sigma\cdot cost_F^{1-r}\cdot\lambda_1^{1-r}\cdot p_{E_X}^{r-1}+cost_F\right)+cost_F=0 \tag{8.143}$$

The solution for p_{E_X} must be found computationally. I then find exporters' profits within a trading relationship, $\pi_{E_X}(\varphi_E,\varphi_I)$ computationally as well. Using this, I find exporters' optimal search effort as in the Cobb-Douglas case, without it being possible to obtain an explicit analytical expression. Computational analysis indicates that the results stated in propositions I through IV hold in the CES case. The reason why the propositions hold in this case, similarly to the Cobb-Douglas case in the main text, is the complementarity in the CES production function. This means 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.

9 Appendix to Section 4

This appendix includes:

9.1] Context: Impact of the FTA on U.S. Exports to Colombia.

9.2] Summary statistics for the variables used for the results in Tables 4.3 through 4.5.

9.3] A version of Tables 4.3 through 4.5 excluding intra-firm trade.

9.4] Other versions of Table 4.4.

9.5] Other versions of Table 4.5.

9.6] The Impact of the Free Trade Agreement on Entry into Exporting and Entry into Importing.

9.1 Context: Impact of the FTA on U.S. Exports to Colombia

To provide evidence on the causality of the impact of the FTA on U.S. exports, I use product-level trade data to compare the evolution of U.S. exports in liberalized and non-liberalized sectors. I show that the Free Trade Agreement increased exports from the U.S. to Colombia following a triple difference in differences empirical design. I compare U.S. exports in liberalized industries to non-liberalized industries (first difference) before and after the agreement (second difference) to Colombia and to other South American markets (third difference). Specifically, I estimate the following gravity equation for (log) U.S. exports to Colombia and every other South American country. I construct a categorical indicator for liberalized industries which I compare to non-liberalized industries. I define two time periods: pre-agreement (June 2011-May 2012) and post-agreement (June 2013 - May 2014).

$$\begin{aligned}\textsc{Exports}_{cit} = {} & \beta_1 \cdot \textsc{Post}_t \cdot \textsc{Lib}_i \cdot \textsc{Colombia}_c + \beta_2 \cdot \textsc{Post}_t \cdot \textsc{Lib}_i + \\ & \beta_3 \cdot \textsc{Post}_t \cdot \textsc{Colombia}_c + \beta_4 \cdot \textsc{Lib}_i \cdot \textsc{Colombia}_c + \epsilon_{cit} \quad (9.1)\end{aligned}$$

In this equation, each observation is a product (i) - destination (c) - year (t) combination. Products are defined at the HS-6 digit level. While the U.S. export data is disaggregated upto the HS-10 level, it can only be matched to the Colombian tariffs at the internationally-standarized HS-6 level. Robust standard errors are clustered by industry, destination and period using multiway clustering. The data on U.S. exports is obtained from the U.S. Census Bureau's "U.S. Exports of Merchandise".

Table 9.1 reports the results for the estimation of equation (9.1). The coefficient of interest on the triple interaction is positive and economically and statistically significant. It can be interpreted as an increase in U.S. exports in liberalized industries compared to non-liberalized industries in Colombia compared to similar South American markets.

Table 9.1: The Effect of the FTA on U.S. Exports to Colombia

Dependent Variable: (log) Value of U.S. Exports	
$\textsc{Post}_t \cdot \textsc{Lib}_i \cdot \textsc{Colombia}_c$	0.1332***
	0.0175
$\textsc{Post}_t \cdot \textsc{Colombia}_c$	0.0174
	0.0334
$\textsc{Lib}_i \cdot \textsc{Colombia}_c$	0.0089
	0.1020
$\textsc{Post}_t \cdot \textsc{Lib}_i$	-0.0115
	0.0181
Country F.E.	Yes
HS-6 Product F.E.	Yes
Time period F.E.	Yes
Observations	48039

Notes: This table reports the results of the estimation of equation (9.1). Destination countries are Colombia, Argentina, Bolivia, Brazil, Chile, Ecuador, Paraguay, Peru, Uruguay and Venezuela. Data is obtained from the U.S. Census Bureau's "U.S. Exports of Merchandise" which reports U.S. exports disaggregated at the country - HS10 product level. Standard errors are reported under the estimated coefficients. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

9.2 Summary statistics for the variables used for the results in Tables 4.3 through 4.5

This section reports the mean and standard deviation of the variables used in Tables 4.3 through 4.5

Table 9.2: Summary Statistics.

