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ABSTRACT

The Buyer Margins of Firms' Exports*

We use highly disaggregated firm-level export data from Costa Rica, Ecuador, and Uruguay over the period 2005-2008 to provide a precise characterization of firms' export margins, across products, destination countries, and crucially customers. We show that a firm's number of buyers and the distribution of sales across them systematically vary with the characteristics of its destination markets. While most firms serve only very few buyers abroad, the number of buyers and the skewness of sales across them increases with the size and the accessibility of destinations. We develop a simple model of selection with heterogeneous buyers and sellers consistent with these findings in which tougher competition induces a better alignment between consumers' ideal variants and firms' core competencies. This generates an additional channel through which tougher competition leads to higher productivity and higher welfare and hints at an additional source of gains from trade as long as freer trade fosters competition.

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1   Introduction

Starting in the mid-1990s, as data became available, there has been a boom of empirical studies examining the role played by firms in international trade. The first empirical contributions allowed gaining valuable microeconomic insights by analyzing firm-level exports and their determinants (e.g., Roberts and Tybout, 1997; Clerides et al., 1998; Bernard and Jensen, 1999). These contributions inspired theoretical models with heterogeneous firms in open economies (e.g., Melitz, 2003; Bernard et al., 2003; Melitz and Ottaviano, 2008) instead of the representative firm models standard in the international trade literature.[1]

While this line of research has substantially broadened and deepened in recent years, most existing analyses are still based on 'one-sided data', i.e., data that identify what firms are either shipping or receiving the goods, but do not simultaneously identify the sender and the receiver.[2] Hence, while precious in several dimensions, they do not provide a complete picture of trade relationships as these are actually two-sided. Evidence on how countries' bilateral trade is made up of varying patterns of firm-to-firm transactions across goods and country-pairs is still missing. More precisely, there is still little evidence on the number of actual partners for trading companies across products and countries as well as on the distribution of firm-level trade across partners.

This paper explores these additional extensive and intensive margins of exports, both empirically and theoretically. On the empirical side, for the first time to our knowledge, we use highly disaggregated firm-level exports from three countries, Costa Rica, Ecuador, and Uruguay to all destination countries for a number of years, 2005-2008, to provide a detailed description of firms' export margins, across products, destination countries, and, crucially, their trading partners. Our findings reveal the presence of additional margins of adjustment whereby market conditions also affect the number of buyers as well as the distribution of export sales (and prices) across buyers in a way that resembles the adjustment across products as evidence by Mayer et al. (2011).

These findings can be summarized as follows. First, most exporters serve few foreign buyers, whereas few exporters serve several foreign buyers. The few exporters that sell several products to several destinations and, in addition, to several buyers account for a large share of aggregate exports. Second, reaching a larger number of buyers is an important channel of export expansion, at the country level as well as at the firm level, both across destinations and within destinations over time. This buyer extensive margin is at least as important as the firm and the product extensive margins for aggregate bilateral exports as well as the firms' product extensive margin for firms' destination-specific exports. Third, the buyer extensive margin responds positively to the market size of the export destination and negatively to its distance. The buyer intensive margin behaves in a similar way. Changes along this margin are primarily driven by changes in average quantities. This holds for both exports at the firm-destination level and for exports at the firm-product-destination level. Fourth, the distribution of firm-product-destination sales across buyers is skewed. Its skewness decreases with distance to the destination market while it increases with the size of this market and the intensity of competition therein. Fifth, in the same destination different buyers pay different prices for the same product sold by the same firm, that is, there is price dispersion at the firm-product-destination level. The price

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[1] See Melitz and Redding (2013a) for a recent survey.

[2] This literature has provided new evidence on the patterns and determinants of firm-level exports across products and destination markets (for a recent survey with detailed references, see Bernard et al., 2012). At the same time, based on samples of manufacturing firms, some researchers have started to look into the patterns and determinants of intra-firm trade by discretely distinguishing firms' imports between those originated from related companies and those originated from independent parties (e.g., Bernard et al., 2008; Corcos et al., 2009) as well as into the role of trade intermediaries (Bernard et al., 2011; Blum et al., 2010 and 2012).

paid by a buyer depends on its share in the firms' total exports of the product: the main buyers tend to pay lower prices. Price dispersion across buyers is more pronounced for differentiated products. It decreases with distance to the destination market and increases with the size of the latter as well as with the intensity of competition therein.

On the theoretical side, the paper explores the implications of these findings asking whether adjustment along the buyer margins can be expected to configure an additional channel of welfare gains associated with international trade. To this end, we rationalize our empirical findings in terms of a simple model of selection with heterogeneous buyers and sellers merging the 'representative consumer approach' to product differentiation (Chamberlin, 1933; Spence, 1976; Dixit and Stiglitz, 1977) with the 'address (or characteristics) approach' (Hotelling, 1929; Lancaster, 1966 and 1979). Whereas the former is the current standard in international trade theory, the latter is more popular in industrial organization, with very few applications to international trade since early works by Lancaster (1980) and Helpman (1981).[3]

In line with the address approach as presented by Anderson et al. (1991), we introduce taste heterogeneity by assuming that the variants of a product can be described as points in a characteristics space. Consumer preferences are defined over all potential variants, and each consumer has an ideal variant ('address') in the characteristics space. Aggregate preferences for within-product diversity arise from the dispersion of ideal points ('segments') over the characteristics space and, for a given price vector, a variant's demand is defined by the mass of consumers preferring that variant over the others. In particular, for each differentiated product there is a measure of ideal variants that, in the wake of Salop (1979), are located around a circle and consumers are assumed to be uniformly distributed along the circle. However, unlike Hotelling (1929) and Salop (1979) but similar to Capozza and Van Order (1978), a consumer can buy a variable amount of her ideal variant of each differentiated product as long as this is available in her market segment. Following the representative consumer approach, the consumer loves product variety and therefore demands each differentiated product provided her ideal variant of the product is available.[4] However, we depart from the CES demand system usually featured by international trade models with monopolistic competition and assume instead linear demand as initially proposed by Ottaviano et al. (2002). This departure is crucial to explain the behavior of the skewness of sales and the dispersion of prices across buyers of the same product from the same firm in the same destination market.

Turning to production, as in Melitz and Ottaviano (2008) and Mayer et al. (2011), firms choose in which country to locate and in which 'core segment' to position themselves prior to entry. Upon entry they draw their total factor productivity in serving their core customers in their domestic market ('core competency'). After drawing, they may also decide to serve non-core customers or foreign markets but in both cases they face additional costs of adaptation or export. In this setting market size has both a direct effect and an indirect effect through the intensity of competition on: the number and market shares of active firms as in Melitz and Ottaviano (2008); the number of variants of their products and the distribution of sales across these variants as in Mayer et al (2011); and, critically, the numbers of their customers and the distribution of sales across them. The last is the crucial novel

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[3] See, e.g., Casella and Rauch (2002), Rauch and Casella (2003) and Rauch and Trindade (2003).

[4] Helpman (1981) adopts a 'pure' adress model. There is only one differentiated product and the fact that a consumer has her own ideal variant of that product rules out 'love for variety' across variants. Anderson, de Palma and Thisse (1991) determine the formal conditions under which address (and discrete choice) models can give rise to aggregate 'love for variety' across variants of the same product when individual preferences for ideal variants are aggregated at the product level. In this respect, though our demand system violates those conditions, our 'segments' could be interpreted as capturing the idea of an intermediate level of aggregation between the individual consumer and the product market as in the marketing literature since Smith (1956).

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feature of our model in that larger market size is shown to induce a better match between consumers' ideal variants and firms' core competencies, generating an additional channel through which tougher competition leads to higher productivity and higher welfare.

To better understand how this welfare effect materializes, it is useful to compare our model with Helpman (1981). In Helpman's model there is no firm heterogeneity, there is only one differentiated product and consumers are continuously and uniformly distributed along the circle representing the characteristics space of that product. Due to increasing returns to scale, firms come in a discrete number, each supplying its unique variant. Hence, available variants occupy a zero measure subset of the circle, along which they are distributed at equidistant points. This implies that the probability a consumer finds a perfect match for her ideal variety is zero and she has to make do with the closest available variant, suffering a utility loss that increases with the distance of that variant from her ideal variant. However, as in a larger market there are more firms, the (symmetric) reciprocal distances between available variants are shorter and, thus, the average distance between a consumer's ideal variant and the closest available variant is shorter too. This reduces the average mismatch and the associated utility loss. Moreover, due to increasing returns, the larger market also offers lower prices for available variants. On both counts, average utility is higher in a larger market.[5]

Differently, in our model a consumer consumes several differentiated products, has an ideal variant of each differentiated product and does not consume any other variant (i.e. the utility loss associated with the consumption of any non-ideal is prohibitive). On the production side, firms are heterogeneous and each of them has its own core variant of the product(s) it supplies. This core variant corresponds to the ideal variant of some consumers and can also be transformed in the ideal variants of other consumers by paying an additional adaptation cost that increases with the distance between the firm's core variant and those other consumers' ideal variants. As the market gets larger, more firms enter and produce. The resulting tougher competition forces producers to focus on their core variants. Consumers whose ideal variants were initially further away from the firms' core variants are not served anymore and the corresponding products disappear from their consumption baskets. This welfare loss in terms of product variety is, however, compensated by new products supplied by new firms. Due to within-product selection, the distance between the core and ideal variants of the new products is shorter than the distance between the core and ideal variants of disappeared products. Tougher competition also reduces prices thanks to the compression of markups, the selection of firms, products as well as variants and the reallocation of expenditure shares towards core variants. For all these reasons, average utility grows with market size.[6]

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[5] In address models the mismatch between buyers and sellers arises from the impossibility for the latter to exactly cover all the heterogeneous needs of the former due to limited resources. The mechanism is different in search models where buyers and sellers cannot instantly find a good trading partner and have to go through a costly search process balancing the loss of delaying trade against the option value of trying again and maybe finding a better match. In search models a larger market can provide higher welfare in the presence of 'thick market externalities', due for instance to increasing returns to scale in the matching function. See, for example, Eaton et al., 2013, for a recent search model applied to importer-exporter relations; Antras and Yeaple, 2013, for a survey stressing the make-or-buy decisions of multinationals.