For Tables 4.3 and 4.4 :

	Mean	Std. Deviation
$\Delta(log)$EXPORTS$_{fs}$	0.313	1.930
ΔTARIFF$_s^{COL}$	-4.250	7.099
NEW PARTNER$_{fs}$	0.313	0.464

For Table 4.5:

	SWITCHERS		FULL SAMPLE	
	Mean	Std. Deviation	Mean	Std. Deviation
Columns 1 and 2:				
ΔTARIFF$_s^{COL}$	-4.072	6.870	-3.877	6.666
ΔPARTNER-SIZE$_{fs}$ (Wld. Imp.)	-0.009	2.755	-0.010	1.624
Columns 3 and 4:				
ΔTARIFF$_s^{COL}$	-3.659	6.189	-3.597	6.269
ΔPARTNER-SIZE$_{fs}$ (Dom. Sales.)	-0.028	1.597	-0.020	0.861

9.3 Version of Tables 4.3 through 4.5, excluding intra-firm trade

EXCLUDING TRADE WITH MULTINATIONAL AFFILIATES: I observe which importers are multinational affiliates of U.S. multinationals.[53] In this section I exclude from the sample all the U.S. exporters in the original sample in Section 4 that trade in either the pre or post FTA periods with any Colombian importer that is an affiliate of a U.S. multinational. This reduces the sample size from 1698 to 1603. (The number of exporters trading with multinational affiliates is relatively low in final consumer goods; it is much higher in intermediate inputs and capital goods).

Below I repeat the estimation results reported in Tables 4.3 to 4.5 with this restricted sample, finding similar results.

Table 9.3: Tariff Cuts Lead to an Increase in U.S. Firms' Exports. (Equivalent to Table 4.3 in the main text.)

DEPENDENT VARIABLE: $\Delta(log)\text{EXPORTS}_{fs}$

	(1)	(2)
$\Delta\text{TARIFF}_s^{COL}$	-0.122***	-0.130**
	(0.045)	(0.056)
FIRM AND INDUSTRY CONTROLS	NO	YES
SECTOR F.E.	YES	YES
OBSERVATIONS	1603	1603

Notes: This table shows the results of the estimation of equation (4.1). All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

[53]Data on affiliates of multinational companies was provided by Dun and Bradstreet through the United Nations and WTO's International Trade Centre.

Table 9.4: Tariff Cuts Lead to Finding New Importing Partners. (Equivalent to Table 4.4 in the main text.)

Dependent Variable: New Partner$_{fs}$		
	(1)	(2)
ΔTariff$_s^{COL}$	-0.097***	-0.090*
	(0.034)	(0.051)
Firm and Industry Controls	No	Yes
Sector F.E.	Yes	Yes
Observations	1603	1603

Notes: This table shows the results of the estimation of equation (4.2) using a probit model. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 9.5: Exporters that Switch their Importing Partner in Response to the Tariff Cuts Switch to Larger Importers. (Equivalent to Table 4.5 in the main text.)

Dependent Variable: ΔPartner-Size$_{fs}$				
	(1)	(2)	(3)	(4)
Partner Size Based on:	World Imports		Domestic Sales	
Sample:	Switchers	Full Sample	Switchers	Full Sample
ΔTariff$_s^{COL}$	-0.212**	-0.124**	-0.277**	-0.170**
	(0.102)	(0.054)	(0.132)	(0.077)
Firm and Industry Controls	Yes	Yes	Yes	Yes
Sector F.E.	Yes	Yes	Yes	Yes
Observations	401	1356	212	806

Notes: This table shows the results of the estimation of equation (4.3). Columns 1 and 2 use world imports as a measure of importing firm size. Columns 3 and 4 use domestic sales as a measure of importing firm size. Columns 1 and 3 are restricted to the sample of exporters switching importing partners. Columns 2 and 4 are estimated on the full sample. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

9.4 Other versions of Table 4.4

The following table reports the results of the estimation of equation (4.2) considering all new partners of an exporter. The results reported in Table 4.4 were restricted to new importing partners already active in the pre-FTA period.

Table 9.6: Tariff Cuts Lead to Finding New Importing Partners. (Equivalent to Table 4.4 in the main text.)

Dependent Variable: New Partner$_{fs}$	(1)	(2)
ΔTariff$_s^{COL}$	-0.116***	-0.109**
	(0.041)	(0.054)
Firm and Industry Controls	No	Yes
Sector F.E.	Yes	Yes
Observations	1698	1698

Notes: This table shows the results of the estimation of equation (4.2) using a probit model. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

The following table reports the results of the estimation of equation (4.2) considering exporters with a single partner in both the pre-FTA and the post-FTA period.

Table 9.7: Tariff Cuts Lead to Finding New Importing Partners. (Equivalent to Table 4.4 in the main text.)

Dependent Variable: New Partner$_{fs}$	(1)	(2)
ΔTariff$_s^{COL}$	-0.119***	-0.136**
	(0.036)	(0.053)
Firm and Industry Controls	No	Yes
Sector F.E.	Yes	Yes
Observations	1030	1030

Notes: This table shows the results of the estimation of equation (4.2) using a probit model. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

The following table reports the results of the estimation of equation (4.2) considering tariffs defined at the HS 4-digit level. This definition of tariffs at a broader level is in response to the concern that exporters switch industries in response to tariff cuts.

Table 9.8: Tariff Cuts Lead to Finding New Importing Partners. (Equivalent to Table 4.4 in the main text.)

Dependent Variable: New Partner$_{fs}$		
	(1)	(2)
ΔTariff$_s^{COL}$	-0.109***	-0.090**
	(0.032)	(0.043)
Firm and Industry Controls	No	Yes
Sector F.E.	Yes	Yes
Observations	1698	1698

Notes: This table shows the results of the estimation of equation (4.2) using a probit model. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

9.5 Other versions of Table 4.5

The following table reports the results of the estimation of equation (4.3) excluding exporters with multiple trading partners. I focus on the measure of importer size based on worldwide imports only, given that the sample size using domestic sales is too small.

Table 9.9: Exporters that Switch their Importing Partner in Response to the Tariff Cuts Switch to Larger Importers. (Equivalent to Table 4.5 in the main text.)

Dependent Variable: ΔPartner-Size$_{fs}$

	(1)	(2)
Partner Size Based on:	World Imports	
Sample:	Switchers	Full Sample
ΔTariff$_s^{COL}$	-0.262*	-0.120
	(0.136)	(0.083)
Firm and Industry Controls	Yes	Yes
Sector F.E.	Yes	Yes
Observations	268	1063

Notes: This table shows the results of the estimation of equation (4.3). Column 1 is restricted to the sample of exporters switching importing partners. Column 2 is estimated on the full sample. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

9.6 The Impact of the Free Trade Agreement on Entry into Exporting and Entry into Importing

I measure the impact of tariff cuts to U.S. exporters to Colombia on i) entry of U.S. exporters and ii) entry of Colombian importers.[54] I exploit the variation in tariffs across industries and estimate the following regression in a panel with two periods: pre-FTA and post-FTA.

$$E_{fst} = \tau_{st} + \epsilon_{fst} \tag{9.2}$$

In the case of entry into exporting, E_{fst} is a dummy equal to one if firm f in sector s is exporting in period t and zero otherwise. I assign tariffs to firms based on the HS 6-digit product they export in the current period, future period (in the case of entry) or past period (in the case of exit). Firms are assigned to a sector based on the goods they export (they are assigned to the HS-6 digit code capturing the largest share of value exported). I estimate this equation using a linear probability model, but estimates based on a probit model produce almost identical results. The results for entry into exporting are reported in Table 9.10. Column 2 includes the same firm and industry-level control variables described in Section 4. The results indicate that a one standard deviation lower tariff is associated to a 0.078 larger standard deviation probability of exporting.