[6] As Helpman (1981) we model the direct interaction between heterogeneous consumers and heterogeneous final producers. A similar logic can be extended to the case in which the interaction between heterogeneous consumers and heterogeneous final producers is mediated by intermediaries. To see this, consider the model by Helpman (1985) who extends Helpman (1981) by introducing a differentiated intermediate input ('middle product') used to produced the differentiated final product. Just like the characteristics space of the final product, also that of the middle product is represented by a circle. Moreover, each variant of the final product has a corresponding best variant of the middle product: when this variant is used, the required quantities of other factors are lowest. Accordingly, the variants of the middle product can be represented by the same circle used to represent the variants of the final product. On the other hand, when a non-ideal variant is used, the required quantities of other factors increase, the more so the longer the

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Our paper contributes to an emerging literature that has started to examine the extensive and intensive margins of exports along the buyer dimension. Modelling marketing costs and distinguishing the cost needed to reach the first customer from the one needed to reach additional customers, Arkolakis (2010) exploits the US-Mexico NAFTA liberalization episode in the Nineties to argue that exports growth materialized through increases not only in the number of exporters ('new firm margin') but also and more importantly through the number of their customers ('new consumer margin'). In so doing, he uses disaggregated product data as buyer information was not available.[7] Blum et al. (2010 and 2012) and Eaton et al. (2013) do make use of data that identify the buyers, but for different purposes and, unlike our data, these are limited to few pairs of countries. In particular, Blum et al. (2010 and 2012) use data on Chilean exporters and matched Colombian importers to motivate their model of trade intermediaries. Eaton et al. (2013) use customs data on the relationships Colombian firms have with their US buyers to quantify several types of trade costs and learning effects and to explore their impacts on aggregate export dynamics. Closer to our paper, in a parallel work, Bernard et al. (2013) use export information from Norway to study the impact of foreign buyers' size heterogeneity on aggregate trade elasticity.[8] However, differently from ours, their analysis does not deepen the investigation of the firm-product level and does not cover the distributions of sales nor prices across buyers.

Our paper also relates to the ongoing debate on the gains from trade with heterogeneous agents (see, e.g., Arkolakis et al., 2012a,b; Costinot and Rodriguez-Clare, 2013; Melitz and Redding, 2013b). This debate has so far focused on models in which sellers are heterogeneous but buyers are not. We introduce heterogeneous buyers and highlight the gains arising from the interaction between sellers' and buyers' heterogeneity.

The rest of the paper is organized in four sections. Section 2 describes our data and presents our empirical findings. Section 3 presents the closed economy version of the theoretical model with single-product firms. Section 4 extends the single-product model to the open economy. Section 5 introduces multi-product firms. Section 6 provides some concluding remarks.

2 Buyers' Margins of Exports

We use three unique databases consisting of highly disaggregated annual firms' export data from three countries, Costa Rica, Ecuador and Uruguay, over the period 2005-2008. In particular, these customs

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distance between the ideal variant and the non-ideal variant actually used. Increasing returns to scale in intermediates imply that only a discrete number of variants of the middle product is available, many variants of the final product are produced with the same variant of the middle product and only a zero measure set of final products actually uses ideal variants of the middle product. In a larger market there are more intermediate producers, the (symmetric) reciprocal distances between the available variants of the middle product are shorter and, thus, the average distance between a final producer's ideal variant and the closest available variant is shorter too. This reduces the average mismatch and the associated productivity loss. Moreover, due to increasing returns, the larger market also offers lower prices for the available variants of the middle product. This extended framework highlights another reason why welfare is higher in a larger market: intermediate and final producers are better matched.

[7]In Arkolakis (2010) consumers with identical tastes may end up consuming different CES bundles of differentiated products due to imperfect marketing penetration. In particular, a consumer buys a good only if she is aware of its existence, and becomes aware of its existence only if she observes a costly ad posted by its producer. The producer serves the market only if it is profitable to incur the marginal cost to reach at least one consumer and then incurs an increasing marginal penetration cost to access additional consumers. Assuming that the marketing technology exhibits increasing returns to scale with respect to population size but decreasing returns to scale with respect to the number of consumers reached, the model is used to reconcile the positive relationship between entry and market size with the existence of many small producers.

[8]Some of our findings concur with those reported by Bernard et al. (2013) for Norwegian exporters.

data are reported at the exporter-product-country-importer level. Hence, we know exactly the value and the quantity (weight) of the shipment of each exporter of each product (10-digit HS level) to each importing company in each destination country, which is the level at which trade actually takes place. Hence, we are able to track not only exporters but also importers over time.

These data virtually cover the whole population of exporting firms in the sample countries and not just a sample of manufacturing firms. In the case of Costa Rica, the sum of the exports of the firms in our database amounts on average to approximately 90% of the country's total merchandise exports as reported by the Central Bank of Costa Rica, with the difference being explained by exports of Gold Coffee, which due to administrative reasons are registered separately, and by the absence of data on the importers' identity for a few exporters. As for Ecuador, only a minor portion of oil exports is not included. Regarding Uruguay, the discrepancy of our data with the Central Bank reports never exceeds 1% over the period under analysis.

2.1   Countries

Table 1 presents aggregate export indicators for the three countries over the sample period. The number of exporters in these countries ranges between 2,000 in the case of Uruguay and 4,000 in the case of Ecuador. These exporting firms sell 3,000 (Uruguay and Ecuador) to 4,000 (Costa Rica) products to more than 11,000 buyers spread approximately across 150 destinations. Hence, these three countries are fairly similar in terms of their aggregate export outcomes.

Bernard et al. (2007), Mayer and Ottaviano (2007) as well as Mayer et al. (2011) use gravity regressions to decompose the behavior of aggregate bilateral trade flows along the number of exporters ('firm extensive margin'), the number of exported products ('product extensive margin'), and average exports per exporter and product ('firm/product intensive margin'). The firm and product extensive margins are found to be positively affected by the size of the destination markets (as proxied by the GDP) and negatively affected by the distance to these markets, whereas the opposite holds for the firm/product intensive margin.

In Table 2 we decompose total bilateral exports along the aforementioned extensive margins and, as a novelty, the number of buyers ('buyer extensive margin') and average exports per exporter-product-buyer combinations that actually register trade ('firm/product/buyer intensive margin') for both 2005 and the entire sample period (2005-2008), whereas in Table 3 we examine how these margins respond to various export market characteristics, respectively.[9]

Our decompositions suggest that the extensive margins account together for more than 50% (and up to two thirds in the case of Uruguay) of the variation of the exports across destinations (see Table 2, left panel). It is worth noting that the buyer extensive margin is slightly more important than the firm and the product extensive margins for bilateral exports and that this applies to our three sample countries. In particular, the buyer extensive margin is responsible for 35% of the overall extensive margin' share and this is remarkably consistent across these countries.

In addition, the extensive margins jointly account for approximately 20% of the expansion of the within-destination sales (see Table 2, right panel).[10] However, there are noticeable differences across countries in this regard, as this share ranges between 15% in the case of Ecuador and 30% in the case of Uruguay. Also remarkable, with the exception of Costa Rica, increases in the number of buyers

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[9] Figures do not add up to one along the rows because we are reporting the contribution of the actual intensive margin, which considers the exporter-product-buyer triples with positive trade, instead of that of the theoretical intensive margin, which considers all their possible combinations.

[10] The joint contribution of the extensive margins is the complement of that of the actual intensive margin.

seem to be as important as and even more important than increases in the number of exporters and products as a driving force for export expansions in given destinations. The share of the buyer extensive margin in the overall contribution of the extensive margins to these expansions lies between 30% and 40%.

Estimates of the gravity equations indicate that the buyer extensive margin behaves much like the other traditional extensive margins: it decreases with the distance to and increases with the size and the per capita income of the destination markets (see Table 3, left and right panels).[11] The actual intensive margin, which in this case incorporates the buyer dimension, reacts qualitatively in the same way to distance and market size, albeit it appears to be less responsive.[12] Moreover, it does not seem to be systematically related to the destination's income per capita. GDP-related results are illustrated in Figure 1.[13]

2.2 Firms

Table 4 describes the distribution of export outcomes across firms in the three sample countries. For parsimony, we focus on 2005 but similar patterns emerge for all years in the sample. The median (average) Costa Rican exporter sells 2 (5.9) products to 2 (6.9) buyers in 2 (2.9) countries for USD 35,000. The median (average) Ecuadorian exporter sells 1 (3.2) products to 1 (4.9) buyers in 1 (2.3) countries for USD 28,000; numbers for the median (average) Uruguayan exporter are very similar. Importantly, columns reporting other percentiles of the distributions of export outcomes clearly suggest that, while most exporters trade with a limited number of foreign buyers, a few firms have broadly diversified trade relationships in terms of the range of buyers they are connected with. Thus, half of the exporters have no more than two buyers, but the top 10% (5%) interact with more than 11 (20) buyers. Such heterogeneity can be visualized with the help of the upper left panel of Figure 2, which presents the cumulative distribution of exporters over the number of trading partners.

Consistently, as shown by the cumulative distribution of exporters over the share of the main buyer in the upper right panel of Figure 2, this main buyer accounts for a large portion or directly all foreign sales of a relatively large number of exporting firms. In contrast, a few firms have their sales spread across many buyers. For the top 10% (5%) exporters in terms of the number of buyers, the average share of the main buyer does not exceed 40% (38%) and is as low as 32% (25%) in the case of Uruguay. The kernel densities estimates in the lower panel of Figure 2 highlight that, as expected, these patterns become more pronounced as the level of disaggregation of the data goes from the firm-level to the firm-product-destination-level. While Figure 2 pools our three countries, similar findings hold for each of them.[14]

Disaggregated data specifically indicate that most exporters sell abroad only a few products to a few buyers in a few destinations. The other side of the coin is that the few firms that export several products to several destinations and, on top, to several buyers account for large shares of total exports. Noteworthy, this is also true relative to firms that also sell several products in several destinations but only to a few buyers. This can be seen in Figure 3, which reports the fraction of exporters that

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[11] GDP is PPP expressed in a common currency and constant prices and comes from the World Bank's World Development Indicators (WDI). The same applies to GDP per capita. Distances, common language, and colony come from the CEPII database. The source for the RTA variable is CEPII and WTO.

[12] Consistent with previous findings, the theoretical intensive margin is positively associated with distance and negatively associated with market size and income level. These results are available from the authors upon request.

[13] An appendix with results from gravity estimations by country of origin and at different levels of aggregation (i.e., country, firm-destination, and firm-product-destination) is available from the authors upon request.

[14] See Figure A1 in the Appendix.

have no less than n buyers in at least one of their m destinations and no less than s buyers of at least one their r (differentiated) products (left panel) and the share of aggregate exports due to exporters that have no less than n buyers in at least one of their m destinations and no less than s buyers of at least one their r (differentiated) products (right panel).[15] This concentration of aggregate exports in the hands of few large firms that sell several products to several markets concurs with the 'happy few' findings of Bernard at al. (2007) for the US and Mayer and Ottaviano (2007) for the EU. Our data additionally reveal that an analogous pattern applies to the number of buyers: firms with a large pool of customers are a very selective sample of the population, and these firms represent a large fraction of the total exports.

2.3   Firms and Destinations

As with aggregate bilateral exports, we now decompose firm-destination exports into their various margins and examine how exports and margins relate to the destinations' characteristics. Table 5 reports the results of the decomposition of *firm-destination* exports into the number of products ('firms' product extensive margin'), the number of buyers ('firms' buyer extensive margin'), and average exports per product-buyer combinations with positive trade ('firms' product/buyer intensive margin').[16] The table shows that the extensive margin accounts for roughly 17% of the variation firms' exports both across countries in a given year (see left panel) and 23% of the variation of firms' exports within given countries over time (see right panel). Nevertheless, behind this aggregate picture there are significant differences across sample countries. Thus, for instance, the share of the extensive margin in the variation of firm-destination exports in a given year is only 10% in Ecuador but more than 20% in Uruguay, whereas that over time reaches 21% in Ecuador and Costa Rica and almost 30% in Uruguay. Still, the buyer extensive margin is comparable to the product extensive margin in terms of its contribution to explain the variation of firms' exports both across and within countries.

Gravity equation estimates indicate that the buyer extensive margin reacts to trade enhancers and barriers like its product analogue: it tends to be positively associated with the market size of the destinations and tends to be negatively associated with the distance to these destinations. Specifically, the number of buyers seems to have a more pronounced response to market size than the number of products. Interestingly, the buyer/product intensive margin behaves in a similar manner (see Table 6). The same applies to the average exports per buyer.[17]

Mayer at al. (2011) show that exporters' sales are not uniformly distributed across its product mix but rather skewed towards some core products, and that this skewness is more pronounced in more accessible and bigger markets. In Table 6 we also assess the behavior of the distribution of firm-destination sales across buyers. In so doing, we proxy the skewness of sales across buyers by the share of the main buyer (SMB) and add the number of buyers in the destination in question to control for any mechanical effect of this variable on our skewness indicator when the number of buyers is small. Our estimates suggest that concentration of sales - conditional on the number of buyers - reacts to distance and market size in the same way as the skewness of the product mix - conditional on the number of products - being higher in closer and larger markets.[18] Figure 4 provides a visualization of

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[15] In distinguishing between differentiated and non-differentiated products, we use the liberal version of the classification developed by Rauch (1999).

[16] Again, figures do not add up to one along the rows because we are reporting the contribution of the actual intensive margin instead of the theoretical intensive margin, which would use as a denominator all possible combinations of products and buyers.

[17] This result is available from the authors upon request.

[18] As we will see below, this finding is robust to using alternative measures of sales' concentration.

the GDP-related gravity-based results.

2.4 Firms, Products, and Destinations

2.4.1 Margins

Turning to firm-product level data, we replicate the previous analysis, this time decomposing firm-product-destination exports into the number of buyers ('firms-products' buyer extensive margin') and average exports per buyer ('firms-products' buyer intensive margin'), which in turn can be decomposed into average unit values and average export quantities (weight) per buyer. The results reported in Table 7 suggest that, also within this more narrowly defined level, the buyer margin plays a relevant role and accounts for up to 10% of the variation of firm-product exports across destinations (left panel) and for up to 17% of the variation of exports within given firm-product-destinations over time (right panel). Average quantity per buyer and, to a lesser extent, average unit values also contribute to explain such exports. Again, there are differences among our sample countries. The buyer extensive margin seems to be relatively more important in Uruguay than in Costa Rica and Ecuador. On the other hand, increases in average unit values appear as a substantive driving force of the export expansion of Costa Rican firms in given product-destinations.

In Table 8 we examine how firm-product-destination exports and their different margins respond to market characteristics. Consistent with results shown above, firms' exports by product and destination country decrease with distance to this country and increase with its economic size. Both the number of buyers and average exports per buyer behave in the same way, with the latter being more elastic with respect to trade determinants. Furthermore, most of the changes in the buyer intensive margin can be traced back to changes in average quantities per buyer. Unit values are primarily influenced by the level of income of the destination market. This in line with findings reported in recent empirical studies on quality differences across space, according to which firms tend to ship higher-priced varieties to more developed countries (e.g., Hummels and Klenow, 2004 and 2005; Hallak, 2006; Manova and Zhang, 2012). Previous results remain robust to including country-random year effects to account for within country-correlation (Wooldridge, 2006); and, when applicable, to using a Poisson estimator (Santos Silva and Tenreyro, 2006) or Tobit-based corrections for sample selection (Wooldridge, 2002) to account for the presence of zeroes.[19]

2.4.2 Sales Distribution and Price Dispersion across Buyers

Our data also make it possible to explore the distribution of sales and price dispersion across buyers at the firm-product-destination level and how these are influenced by the destinations' attributes. This is done in Figures 5 and 6 and Tables 9 to 11. In particular, Figure 5 presents the distribution of the share of the main buyer and the standard deviation of prices across buyers for both differentiated and non-differentiated products. While there is no distinguishing pattern in terms of how sales are spread across buyers, as expected, prices of differentiated goods are clearly more heterogeneous than those of non-differentiated goods.[20] Interestingly, within given exporting firm-product-destination(-year) combinations, the main buyer seems to systematically pay lower prices than other buyers.[21] In Table

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[19] These estimation results are available from the authors upon request.

[20] The Kolmogorov-Smirnov test-based procedure proposed by Delgado et al. (2002) indicates that the distribution of the price dispersion of differentiated goods stochastically dominates that of the price dispersion of non-differentiated goods. Test statistics are available from the authors upon request.

[21] We specifically regress the natural logarithm of the unit value paid by a buyer of a given product in a given country from a given exporter on a binary indicator that takes the value of one if the buyer is the most important - in terms

9 we report the effects of distance, market size, and income per capita on the share of the main buyer (SMB).[22] We also present the impact on the same outcome variable of the toughness of competition as proxied by the number of other firms from the three sample countries exporting the same HS2-product to the same destination as the exporter in question (Mayer et al., 2011), the size of its market, and the degree of freeness of trade in this destination as measured by a country-HS2-level indicator computed from gravity equation estimates (Mayer et al. 2011). In both cases, we consider all products (left panel) and only differentiated products (right panel), while including firm-product-year fixed effects to account for firm-product factors that vary over time such as firms' productivity and changing firms' competencies across products, and the number of buyers to control for any mechanical effect on skewness. Estimates indicate that the distribution of sales across buyers - conditional on the number of buyers - is more skewed in closer and larger markets (see also Figure 6). Hence, the concentration of sales across buyers exhibits the same behavior observed at the firm-destination level. Moreover, results clearly suggest that the concentration of sales in the main buyer increases with the intensity of the competition prevailing in the destination. The same holds for the destination's freeness of trade.

Table 10 shows that similar responses are found when using alternative concentration measures such as the sales ratio of the most important buyer to the least important buyer (B1/BL) and indicators that use information on the entire distribution of sales across buyers such as the Herfindahl index (HI), the Theil index (TI), and the coefficient of variation (CV), thus corroborating the baseline estimates.[23] Results convey the same message when using quantities (weight) instead of values to compute sales' concentration measures; when restricting the sample to firm-product-destinations observations with at least two buyers (i.e., those used in estimations in which the dependent variable is the sales' ratio); when excluding flows associated with trade between (vertically) related companies, and on both capital and intermediate goods and consumer goods.[24] Also important, these results remain robust to including country-year random effects to control for within country-correlation (Wooldridge, 2006).[25]

Finally, in Table 11 we investigate how market characteristics affect price dispersion at the firm-product-destination level. The price dispersion indicators are: the difference between the maximum and the minimum prices (PM-Pm), the coefficient of variation (CV), and the standard deviation (SD). The covariates are those used in previous estimations. According to the estimates presented in this table, price dispersion is larger in closer and bigger destination markets (see also Figure 6). In addition, the results indicate that dispersion at this level tends to increase with stronger competition. It also seems to rise with the freeness of trade in the destination. Again, these results are robust to several checks such as removing observations in which (vertically) related firms are involved; and incorporating country-year random effects to control for within country-correlation (Woorldridge, 2006).[26] Hence, a more skewed buyer mix comes with higher price dispersion.

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of its share in the total quantity (weight) sold by the exporter in that product-destination combination - as well as on exporting firm-product-destination-year fixed effects. A table with estimation results and test statistics are available from the authors upon request.

[22]Results reported in Table 9 are based on estimations in which the dependent variable is the natural logarithm of the share of the main buyer. Estimates are qualitatively similar when using, instead, directly the share of the main buyer as the dependent variable. These estimates are available from the authors upon request.

[23]In the estimations whose results are presented in Table 10 the dependent variables (Herfindahl index, Theil index, and coefficient of variation) are expressed in natural logarithms. Results are comparable when we do not take logarithms. These results are available from the authors upon request.

[24]We use the WorldBase to identify firms that are vertically related (Alfaro and Chen, 2012).

[25]These estimation results are available from the authors upon request.

[26]These estimation results are available from the authors upon request.

2.5 Summary

Our data analysis has revealed the importance of the buyer margins for aggregate exports and has shed light on their composition. Most firms export only few products to few buyers in few destinations. The flip side of the coin is that the few exporters that sell multiple products to multiple destinations and, on top, to multiple buyers are responsible for large shares of total exports. This is also true relative to firms that also sell several products in several destinations but only to a few buyers.

When investigating whether and how the buyer margins are shaped by the characteristics of destinations, we have found that a firm's (firm-product's) number of buyers and the distribution of sales across them systematically vary with destination characteristics. In particular, the number of buyers and the average exports per buyer increase with the size and the accessibility of the destination country. Conditional on the number of buyers, the same holds for the concentration of firm (firm-product) sales across them.

Finally, we have drawn attention to the behavior of prices, in particular of their dispersion: even within a specific destination different buyers pay different prices to the same firm for the same product, and these price differences are sizable for differentiated products. In particular, buyers that account for larger shares of a firm's sales of a given product pay lower prices for that product. We have also shown how price dispersion is affected by country characteristics, being more pronounced in destinations that are bigger and more accessible.

In the next sections we propose a model that generates predictions consistent with our empirical findings and use it to show that adjustments along the buyer margins can be expected to configure an additional channel of gains from trade.

3 Single-Product Model in Closed Economy

As discussed by Anderson, de Palma and Thisse (1991), there are three main approaches to modeling product differentiation: the representative consumer approach (Chamberlin, 1933; Spence, 1976; Dixit and Stiglitz, 1977), the address (or characteristics) approach (Hotelling, 1929; Lancaster, 1966 and 1977) and the discrete choice approach (McFadden, 1974; Manski, 1977). This section combines the first two approaches to develop a simple model of selection with heterogeneous consumers and firms. In the proposed model the intensity of competition affects the number and market shares of active firms as in Melitz and Ottaviano (2008), the number of variants of their products and the distribution of sales across these variants as in Mayer et al. (2011) as well as the numbers of their customers and the distribution of sales across them.

This is the key original aspect of the proposed model in that tougher competition in a larger market induces a better match between consumers' ideal variants and firms' core competencies, generating a new channel through which tougher competition leads to higher productivity and higher welfare. This paves the way to an additional source of gains from trade in the spirit of Helpman (1981).

3.1 Heterogeneous Consumers

There are L consumers with preferences defined over a homogenous good 0 and a set Ω of horizontally differentiated products indexed $i \in \Omega$. Each consumer is endowed with $\overline{q}_0$ units of the homogeneous good and one unit of labor that she inelastically supplies to the market. Each differentiated product comes itself in different variants and consumers differ in terms of their tastes for these variants.