In the case of entry into importing, E_{fst} is a dummy equal to one if firm f in sector s is importing in period t and zero otherwise. Firms are assigned to a sector based on the goods they import (they are assigned to the HS-6 digit code capturing the largest share of value imported). The results for entry into importing are reported in Table 9.11. The results indicate that a one standard deviation lower tariff is associated to a 0.082 standard deviation larger probability of importing. These results, however, are not statistically significant.

Table 9.10: Tariff Cuts Lead to Entry into Exporting

Dependent Variable: Entry$_{fst}$		
	(1)	(2)
Tariff$_{ts}^{COL}$	-0.126***	-0.078**
	(0.045)	(0.034)
Firm and Industry Controls	No	Yes
Sector F.E.	Yes	Yes
Observations	4338	4338

Notes: This table shows the results of the estimation of equation 9.2 using a linear probability model. All columns include sector fixed effects at the HS-2 digit level. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

[54] Earlier work on the impact of free trade agreements on entry into exporting is in Bustos (2011). I am not aware of previous work on the impact of free trade agreeements on entry into importing

Table 9.11: Tariff Cuts Lead to Entry into Importing

DEPENDENT VARIABLE: ENTRY$_{fst}$

	(1)	(2)
TARIFF$_{ts}^{COL}$	-0.115	-0.081
	(0.080)	(0.069)
FIRM AND INDUSTRY CONTROLS	NO	YES
SECTOR F.E.	YES	YES
OBSERVATIONS	2046	2046

Notes: This table shows the results of the estimation of equation 9.2 using a linear probability model. All columns include sector fixed effects at the HS-2 digit level. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by by sector at the HS 2-digit level. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

10 Standardizing Names of French Exporters and Matching Them to Balance Sheet Data

This section describes the procedure employed to standardize names of French exporters in the data used in Section 2. The Colombian Customs Transactions Data used in the paper includes a tax ID number (and a name) for Colombian importers, so no further processing is needed. For foreign (in this case French) exporters to Colombia, no tax ID to define a firm is included. Fields included for foreign firms exporting to Colombia are: i) firm name, ii) street address, iii) city and iv) contact information (email or phone (or fax) number). Missing observations are minimal (practically nonexistent).

In Section 2 I match to these customs data to balance sheet data on French firms. This balance sheet data includes firms' name and the address of every establishment, which makes the matching process with the customs data easy. The data 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.[55]

To match both datasets I manually search for each individual firm name and address found in the customs data in the balance sheet data. This is feasible, as the number of French exporters to Colombia is fairly small. I assign a unique "SIREN" number to each firm.[56] There are 963 exporting firms in France which I can identify and assign a SIREN number to and approximately 50 exporters that were not identified. Some of these are individuals rather than firms (and export very small amounts). In terms of value, the matched dataset I use represents 99.4% of the exports from France to Colombia.

11 Standardizing Names of U.S. Exporters

This section describes the procedure employed to standardize names of U.S. exporters in the data used in Section 4. The Colombian Customs Transactions Data used in the paper includes a tax ID number (and a name) for Colombian importers, so no further processing is needed. For foreign (in this case U.S.) exporters to Colombia, no tax ID to define a firm is included.

First I describe the data and its quality. Second I describe two alternative standardizing procedures used (including the treatment of firm names more likely to be over or under matched). Finally, I show that the results in Section 4 are robust to employing different standardizing methods.

11.1 Data Description and Data Quality

Fields included for foreign firms exporting to Colombia are: i) firm name, ii) street address, iii) city and iv) contact information (email or phone (or fax) number).[57] This fields do not

[55]Other sources reporting the same data on firms' revenue do not include include the address of every establishment of each firm, which is key to obtain a better matching to the Colombian customs data.

[56]SIREN numbers are what the French Statistical Institute (INSEE) uses to identify firms in their data products.

[57]Note that the Customs Declaration form ("Declaracion de Importacion - DIAN Formulario 500") that Colombian importers must file when importing into Colombia and which is the source of the transactions data requires foreign exporters' names to be reported in a standardized way, using the foreign exporting's firm "razon social" (legal business name).

vary over time. Missing observations are minimal (practically nonexistent) in both the pre and post FTA periods as shown in Table 11.1.