Following the address approach, taste heterogeneity is introduced by assuming that a product's variants can be described as points in a characteristics space. Consumer preferences are defined over all potential variants, and each consumer has a most preferred variant known as her ideal point (or 'address') in the characteristics space. Aggregate preferences for within-product diversity arise from the dispersion of ideal points over the characteristics space and, for a given price vector, a variant's demand is defined by the mass of consumers preferring that variant over the others.[27] In particular, for each differentiated product i there is a measure 2 of ideal variants that, in the wake of Salop (1979) and Helpman (1981), are located around a circle C of circumference 2 and are indexed $s \in [0, 2]$ in a clockwise manner starting from noon (see Figure 7). The location of the ideal variant of a given consumer is assumed to be the same across all products, so each ideal variant s defines a market segment consisting of the set of consumers whose ideal variant is s for all products. Consumers are further assumed to be uniformly distributed across the segments. Each segment, therefore, consists of $L/2$ consumers. These assumptions assure the symmetry of the address model, simplifying the ensuing analysis without affecting its main insights.

Differently from Hotelling (1929) and Salop (1979) but just like Capozza and Van Order (1978), a consumer can buy a variable amount of her ideal variant of each differentiated product as long as available in her market segment. In particular, let $\Omega^s \subseteq \Omega$ be the set of products whose variants are available in segment s. The utility function of a typical consumer in segment s is then given by

$$U_c^s = q_c^s(0) + \alpha \int_{i \in \Omega^s} q_c^s(i) di - \frac{1}{2}\gamma \int_{i \in \Omega^s} [q_c^s(i)]^2 di - \frac{1}{2}\eta \left[\int_{i \in \Omega} q_c^s(i) di \right]^2 \tag{1}$$

where $\gamma > 0$ measures the 'love for variety' of the different products while α and η measure the preference for the differentiated products with respect to the homogeneous good. The initial endowment $\overline{q}_0$ of the homogeneous good is assumed to be large enough for its consumption to be strictly positive at the market equilibrium. According to this preference structure, each market segment is characterized in terms of a set of identical consumers who like a variety of differentiated products but demand a specific ideal variant of each of them. When their ideal variant of a product is not available, the consumers does not demand that product at all.

3.2 Heterogeneous Firms

Labor is the only input. It can be employed in the production of the homogeneous good under perfect competition and constant returns to scale with unit labor requirement equal to one. It can also be employed in the production of the differentiated products under monopolistic competition. In each segment s there is an infinite number of potential entrants with entry requiring a R&D effort of $f > 0$ units of labor to design a new product in that segment together with its production process, which is also characterized by constant returns to scale. Effort f leads to the design of a new product in segment s with certainty whereas the unit labor requirement c of the corresponding production process is uncertain, being randomly drawn from a continuous distribution with cumulative density

$$G(c) = \left(\frac{c}{c_M} \right)^k, \ c \in [0, c_M] \tag{2}$$

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[27] As pointed out by Anderson, de Palma and Thisse (1991), this address model is equivalent to a discrete choice model with each consumer choosing the variant yielding the highest utility, while the taste distribution can be obtained from the distribution of ideal points.

This corresponds to the case in which marginal productivity $1/c$ is Pareto distributed with shape parameter $k \geq 1$ over the support $[1/c_M, \infty)$.[28] Hence, as k rises, density is skewed towards the upper bound of the support of $G(c)$.

The R&D effort cannot be recovered and this gives rise to a sunk entry cost. By sinking f in a given segment, an entrant selects it as its 'core segment', inventing the corresponding 'core variant' of its product with corresponding 'core unit input requirement' (or 'core competency') c. However, after entry, the entrant can also decide to supply variants of its product to other non-core segments. This involves additional adaptation that imposes incrementally higher unit labor requirements for the variants the further away their segments are from the entrant's core segment. Specifically, if the core variant introduced in segment s entails a unit labor requirement c, its non-core variant adapted to segment s' entails a unit labor requirement $e^{\delta|s-s'|}c$, where $|s-s'|$ is the length of shortest arc linking s and s' on the circle C (see Figure 7). In this setup, the parameter $\delta > 0$ can be interpreted as an index of 'taste heterogeneity'. When $\delta = 0$, all consumers share the same ideal variants of the differentiated products and no adaptation is thus required as in Melitz and Ottaviano (2008). As δ grows, consumers' ideal variants diverge and adaptation becomes increasingly costly.[29]

3.3 Firms' Selection

On the demand side, utility maximization gives the following individual inverse demand for product i's variant in segment s

$$p^s(i) = \alpha - \gamma q_c^s(i) - \eta Q_c^s \tag{3}$$

with $Q_c^s = \int_{i \in \Omega_s} q_c^s(i) di$, as long as $q_c^s(i) > 0$. Total demand in segment s therefore equals

$$q^s(i) \equiv L^s q_c^s(i) = \frac{\alpha L^s}{\eta N^s + \gamma} - \frac{L^s}{\gamma} p^s(i) + \frac{\eta N^s}{\eta N^s + \gamma} \frac{L^s}{\gamma} \overline{p}^s, \ \forall i \in \Omega_*^s \tag{4}$$

where the set Ω_*^s is the largest subset of Ω^s such that demand is positive, N^s is the measure ('number') of products in Ω_*^s and $\overline{p}^s = (1/N^s) \int_{i \in \Omega_*^s} p^s(i) di$ is their average price. Product i belongs to this set when

$$p^s(i) \leq \frac{1}{\eta N^s + \gamma} \left(\gamma\alpha + \eta N^s \overline{p}^s \right) \equiv p_{\max}^s \tag{5}$$

where $p_{\max}^s \leq \alpha$ represents the price at which demand for a product is driven to zero. Given (3), lower $p_{\max}^s$ implies higher price elasticity of demand.

On the supply side, due to perfect competition and the assumed unit labor requirement for the production of the homogeneous good, choosing this good as numeraire sets also the wage equal to one. Accordingly, we can refer to unit labor requirement and marginal cost interchangeably as they coincide. Turning to the monopolistically competitive sector, consider a firm with marginal cost c in its core segment s that maximizes the profit from selling to segment s'. We assume market segmentation,

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[28] As argued by Mayer et al. (2011), the distributional assumption (2) yields, up to an additive shift, a Pareto distribution for firm size and product sales that fits empirical patterns well.

[29] Whereas in our data both sellers and buyers are firms, in our model buyers are consumers. This apparent inconsistency that abstracts from intermediaries is customary in international trade theory. In the present setup, it can be circumvented by assuming that each market segment is populated by perfectly competitive final producers that buy segment-specific intermediates from the monopolistically competitive firms and transform them one-to-one into segment-specific final products. Such a model with 'middle products' would be homomorphic to the model we propose and we prefer to stick to the latter for ease of exposition. See, e.g., Helpman (1985) for a full-fledged address model with 'middle products'.

so the problem of profit maximization is solved for each segment s' independently. In particular, a firm with marginal cost c will sell to segment s' if and only if $c \leq c^{s'} e^{-\delta|s-s'|}$, where $c^{s'} = p_{\max}^{s'}$ is the threshold below which the marginals costs of any firm with core segment s' has to fall for the firm to be able to profitably serve its core segment ('core cutoff cost'). The first order condition for profit maximization is satisfied by an output level equals to

$$q^{ss'}(c) = \frac{L}{4\gamma}\left(c^{s'} - e^{\delta|s-s'|}c\right) \tag{6}$$

with corresponding price, markup, revenue and profit

$$p^{ss'}(c) = \frac{1}{2}\left(c^{s'} + e^{\delta|s-s'|}c\right) \tag{7}$$

$$\mu^{ss'}(c) = \frac{1}{2}\left(c^{s'} - e^{\delta|s-s'|}c\right) \tag{8}$$

$$r^{ss'}(c) = \frac{L}{8\gamma}\left[\left(c^{s'}\right)^2 - \left(e^{\delta|s-s'|}c\right)^2\right] \tag{9}$$

$$\pi^{ss'}(c) = \frac{L}{8\gamma}\left(c^{s'} - e^{\delta|s-s'|}c\right)^2 \tag{10}$$

This last expression determines a cutoff rule for selling to segment s'. In particular, a firm with marginal cost c will sell to segment s' if and only if $c \leq c^{s'} e^{-\delta|s-s'|}$, where $c^{s'} = p_{\max}^{s'}$ is the threshold below which the marginals costs of any firm with core segment s' has to fall for the firm to be able to profitably serve its core segment ('core cutoff cost'). The cutoff rule explains the theoretical appeal of the distributional assumption (2) in that any truncation of $G(c)$ from above maintains its distributional properties. For instance, the distribution of firms with core segment s selling to segment s' is given by $G^{ss'}(c) = \left(c/c^{ss'}\right)^k$, with $c \in \left[0, c^{ss'}\right]$, where $c^{ss'} \equiv c^{s'} e^{-\delta|s-s'|}c$ is the marginal cost of producers with core segment s that are just indifferent between serving segment s' or not.

Due to free entry expected profit from entry into the segment has to be zero in equilibrium. This requires

$$\int_0^2 \left[\int_0^{c^{ss'}} \pi^{ss'}(c)dG(c)\right] ds' = f \tag{11}$$

which generates a set of free entry conditions, one for each segment. The symmetry of the address model, however, simplifies the analysis a lot. First of all, it implies that the core cutoff cost has to be the same in all segments: $c^{s'} = c^s = c_D$. Then, as all firms face symmetric conditions whatever their core segments may be, we can index $m \in [0,1]$ the variants of the product sold by a firm in increasing order of shortest arc distance from its core segment ($m = 0$). We thus have $e^{-\delta|s-s'|} = e^{-\delta m}$ so that the free entry condition (11) can be rewritten as

$$\int_0^1 \left[\int_0^{c_D e^{-\delta m}} \frac{L}{4\gamma}\left(c_D - e^{\delta m}c\right)^2 dG(c)\right] dm = f \tag{12}$$

and solved for the common core cutoff cost

$$c_D = \left(\frac{\gamma\phi}{\Lambda L}\right)^{\frac{1}{k+2}} \tag{13}$$

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where $\phi \equiv 2(k+2)(k+1)(c_M)^k f$ is a bundle of technological parameters and $\Lambda \equiv \int_0^1 (e^{-\delta m})^k dm = (1 - e^{-k\delta})/k\delta \in (0,1)$ is the share of consumers (and, therefore, of segments) successful entrants serve on average. Accordingly, we call Λ the average 'market penetration' (Arkolakis, 2010).[30] This is affected by the extent of consumer and firm heterogeneity. When $\delta = 0$, taste heterogeneity disappears and Λ equals 1: all active firms serve each and every consumer as in Melitz and Ottaviano (2008) who assume homogeneous consumers and, therefore, a single market segment. As δ increases, Λ decreases: more taste heterogeneity makes market penetration more difficult and firms reduce the share of consumers they serve.[31] The same happens when k increases: as firms with high marginal production costs become more frequent, the average ability to penetrate the market falls.[32] Accordingly, more taste heterogeneity (larger δ) is associated with weaker competition and selection (higher c_D).

To find the common number of sellers N in any given segment, we call $G_D^m(c) = G(c)/G(c_D e^{-\delta m}) = \left[c/\left(c_D e^{-\delta m}\right)\right]^k$ the conditional distribution of firms with core segment at distance m from the segment under consideration and use (7) to write the price of one of those firms as

$$p^m(c) = \frac{1}{2}\left(c_D + e^{\delta m}c\right)$$

The average price in the segment can then be rewritten as

$$\bar{p} = \int_0^1 \left[\int_0^{c_D e^{-\delta m}} p^m(c) dG_D^m(c)\right] dm = \frac{2k+1}{2(k+1)}c_D$$

With this result at hand, imposing $p_{\max}^s = c_D$ in (5) allows us to solve the resulting equation for the number of sellers

$$N = \frac{2(k+1)\gamma}{\eta}\frac{\alpha - c_D}{c_D} \tag{14}$$

while the number of producers whose core segment is the segment under consideration is $N^P = N/2$ and the associated number of entrants is $N^E = G(c_D)N^P = (c_D/c_M)^k N^P$. Expressions (13) and (14) fully characterize the equilibrium.

3.4   Consumers' Selection

How many consumers does a firm with core marginal cost c serve? As adaptation costs rise with distance from the core segment and core cutoff costs are the same in all segments, demand in a segment for the product of a firm whose core segment is at distance m from the segment under consideration falls when the shortest arc distance m from the core increases. Along the circle there are two segments at such distance and their combined demand evaluates to

$$q^m(c) = \frac{L}{2\gamma}\left(c_D - e^{\delta m}c\right) \tag{15}$$

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[30] In the terminology of Arkolakis (2010) our parameter δ would regulate the marginal cost of market penetration, which increases with the number of segments reached.

[31] Even a small degree of taste heterogeneity is enough to prevent some firms (the least productive ones) from serving all consumers: $\Lambda < 1$ for $\delta > 0$.

[32] The sign $\partial\Lambda/\partial\delta < 0$ follows from $\partial\left[\delta/(1 - e^{-k\delta})\right]/\partial\delta = \left[1 - (1+k\delta)e^{-k\delta}\right]\left(1 - e^{-k\delta}\right)^2 > 0$ as $\left[1 - (1+k\delta)e^{-k\delta}\right]$ equals 0 for $\delta = 0$ and increases with δ for $\delta > 0$. An analogous argument can be used to show that also $\partial\Lambda/\partial k < 0$ holds.

which implies that there exists some threshold distance $m_D(c)$ at which consumers are just indifferent between buying or not, that is: $q^m(c) = 0$ for $m = m_D(c)$. This threshold defines the firm's 'cutoff segment' with

$$m_D(c) = \begin{cases} 1 & \text{if} & c \leq c_D e^{-\delta} \\ \frac{1}{\delta} \ln\left(\frac{c_D}{c}\right) & \text{if} & c_D e^{-\delta} < c \leq c_D \\ 0 & \text{if} & c > c_D \end{cases} \tag{16}$$

As there are two such segments, one on each side of the circle starting from the firm's core segment, the total number of segments served by the firm is $2m_D(c)$. The corresponding number of consumers served from the core segment up to the two cutoff segments is thus $m_D(c)L$ while the combined demand by segments at distance $m \leq m_D(c)$ from the core is given by (15). Accordingly, the lower c the larger the numbers of segments $2m_D(c)$ and consumers $m_D(c)L$ the firm serves, and the larger the output $q^m(c)$ it sells at any given distance from its core segment $m \leq m_D(c)$. This shows that firms with lower core marginal cost have a wider and thicker market, and only firms whose core marginal costs is low enough are able to serve all consumers.

3.5 Firm Performance

Expressions (7)-(10) can be rewritten so as to show that at any distance $m \leq m_D(c)$ firms with lower core marginal cost c quote lower prices but enjoy higher markups, revenues and profits:

$$p^m(c) = \frac{1}{2}\left(c_D + e^{\delta m}c\right)$$

$$\mu^m(c) = \frac{1}{2}\left(c_D - e^{\delta m}c\right)$$

$$r^m(c) = \frac{L}{8\gamma}\left[(c_D)^2 - \left(e^{\delta m}c\right)^2\right]$$

$$\pi^m(c) = \frac{L}{8\gamma}\left(c_D - e^{\delta m}c\right)^2$$

This implies that firms with lower c are also larger in terms of both total output $Q(c)$ and total revenue $R(c)$ defined as

$$Q(c) = 2\int_0^{m_D(c)} q^m(c)dm = \frac{L}{2\gamma}\int_0^{m_D(c)} \left(c_D - e^{\delta m}c\right)dm \tag{17}$$

$$R(c) = 2\int_0^{m_D(c)} r^m(c)dm = \frac{L}{4\gamma}\int_0^{m_D(c)} \left[(c_D)^2 - \left(e^{\delta m}c\right)^2\right]dm$$

They also achieve higher total profit

$$\Pi(c) = 2\int_0^{m_D(c)} \pi^m(c)dm = \frac{L}{4\gamma}\int_0^{m_D(c)} \left(c_D - e^{\delta m}c\right)^2 dm$$

so that the free entry condition (12) can be equivalently stated as

$$\int_0^{c_D} \Pi(c)dG(c) = f \tag{18}$$

This will come handy when we open up the economy to international trade.

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Finally, firms with lower core marginal cost are more productive in terms of both physical productivity and revenue based productivity, respectively defined as

$$\Phi(c) = \frac{Q(c)}{C(c)} = \frac{\int_0^{m_D(c)} \left(c_D - e^{\delta m}c\right) dm}{\int_0^{m_D(c)} c\left(c_D - e^{\delta m}c\right) dm}$$

and

$$\Phi_R(c) = \frac{R(c)/\overline{P}}{C(c)} = \frac{\int_0^{m_D(c)} \left[(c_D)^2 - \left(e^{\delta m}c\right)^2\right] dm/\overline{P}}{\int_0^{m_D(c)} c\left(c_D - e^{\delta m}c\right) dm}$$

where $C(c) = [L/(2\gamma)]\int_0^{m_D(c)} c\left(c_D - e^{\delta m}c\right) dm$ is total cost (as well as total employment) and $\overline{P}$ is the price deflator

$$\overline{P} \equiv \frac{\int_0^{c_D} R(c)dG(c)}{\int_0^{c_D} Q(c)dG(c)} = \frac{k+1}{k+2}c_D$$

This deflator is the average of the prices of all the variants of all the products weighted by their output share. We could also have used the unweighted price average $\bar{p}$ that we previously defined, or an average weighted by a variant's revenue share (i.e. its market share) instead of output share. In our model, as in Mayer et al. (2011), all of these price averages only differ by a multiplicative constant, so the effects of competition (i.e., the changes in the cutoff c_D) on productivity do not depend on this choice of price averages.

3.6   Aggregate Performance

At the aggregate level, computing average physical productivity

$$\overline{\Phi} = \frac{\int_0^{c_D} \left[\int_0^{m_D(c)} \left(c_D - e^{\delta m}c\right) dm\right] dG(c)}{\int_0^{c_D} \left[\int_0^{m_D(c)} c\left(c_D - e^{\delta m}c\right) dm\right] dG(c)}$$

and average revenue based productivity

$$\overline{\Phi}_R = \frac{\int_0^{m_D(c)} \left[(c_D)^2 - \left(e^{\delta m}c\right)^2\right] dm/\overline{P}}{\int_0^{c_D} \left[\int_0^{m_D(c)} c\left(c_D - e^{\delta m}c\right) dm\right] dG(c)}$$

give the same result

$$\overline{\Phi} = \overline{\Phi}_R = \frac{k+2}{k}\frac{1}{c_D} \tag{19}$$

This reveals that, as δ increases from zero, rising c_D leads to lower aggregate productivity. Thus, the fact that consumer heterogeneity relaxes competition and firm selection implies that it also hampers productivity.

Lastly, due to the symmetry of the address model, in equilibrium all consumer achieve the same level of utility whatever their ideal variants. Welfare can then be measured in terms of the indirect utility of any individual consumer and this evaluates to

$$U = 1 + \frac{1}{2\eta}(\alpha - c_D)\left(\alpha - \frac{k+1}{k+2}c_D\right) \tag{20}$$

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This is the same function of c_D as in Melitz and Ottaviano (2008). What differs here is the fact that the cutoff cost c_D now depends on taste heterogeneity through Λ as shown by (13). In particular, more taste heterogeneity (smaller Λ) reduces welfare as it becomes harder for producers to satisfy the specific needs of different consumers with a given amount of resources.

3.7 Market Size, Productivity and Welfare

A hallmark result in Melitz and Ottaviano (2008) concerns the impact of market size on aggregate productivity through firm selection as a larger number of consumers makes competition tougher by compressing the cutoff marginal cost and firms' markups. As a consequence, high marginal cost firms exit and market shares are disproportionately reallocated towards the lowest marginal cost survivors.

Here similar reallocations take place but there is an additional round of adjustment. As survivors retreat from segments distant from their core ones, they stop serving some customers whose ideal varieties are too far away from their core segments and reallocate resources disproportionately towards these segments. The result is a better alignment between consumers' ideal varieties and firms' core competencies, which generates a new channel through which larger market size leads to higher productivity and higher welfare thanks to lower c_D (see (19) and (20)).

In particular, from (13) we see that larger L compresses c_D. By (14), lower c_D increases the number of sellers in each segment. This happens despite the associated fall in the total sales of each producer as entailed by (17) as well as in the number of customers served by each producer and in the number of producers tapped by each customer as entailed by (16). Note, however, that average market penetration Λ is unaffected. This is explained by the presence of opposing effects that exactly offset each other. Tougher competition shrinks the market penetration of all firms with marginal cost c in the interval $c_D e^{-\delta} < c \leq c_D$. By itself this effect would reduce average market penetration. At the same time, however, tougher competition also forces some firms out of the market altogether. As these are the firms with marginal cost $c > c_D$ that already had the smallest market penetration to start with, by itself their exit would increase average market penetration. It is a specific implication of the assumed distribution (2) that the two opposing effects exactly elicit each other. We do not emphasize this exact result, but rather the presence of opposing forces generating the relationship between market size and average market penetration. No change in the average number of segments a firm covers then implies that in a larger market firms serve, on average, a larger number of consumers. This is consistent with the evidence presented in Section 2.