Table 11.1: Missing Observations in Colombia's Import Transactions Data

	Pre FTA		Post FTA	
	Number	Share	Number	Share
Total Number of Observations	526702	1	547466	1
Missing Name	0	0	0	0
Missing Address	961	0.0018	721	0.0013
Missing City	957	0.0018	721	0.0013
Missing Contact Information	985	0.0019	759	0.0014

Notes: This table reports the number and fraction of transactions with missing fields in U.S. exports to Colombia.

11.2 Name Standardizing: Procedure A

The first approach to standardize U.S. exporters' names and define exporting firms consists of the following steps:

- The first step is to remove common symbols (such as "+", "−", ".", "(", "#" etc.), remove leading and trailing spaces, replace double or triple spaces for single spaces, and convert everything to lower case.
- Next I remove very common prefixes or suffixes such as "inc" or "llc" among others.
- The third step is to standardize commonly used terms (such as "Manufacturing", "International", etc.).[58]
- Fourth, I assign a common firm identifier to names that are spelled slightly different. For this purpose I compute the Levenshtein distance between all possible pairs of names. This distance (or "edit distance") is defined as the minimum number of characters that need to be substituted, added or deleted from one string to make it equal to the other. I then normalize this distance by the number of characters in the shorter string in the pair. Two names belong to the same company if the normalized distance is less or equal to a threshold.[59] If names A and B belong to the same firm, and names B and C belong to the same firm, then names A and C also belong to the same firm.

[58] This procedure is common when matching names and is used in reseach using patent data, such as Kline et al. (2018).

[59] I have checked that the results are robust for various values of this threshold.

11.2.1 Firm Names Containing Common Words

Some firms' names contain words that are very common. This increases the likelihood that they can be assigned to the same firm ID incorrectly. For example: "Cat International" and "Mat International" could be assigned to the same firm more easily than "Cat" and "Mat", but the word "International" does not add much information because it appears very commonly in many firms' names. Other similar words are "Manufacturing", "Systems" etc. To address this issue, I identify these very common words by first creating a list of all words in the data. I then mark strings containing these common words. I standardize these common words and require them to match, and I measure Levenshtein distances to apply firm identifiers as described above only on the non-common part of the name. Alternatively, I demand a higher threshold for names to match if they contain this common words.

11.2.2 Large vs. Small Firms

Firms with more transactions could be more likely to be matched to names not really belonging to the firm. One reason for this is the following. Suppose a first firm ("small firm") appears with two names, A and C, but A and C have an edit distance large enough to reject these names belong to the same firm. Now suppose a second firm ("large firm") also appears with names A and C (distant enough to reject these belonging to the same firm), but it also appears with a third name, B. A and B are close enough, and B and C are close enough, so A, B and C are assigned to the same firm. In other words, having more transactions might help assign names to a same firm.

First, a strict and thorough data cleaning procedure as described above helps mitigate this issue. Second, I implement a version of the algorithm above in which the threshold for the normalized edit distance for firms to be matched is proportional to the number of transactions a firm has. I also explore other characteristics that could be associated to a larger chance of being matched, such as volume exported, but I believe the number of transactions is the main relevant characteristic.

11.3 Name Standardizing: Procedure B

The second approach uses the standardization procedure of foreign suppliers in U.S. import transactions data. As Kamal and Monarch (2018) document, that U.S. imports transactions data contain a "Manufacturer ID" (MID) that is used to identify foreign suppliers. This MID variable is constructed using the exporting country, and part of the name, address and city of the exporting firm.[60] As Kamal and Monarch (2018) state, 13% of U.S. import value lacks a MID identifier. This variable is used by Eaton et al. (2014), Monarch (2015) Monarch and Schmidt-Eisenlohr (2016), Kamal and Sundaram (2016), Pierce and Schott (2016), Redding and Weinstein (2017) and Heise (2017).

The Colombian imports data I used contains the necessary information to construct an "MID equivalent". In addition, the missing information in the Colombian data is minimal

[60] Kamal and Monarch (2018) describe the construction of the MID as follows: "The first two characters of the MID must contain the two-digit International Organization for Standardization (ISO) country code of the supplier, the next three characters the start of the first word of the exporter's name, the next three characters the start of the second word, the next four characters the beginning of the largest number of the street address of the foreign exporter, and the last three characters the start of the foreign exporter's city. The MID has a maximum length of 15 characters."

in comparison to that in U.S. data (see Table 11.1).