Lower c_D also skews the distribution of sales away from higher marginal cost towards lower marginal cost variants, which implies that: lower marginal cost firms gain market share; among the customers of a firm, the output and revenue shares of those closer to the core segment increase; among the producers tapped by a consumer, the consumption and expenditure shares of those closer to her ideal variety increase. To see how skewness is affected, consider two variants of a firm's product at distance m and m' from its core segment with $m > m'$. Given (15), their output and revenue ratios evaluate to

$$\frac{q^{m'}(c)}{q^m(c)} = \frac{c_D - e^{\delta m'}c}{c_D - e^{\delta m}c} > 1, \quad \frac{r^{m'}(c)}{q^m(c)} = \frac{(c_D)^2 - \left(e^{\delta m'}c\right)^2}{(c_D)^2 - (e^{\delta m}c)^2} > 1$$

which are decreasing functions of c_D as long as $m > m'$ and, thus, lower c_D enhances the skewness of sales towards the closer segment to the core. This effect is driven by the fact that falling c_D puts a stronger downward pressure on the markups of low marginal cost variants than on the markups of high marginal cost variants as the demand elasticity faced by the former rises more than that faced

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by the latter. This leads to a parallel decrease in the price ratio

$$\frac{p^{m'}(c)}{p^m(c)} = \frac{c_D + e^{\delta m'}c}{c_D + e^{\delta m}c} < 1$$

Hence, in a larger market all firms with $c_D e^{-\delta} < c \leq c_D$ cover fewer segments with a larger fraction of sales concentrated in their core segment and a wider price dispersion across the segments they serve.

4 Single-Product Model in Open Economy

We now turn to the open economy in order to examine how the characteristics of export destinations affect the buyer margins of exports. In so doing, we follow Melitz and Ottaviano (2008) and consider an arbitrary number of countries allowing for asymmetric bilateral trade costs. We use J to denote the number of countries, indexing them by $l = 1, ..., J$, and call L_l country l's population. All countries share the same characterization of demand with taste heterogeneity modeled in terms of an address model in which consumers' ideal varieties are located around a circle C of circumference 2 and are indexed $s \in [0, 2]$ in a clockwise manner starting from noon (see, again, Figure 7). Consumers are assumed to be uniformly distributed across segments so that in country l each segment consists of $L^l/2$ consumers. Within-segment preferences are again given by (1).

As for technology, we maintain the same assumptions as in the closed economy. Firms choose a production location and a segment before entering and paying the sunk entry cost f. We assume that the entry cost f and the cost distribution (2) are common across countries.[33] We further assume that the homogeneous good is freely traded and choose it as our numeraire good. This implies that the wage equals one in all countries. International trade in differentiated products is, instead, hampered by iceberg costs and the national markets of these products are assumed to be segmented. Any variant produced for segment s in country l can be exported to the same segment s in country h subject to an iceberg trade cost $\tau_{lh} > 1$. Local delivery is, instead, free: $\tau_{ll} = 1$. As segments are symmetric, from the viewpoint of a firm what matters for its delivered cost is their shortest arc distance m from its core segment $m = 0$. Hence, for a firm with core marginal cost c producing in country l and delivering to country h, the marginal delivered cost to a segment located at distance m from its core segment equals $\tau_{lh} e^{\delta m} c$.

4.1 Buyers' and Sellers' Selection

Exploiting again segments' symmetry, let p_l denote the price threshold for positive demand in any segment of country l. Then (5) implies

$$p_l = \frac{1}{\eta N_l^s + \gamma} \left(\gamma \alpha + \eta N_l \bar{p}_l \right), \tag{21}$$

where N_l is the total number of variants (and thus firms) selling in each segment of country l and $\bar{p}_l$ is their average price. Given that a firm with core marginal cost c producing in country l and delivering to country h has two symmetric segments at distance m both in the domestic and the export markets,

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[33]These assumptions can be relaxed as in Melitz and Ottaviano (2008).

its maximized profits from variants m in the two markets are respectively:

$$\pi_{ll}^m(c) = \frac{L_l}{4\gamma}\left(c_{ll} - e^{\delta m}c\right)^2,$$
$$\pi_{lh}^m(v) = \frac{L_h}{4\gamma}\left(c_{hh} - \tau_{lh}e^{\delta m}c\right)^2 \tag{22}$$

where $c_{ll} = p_l$ and $c_{lh} = p_h/\tau_{lh}$ are the marginal cost cutoffs for positive domestic and export sales: a firm with core cost c will produce all variants m such that $\pi_{ll}^m(c) \geq 0$ and export to h the subset of variants m such that $\pi_{lh}^m(c) \geq 0$. Accordingly, the total numbers of variants produced $(m_{ll}(c))$ and exported $(m_{lh}(c))$ by the firm are determined by the firm's domestic and export 'cutoff segments'

$$m_{ll}(c) = \begin{cases} 1 & \text{if} & c \leq c_{ll}e^{-\delta} \\ \frac{1}{\delta}\ln\left(\frac{c_{ll}}{c}\right) & \text{for} & c_{ll}e^{-\delta} < c \leq c_{ll} \\ 0 & \text{for} & c > c_{ll} \end{cases} \tag{23}$$

$$m_{lh}(c) = \begin{cases} 1 & \text{for} & c \leq c_{lh}e^{-\delta} = c_{hh}e^{-\delta}/\tau_{lh} \\ \frac{1}{\delta}\ln\left(\frac{c_{lh}}{c}\right) & \text{for} & c_{hh}e^{-\delta}/\tau_{lh} < c \leq c_{hh}/\tau_{lh} \\ 0 & \text{for} & c > c_{hh}/\tau_{lh} \end{cases}$$

where we have used the fact that $c_{hh} = p_h$ and $c_{lh} = p_h/\tau_{lh}$ imply $c_{lh} = c_{hh}/\tau_{lh}$. In each market there are two cutoff segments, one on each side of the circle starting from the firm's core segment. The corresponding numbers of consumers served are $m_{ll}(c)L_l$ and $m_{lh}(c)L_h$, and the consumption levels of domestic and foreign consumers located respectively at distance $m \leq m_{ll}(c)$ and $m \leq m_{lh}(c)$ from the core equal

$$q_{ll}^m(c) = \frac{L_l}{2\gamma}\left(c_{ll} - e^{\delta m}c\right) \tag{24}$$
$$q_{lh}^m(c) = \frac{L_h}{2\gamma}\left(c_{hh} - \tau_{lh}e^{\delta m}c\right)$$

with associated revenues

$$r_{ll}^m(c) = \frac{L_l}{4\gamma}\left[(c_{ll})^2 - \left(e^{\delta m}c\right)^2\right] \tag{25}$$
$$r_{lh}^m(c) = \frac{L_h}{4\gamma}\left[(c_{hh})^2 - \left(\tau_{lh}e^{\delta m}c\right)^2\right]$$

The lower c, the larger the numbers of segments $(m_{ll}(c)$ and $m_{lh}(c))$ and consumers $(m_{ll}(c)L_l$ and $m_{lh}(c)L_h)$ a firm serves, and the larger the output sold and the revenue earned at any given distance from its core segments (for $m \leq m_{ll}(c)$ and $m \leq m_{lh}(c)$). Firms with lower core marginal cost thus serve a larger number of segments and sell larger amounts of their variants at any given distance from the core. However, only firms whose core marginal cost is low enough are able to serve all consumers in all markets. Moreover, according to (23), trade costs create a wedge in the penetration of domestic and export markets. In particular, $m_{hh}(c) - m_{lh}(c) = \ln(\tau_{lh})/\delta$ reveals that the number of segments covered (and thus the number of customers served) is larger in the domestic than in the foreign markets. The more so, the higher the trade barriers (the larger τ_{lh}) and the lower the heterogeneity in consumers' tastes (the smaller δ).

Due to free entry, expected profits of entrants have to be zero in equilibrium, which imposes a free entry condition analogous to (18)

$$\int_0^{c_{ll}} \Pi_{ll}(c)dG(c) + \sum_{h \neq l} \int_0^{c_{lh}} \Pi_{lh}(c)dG(c) = f \tag{26}$$

where

$$\Pi_{ll}(c) = \int_0^{m_{ll}(c)} \pi_{ll}^m(c)dm = \frac{L_l}{4\gamma} \int_0^{m_{ll}(c)} \left(c_{ll} - e^{\delta m}c\right)^2 dm$$

$$\Pi_{lh}(c) = \int_0^{m_{lh}(c)} \pi_{lh}^m(c)dm = \frac{L_h}{4\gamma} \int_0^{m_{lh}(c)} \left(c_{lh} - \tau_{lh}e^{\delta m}c\right)^2 dm$$

are a firm's total domestic and export profits as obtained aggregating across the segments it serves. Given (2), the free entry condition (26) can then be rewritten as

$$\sum_{h=1}^{J} \rho_{lh} L_h c_{hh}^{k+2} = \frac{\gamma\phi}{\Lambda} \qquad l = 1, ..., J. \tag{27}$$

where $\rho_{lh} \equiv \tau_{lh}^{-k} < 1$ is a measure of the 'freeness' of trade from country l to country h that varies inversely with the trade costs τ_{lh}.

The free entry conditions (27) yield a system of J equations that can be solved for the J equilibrium domestic cutoff marginal costs using Cramer's rule

$$c_{hh} = \left(\frac{\gamma\phi}{\Lambda L_h} \frac{\sum_{l=1}^{J} |C_{lh}|}{|\mathcal{P}|}\right)^{\frac{1}{k+2}} \tag{28}$$

where $|\mathcal{P}|$ is the determinant of the trade freeness matrix

$$\mathcal{P} \equiv \begin{pmatrix} 1 & \rho_{12} & \cdots & \rho_{1M} \\ \rho_{21} & 1 & \cdots & \rho_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_{M1} & \rho_{M2} & \cdots & 1 \end{pmatrix}$$

and $|C_{lh}|$ is the cofactor of its ρ_{lh} element. Expression (28) shows that, as in the closed economy, domestic cutoffs are determined by local market size: all the rest given, competition is tougher in a larger market. However, cross-country differences in cutoffs now arise also from differences in $\sum_{l=1}^{J} |C_{lh}| / |\mathcal{P}|$, which is a measure of geographical remoteness: all the rest given, central countries exhibit tougher competition.[34]

As in the closed economy, (21) can be used to relate the core marginal cost cutoff with the mass of variants sold in each segment in country h:

$$N_h = \frac{2(k+1)\gamma}{\eta} \frac{\alpha - c_{hh}}{c_{hh}}. \tag{29}$$

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[34] When trade costs are prohibitively large, (28) boils down to the closed economy result (13).

Then, given a positive mass of entrants $N_{E,l}$ in country l, there will be $G(c_{lh})N_{E,l}$ firms exporting on average Λ variants to each segment of country h. Summing over all these variants (including those produced and sold in h) yields

$$\sum_{l=1}^{J} \rho_{lh} N_{E,l} = \frac{N_h}{\Lambda c_{hh}^k}.$$

which provides a system of J linear equations that, using Cramer's rule, can be solved for the number of entrants in the J countries:[35]

$$N_{E,l} = \frac{\phi\gamma}{\Lambda\eta(k+2)f_E} \sum_{h=1}^{J} \frac{(\alpha - c_{hh})}{c_{hh}^{k+1}} \frac{|C_{lh}|}{|\mathcal{P}|}. \tag{30}$$

As in the closed economy, the cutoff level completely summarizes the distribution of prices as well as all the other performance measures. The cutoff in each country also uniquely determines its welfare through a relationship that is the same as in the closed economy (see (20)). Central countries benefiting from a large local market have lower cutoffs and thus higher welfare than peripheral countries with a small local market.