I construct an MID equivalent variable for foreign exporters to Colombia. I first implement the first three steps described in the first standardizing procedure (removing common characters, prefixes and suffixes, from both names and addresses, and standardizing commonly used terms such as "Manufacturing"). I then follow the construction of the MID variable as described by Kamal and Monarch (2018).

A first point to note is that the MID variable might reflect plants, not firms, as it uses addresses, and some firms can have various addresses. A second point to note is that the MID variable is constructed to identify manufacturers, not trading companies. While this is not a problem in my analysis, I follow Ahn, Khandelwal and Wei (2011) to identify trading companies by whether they contain words such as "Export", "Import", "Trading" and others in their names and check that the results are valid excluding these.

Finally, note that Kamal and Monarch (2018) explores algorithms similar to those done by me in the first procedure described above to increase the reliability of the MID variable (although this approach is not used by the papers listed above using the MID). I have checked that constructing the MID variable and then identifying similar MIDs based on edit distances yields similar results.

11.4 Robustness of Results in Section 4 under Different Standardizing Procedures

The following tables report the results of Tables 4.3, 4.4 and 4.5 in the main text with different procedures for standardizing U.S. exporters' names.

• In each table, the heading Clean Names refers to removing common symbols, prefixes and suffixes, and standardizing commonly used terms such as "Manufacturing" or "International"). (These are the first three steps listed under procedure A).

• The heading Clean Names + Edit Distance consists of applying procedure A entirely.

• The heading Clean Names + MID consists of applying procedure B.

Table 11.2: Tariff Cuts Lead to an Increase in U.S. Firms' Exports. (Equivalent to Table 4.3 in the main text.)

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

	(1) Clean Names	(2) Clean Names + Edit Distance	(3) Clean Names + MID
$\Delta\text{Tariff}_s^{COL}$	-0.114*	-0.142**	-0.170***
	(0.067)	(0.057)	(0.057)
Firm and Ind. Controls	Yes	Yes	Yes
Sector F.E.	Yes	Yes	Yes
Observations	1861	1698	1897

Notes: This table shows the results of the estimation of equation (4.1). All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 11.3: Tariff Cuts Lead to Finding New Importing Partners. (Equivalent to Table 4.4 in the main text.)

Dependent Variable: New Partner$_{fs}$

	(1)	(2)	(3)
	Clean Names	Clean Names + Edit Distance	Clean Names + MID
ΔTariff$_s^{COL}$	-0.118***	-0.100**	-0.126***
	(0.042)	(0.048)	(0.048)
Firm and Industry Controls	Yes	Yes	Yes
Sector F.E.	Yes	Yes	Yes
Observations	1861	1698	1897

Notes: This table shows the results of the estimation of equation (4.2) using a probit model. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.

Table 11.4: Exporters that Switch their Importing Partner in Response to the Tariff Cuts Switch to Larger Importers. (Equivalent to first two columns of Table 4.5 in the main text.)

Dependent Variable: ΔPartner-Size$_{fs}$
Partner Size Based on: World Imports

	(1)	(2)	(3)	(4)	(5)	(6)
	Clean Names		Clean Names + Edit Distance		Clean Names + MID	
Sample:	Switchers	Full Sample	Switchers	Full Sample	Switchers	Full Sample
ΔTariff$_s^{COL}$	-0.157**	-0.060*	-0.213**	-0.121**	-0.117*	-0.074**
	(0.072)	(0.034)	(0.097)	(0.053)	(0.064)	(0.034)
Firm and Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	439	1608	430	1442	452	1672

Notes: This table shows the results of the estimation of equation (4.3). All columns use world imports as a measure of importing firm size. Columns 1, 3, and 5 are restricted to the sample of exporters switching importing partners. Columns 2, 4, and 6 are estimated on the full sample. All columns include sector fixed effects at the HS-2 digit level, based on firms main sector in the initial period. All variables are standardized. Standard errors are reported under the estimated coefficients. Errors are clustered by sector at the HS 2-digit level, based on firms main sector in the initial period. ***. ** and * denote significance at the 1%, 5% and 10% confidence levels.