4.2 Bilateral Export Patterns

We have now completely characterized the multi-country open economy equilibrium. Selection operates at many different margins: a subset of firms survive in each country, and a smaller subset of those export to any given destination. Within a firm, there is an endogenous selection of customers dictated by the number of segments served. The firm serves the largest set of segments in its domestic market, while it reaches only a subset of those in each export market.

Putting together all the different margins of trade, we can use our model to generate predictions for aggregate bilateral exports. If its variant m is indeed exported from country l to country h, an exporter with core marginal cost c generates export sales of that variant equal to (25). Aggregate exports from l to h then equal:

$$\text{EXP}_{lh} = N_{E,l} \frac{1 - e^{-k\delta}}{k\delta} \rho^{lh} \int_0^{c_{lh}} r_{lh}^m(c) dG(c)$$

$$= N_{E,l} \left(\frac{c_{hh}}{c_M}\right)^k \rho_{lh} \cdot \Lambda L_h \cdot \frac{(c_{hh})^2}{2\gamma(k+2)} \tag{31}$$

where $N_{E,l} (c_{hh}/c_M)^k \rho_{lh}$ is the number of sellers from l to h ('firm extensive margin'), ΛL_h is the number of consumers who buy l's products in h ('buyer extensive margin'), and $(c_{hh})^2 / [2\gamma(k+2)]$ is average sales per seller-buyer pair ('firm/buyer intensive margin'). Note that, in contrast with our empirical findings, the buyer extensive margin is not affected by country characteristics such as the trade costs and the size of the export market. The reason is that, under (2), there are two effects that exactly offset each other. As the size of the destination market decreases (L_h falls) or its distance increases (ρ_{lh} falls), the foreign market penetration of all exporters with marginal cost c in the interval $c_{hh}e^{-\delta}/\tau_{lh} < c \leq c_{hh}/\tau_{lh}$ shrinks. By itself this effect would reduce average foreign market penetration. At the same time, however, tougher competition also forces some exporters out

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[35] The result exploits the properties that relate the freeness matrix P and its transpose in terms of determinants and cofactors.

of the foreign market altogether. As these are the exporters with marginal cost $c > c_{hh}/\tau_{lh}$ that already had the smallest foreign market penetration to start with, by itself their exit would increase average foreign market penetration. Once more, the fact that these two opposing effects exactly compensate each other is a specific implication of the assumed distribution (2). We do not emphasize this exact result, but rather the presence of opposing forces generating the relationship between trade costs, market size and average market penetration. No change in the average number of segments a firm covers then implies that in a larger foreign market firms serve, on average, a larger number of consumers.

Thus, (31) implies that our model predicts that aggregate bilateral exports follow a standard gravity specification based on country fixed effects (separate fixed effects for the exporter and importer) and a bilateral term that captures the effects of all bilateral barriers/enhancers to trade. This is the type of specification we have estimated in the empirical section. Yet, it does not represent a prediction that is unique to our model. Indeed, as shown by Head and Mayer (2013), such type of structural gravity specification is generated by a large set of different modeling frameworks.

4.3 Exporters' Buyer Mix

We now turn to some additional predictions of our model that are also consistent with our empirical findings but other modeling frameworks have a harder time reproducing. Specifically, in the closed economy we have described how firms respond to tougher competition in a larger market by skewing their sales towards their core customers. We have also analyzed how this buyer mix response raises firm productivity. We now show how differences in competition across export market destinations due to different market size and remoteness induce exporters to those markets to respond in very similar ways: when exporting to markets with tougher competition, exporters skew their exports towards their core customers.

In so doing, we proceed in a similar way as we did for the closed economy by examining a given firm's ratio of exports of two variants m and m', where m' is closer to the firm's core segment. Using (24) and (25), we can write the output and revenue ratios as

$$\frac{q_{lh}^{m'}(c)}{q_{lh}^{m}(c)} = \frac{c_{hh} - \tau_{lh}e^{\delta m'}c}{c_{hh} - \tau_{lh}e^{\delta m}c} > 1, \quad \frac{r_{lh}^{m'}(c)}{r_{lh}^{m}(c)} = \frac{(c_{hh})^2 - \left(\tau_{lh}e^{\delta m'}c\right)^2}{(c_{hh})^2 - \left(\tau_{lh}e^{\delta m}c\right)^2} > 1 \qquad (32)$$

Tougher competition in an export market (lower c_{hh}) increases this ratio, which captures how firms skew their exports toward their core variants. The intuition behind this result is very similar to the one we described for the closed economy. Tougher competition in a market increases the price elasticity of demand for all variants exported to that market. As in the closed economy, this skews relative demand and relative export sales towards the variants closer to the core segment. It also increases price dispersion as captured by a fall in the price ratio

$$\frac{p_{lh}^{m'}(c)}{p_{lh}^{m}(c)} = \frac{c_{hh} + \tau_{lh}e^{\delta m'}c}{c_{hh} + \tau_{lh}e^{\delta m}c} < 1$$

Hence, when c_{hh} falls, domestic firms with $c_{hh}e^{-\delta} < c \le c_{hh}$ and exporters with $c_{hh}e^{-\delta}/\tau_{lh} < c \le c_{hh}$ cover fewer segments with a larger fraction of sales concentrated in their core segment and a wider price dispersion across the segments they serve. Domestic firms with $c \le c_{hh}e^{-\delta}$ and exporters with $c \le c_{hh}e^{-\delta}/\tau_{lh}$ still cover all segments but also in their case a larger fraction of sales is concentrated in their core segment with a wider price dispersion across the segments they serve.

Finally, as was the case for the closed economy, the skewing of a firm's buyer mix towards core variants also entails increases in firm productivity. Empirically, we cannot separately measure a firm's productivity with respect to its production for each export market. However, we can follow Mayer at al. (2011) and theoretically define such a productivity measure in an analogous way to $\Phi(c) \equiv Q(c)/C(c)$ for the closed economy as $\Phi_{lh}(c) \equiv Q_{lh}(c)/C_{lh}(c)$, where $Q_{lh}(c)$ are the total units of output that firm c exports to h, and $C_{lh}(c)$ are the total labor costs incurred by firm c to produce those units. This export market-specific productivity measure (as well as the associated measure $\Phi_{R,lh}(c)$ based on deflated sales) increases when c_{hh} decreases, thus implying that changes in the exported buyer mix may have important implications for firm productivity.

5 Multi-Product Model in Open Economy

Our data show that tougher competition skews a given firm's sales towards its core buyers and increases the dispersion of prices across all buyers. The model so far assumes that firms and products coincide, so that it does not account for the empirical findings when the product dimension is considered. This requires its extension to a multi-product environment where each firm can offer several products and variants of these products to the various market segments.

In allowing firms to handle a portfolio of products, we build on Mayer at al. (2011). Entry still requires a firm to incur a sunk startup cost f and subsequent production exhibits constant returns to scale but, after sinking f, the firm may now decide to produce more than one product. The firm has, however, one 'core product' corresponding to its 'core competency' associated with its core marginal cost c. When a firm introduces additional products, each of them requires an additional customization cost because it pulls the firm away from its core competency. Accordingly, supplying a non-core product to a non-core segment incurs both a 'customization cost' (because the product is non-core) and an 'adaptation cost' (because the segment is non-core).

We index by n the countable products produced by a firm in increasing order of distance from its core competency $n = 0$ (the firm's core product). We then denote $v^m(n, c)$ the marginal cost for product n that a firm with core marginal cost c sells to a segment at distance m from its core segment. We assume $v^m(n, c) = \omega^{-n} v^m(0, c) = \omega^{-n} e^{\delta m} c$ with $\omega \in (0, 1)$. Note that, whereas m is a continuous variable, n is instead a discrete variable so as to remove cannibalization effects.[36] This defines a firm-level 'competence ladder' with increasing customization and adaptation costs, which nests the cases of: multi-buyer single-product firms as in the previous section when ω goes to 0; single-buyer multi-product firms as in Mayer et al. (2011) when δ goes to 0; single-buyer single-product firms as in Melitz and Ottaviano (2008) when both ω and δ go to zero.

The absence of cannibalization implies that the multi-product extension alters only the free entry condition (26) since now the sunk cost f allows for the supply of several products. As N_l denotes the measure of products sold in country l, the price threshold for positive demand in that country still satisfies (21) with marginal cost cutoffs for positive domestic and export sales equal to $c_{ll} = p_l$ and $c_{lh} = p_h/\tau_{lh} = c_h/\tau_{lh}$ respectively. Accordingly, country l's firms sell domestically products with marginal cost $v^m(n, c) \leq c_{ll}$ and export to country h those with marginal cost $v^m(n, c) \leq c_{lh}$.

Extending (22) implies that the corresponding profits evaluate to

$$\pi_{ll}^m(n, c) = \frac{L_l}{4\gamma} \left(c_{ll} - \omega^{-n} e^{\delta m} c \right)^2, \ \pi_{lh}^m(n, c) = \frac{L_h}{4\gamma} \left(c_{hh} - \tau_{lh} \omega^{-n} e^{\delta m} c \right)^2$$

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[36] For a study of cannibalization effects in a demand system similar to ours see Dhingra (2012). The implications of abstracting from those effects are also discussed in Mayer et al. (2011).

The free entry condition (26) then has to hold provided total profits from domestic and export sales are restated to account for multiple products as

$$\Pi_{ll}(c) = \sum_{n=0}^{N_{ll}(c)-1} \int_0^{m_{ll}(n,c)} \pi_{ll}^m(n,c)dm$$

$$\Pi_{lh}(c) = \sum_{n=0}^{N_{lh}(c)-1} \int_0^{m_{lh}(n,c)} \pi_{lh}^m(n,c)dm$$

In these expressions $m_{ll}(n,c)$ and $m_{lh}(n,c)$ are the measures ('numbers') of variants of product n that a producer in l with core marginal cost c sells in countries l and h respectively:

$$m_{ll}(n,c) = \begin{cases} 1 & \text{if} & c \le c_{ll}\omega^n e^{-\delta} \\ \frac{1}{\delta}\ln\left(\frac{c_{ll}}{c}\right) & \text{for} & c_{ll}\omega^n e^{-\delta} < c \le c_{ll}\omega^n \\ 0 & \text{for} & c > c_{ll}\omega^n \end{cases}$$

$$m_{lh}(n,c) = \begin{cases} 1 & \text{for} & c \le c_{lh}\omega^n e^{-\delta} = c_{hh}\omega^n e^{-\delta}/\tau_{lh} \\ \frac{1}{\delta}\ln\left(\frac{c_{lh}}{c}\right) & \text{for} & c_{hh}\omega^n e^{-\delta}/\tau_{lh} < c \le c_{hh}\omega^n \\ 0 & \text{for} & c > c_{hh}\omega^n \end{cases}$$

These are positive provided that the product can be sold at least in the core segment. $N_{ll}(c)$ and $N_{lh}(c)$ are, instead, the (discrete) numbers of products a producer in l with core marginal cost c sells in countries l and h:

$$N_{ll}(c) = \begin{cases} 0 & \text{if } c > c_{ll}, \\ \max\{n \mid c \le c_{ll}\omega^n\} + 1 & \text{if } c \le c_{ll}, \end{cases}$$

$$N_{lh}(c) = \begin{cases} 0 & \text{if } c > c_{lh}, \\ \max\{n \mid c \le c_{lh}\omega^n\} + 1 & \text{if } c \le c_{lh}. \end{cases}$$

These are positive provided that at least the core product is supplied at least to the core segment. Note that a lower cutoff in a market makes all firms (weakly) reduce the numbers of segments and products supplied in that market.

Using (2) and (23), the free entry condition for the multi-product case can be written as

$$\sum_{h=1}^{J} \rho_{lh} L_h c_{hh}^{k+2} = \frac{\gamma\phi}{\Lambda\Omega} \qquad l = 1, ..., J.$$

and solved for

$$c_{hh} = \left(\frac{\gamma\phi}{\Lambda\Omega L_h} \frac{\sum_{l=1}^{J}|C_{lh}|}{|\mathcal{P}|}\right)^{\frac{1}{k+2}} \qquad h = 1, ..., J.$$

where $\Omega = \left(1-\omega^k\right)^{-1} > 1$ is an index of multi-product flexibility increasing in ω that in equilibrium determines one-to-one the average number of products firms supply. All the rest given, higher multi-product flexibility (larger Ω) leads to a larger number of products per firm and tougher competition (lower c_{hh}).

Whereas the total number of products sold in each segment of country h is still given by (29), the number of entrants in country l now evaluates to

$$N_{E,l} = \frac{\phi\gamma}{\Lambda\Omega\eta\,(k+2)\,f_E} \sum_{h=1}^{J} \frac{(\alpha - c_{hh})}{c_{hh}^{k+1}} \frac{|C_{lh}|}{|\mathcal{P}|}$$

Once more, the domestic cutoff marginal cost c_{hh} completely summarizes the distribution of prices as well as all the other performance measures and uniquely determines welfare through the relationship (20).

Aggregate exports from l to h then equal:

$$\text{EXP}_{lh} = \Omega N_{E,l} \left(\frac{c_{hh}}{c_M}\right)^k \rho_{lh} \cdot \Lambda L_h \cdot \frac{(c_{hh})^2}{2\gamma\,(k+2)}$$

where $\Omega N_{E,l}\,(c_{hh}/c_M)^k\,\rho_{lh}$ is the number of products exported from l to h ('product extensive margin'), ΛL_h is again the number of consumers who buy l's products in h ('buyer extensive margin'), and $(c_{hh})^2 / [2\gamma\,(k+2)]$ is average sales per product-buyer pair ('product/buyer intensive margin').

We now show that multi-product firms respond to tougher competition by skewing the sales of each product towards their core customers. The quantity of its product n a producer in country l with core marginal cost c sells to its two segments m in country h is

$$q_{lh}^m(n,c) = \frac{L_h}{2\gamma}\left(c_{hh} - \tau_{lh}\omega^{-n}e^{\delta m}c\right)$$

with associated revenue

$$r_{lh}^m(n,c) = \frac{L_h}{4\gamma}\left[(c_{hh})^2 - \left(\tau_{lh}\omega^{-n}e^{\delta m}c\right)^2\right].$$

The firm's output and revenue ratios of exports of two variants m and m' (with $m' < m$) of product n then evaluate to

$$\frac{q_{lh}^{m'}(n,c)}{q_{lh}^m(n,c)} = \frac{c_{hh} - \tau_{lh}\omega^{-n}e^{\delta m'}c}{c_{hh} - \tau_{lh}\omega^{-n}e^{\delta m}c} > 1, \quad \frac{r_{lh}^{m'}(n,c)}{r_{lh}^m(n,c)} = \frac{(c_{hh})^2 - \left(\tau_{lh}\omega^{-n}e^{\delta m'}c\right)^2}{(c_{hh})^2 - \left(\tau_{lh}\omega^{-n}e^{\delta m}c\right)^2} > 1$$

As long as m' is closer to the firm's core segment, tougher competition in the export market (lower c_{hh}) increases both the output and the revenue ratios: the firm skews its exports toward the variant of its product closer to the core due to a larger increase in the price elasticity of demand for that variant. Price dispersion increases accordingly given that the price ratio

$$\frac{p_{lh}^{m'}(n,c)}{p_{lh}^m(n,c)} = \frac{c_{hh} + \tau_{lh}\omega^{-n}e^{\delta m'}c}{c_{hh} + \tau_{lh}\omega^{-n}e^{\delta m}c} < 1$$

falls. Hence, when c_{hh} falls, the firm concentrates a larger fraction of the sales of its product in its segments closer to the core with a wider price dispersion across all segments. This is consistent with our regression results at the firm-product-destination level (see Tables 9-11).

Finally, the skewing of a firm's product mix towards core products and variants also leads to higher firm productivity as measured by the ratio of the total units of exported output or sales in a given destination market to the total labor cost of producing those units. These export market-specific productivity measures increase with the toughness of competition in that export market.

6   Conclusion

We have used unique firm-level export datasets from three countries, Costa Rica, Ecuador, and Uruguay, to all destinations around the world over the period 2005-2008 to present an in-depth characterization of firms' export margins, across products, destination countries, and fundamentally their buyers. Our analysis has highlighted the relevance of the buyer margins for aggregate exports and has provided new insights on their composition. While most exporters sell abroad only few products to few buyers in few destinations, the few firms that export several products to several destinations and, on top, to several buyers account for large shares of total exports. A firm's (firm-product's) number of buyers and average exports per buyer increase with the size and the accessibility of the destination country. Conditional on the number of buyers, the concentration of firm (firm-product) export sales behaves in a similar way. We have also investigated the behavior of prices. In the same destination different buyers pay different prices to the same firm for the same product. Buyers that account for larger shares of a firm's sales of a given product tend to be charged a lower prices for that product. Price dispersion is affected by country characteristics: it is higher in bigger and more accessible destinations.

We have then proposed a model that generates predictions consistent with our empirical findings and we have used it to reveal that adjustments along the buyer margins can be an additional channel through which trade can lead to welfare gains. In so doing, we have developed a simple model of selection with heterogeneous buyers and sellers, merging the 'representative consumer approach' to product differentiation that is standard in international trade theory with the 'address (or characteristics) approach' that is more popular in industrial organization. In our model the intensity of competition affects the number and market shares of active firms as well as the number of their products, the number of the variants of these products and the distribution of sales across these variants. Importantly, and consistent with the evidence reported above, it also affects the numbers of their customers as well as the distributions of sales and prices across them. This last feature is the main innovation of the model. Tougher competition allows for a better alignment between ideal variants of consumers and core Competencies of firms, generating an additional channel through which tougher competition leads to higher productivity and higher welfare. This points to an additional source of gains from trade provided that freer trade leads to fiercer competition.

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Table 1

		Aggregate Export Indicators 2005-2008			
		Costa Rica			
Year	Total Exports	Number of Exporters	Number of Destinations	Number of Products	Number of Buyers
2005	5,794	2667	138	3,737	13,257
2006	6,960	2808	133	4,039	14,387
2007	8,276	2896	150	4,253	15,020
2008	8,678	2753	143	4,117	14,705
		Ecuador			
Year	Total Exports	Number of Exporters	Number of Destinations	Number of Products	Number of Buyers
2005	9,265	2223	127	2,238	8,769
2006	12,400	3052	143	2,579	11,311
2007	12,817	3370	147	3,081	11,782
2008	19,494	3962	151	3,086	12,243
		Uruguay			
Year	Total Exports	Number of Exporters	Number of Destinations	Number of Products	Number of Buyers
2005	3,420	1940	140	2,873	11,034
2006	3,984	1997	149	2,874	11,829
2007	4,515	2088	154	2,872	12,071
2008	5,969	2130	160	3,039	11,959

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

Table 2

Decomposition of Aggregate Bilateral Exports							
	2005				**2005-2008**		
	All Countries						
	NF	**NP**	**NB**	**IM**	**NF**	**NP**	**NB**	**IM**
Total Exports	0.436***	0.442***	0.482***	0.466***	0.156***	0.138***	0.159***	0.787***
	(0.022)	(0.023)	(0.025)	(0.027)	(0.022)	(0.021)	(0.021)	(0.026)
Country Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Country Pair Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	403	403	403	403	1,726	1,726	1,726	1,726
	Costa Rica							
	NF	**NP**	**NB**	**IM**	**NF**	**NP**	**NB**	**IM**
Total Exports	0.439***	0.473***	0.478***	0.445***	0.195***	0.154***	0.160***	0.746***
	(0.024)	(0.026)	(0.026)	(0.029)	(0.048)	(0.045)	(0.037)	(0.056)
Country Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Country Pair Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	137	137	137	137	560	560	560	560
	Ecuador							
	NF	**NP**	**NB**	**IM**	**NF**	**NP**	**NB**	**IM**
Total Exports	0.385***	0.361***	0.422***	0.549***	0.107***	0.106***	0.111***	0.846***
	(0.042)	(0.039)	(0.047)	(0.047)	(0.025)	(0.029)	(0.025)	(0.033)
Country Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Country Pair Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	126	126	126	126	564	564	564	564
	Uruguay							
	NF	**NP**	**NB**	**IM**	**NF**	**NP**	**NB**	**IM**
Total Exports	0.550***	0.565***	0.625***	0.322***	0.214***	0.177***	0.267***	0.712***
	(0.021)	(0.028)	(0.022)	(0.030)	(0.023)	(0.029)	(0.024)	(0.028)
Country Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Country Pair Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	140	140	140	140	602	602	602	602

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports estimates of the equations: (1) $lnM_{cd} = \alpha_0 + \alpha_1 lnX_{cd} + \gamma_c + \varepsilon_{cd}$ for a given year (here 2005) and (2) $lnM_{cdt} = \alpha_0 + \alpha_1 lnX_{cd} + \delta_{cd} + \tau_t + \mu_{cdt}$ for the entire sample period (2005-2008), where M corresponds to the following export margins: the number of exporting firms (N^F), the number of exported products (N^P), the number of buyers (N^B), and average exports per exporting firm, product and buyer that actually register trade (IM). Figures do not add up to one along the rows because we present the contribution of the actual intensive margin (IM) instead of the theoretical intensive margin, i.e., average exports per exporter, product, and buyer, where the denominator is the set of all their potential combinations; γ_c is a set of exporting country fixed effects, δ_{cd} is a set of country-pair fixed effects, and τ_t denotes year fixed effects. Robust standard errors are reported below the estimated coefficients in the left panel (2005) and standard errors clustered by country-pair are reported below the estimated coefficients in the right panel (2005-2008).

Table 3

Response of Aggregate Bilateral Exports and Their Margins to Trade Enhancers/Barriers
Sample: All Exporting Countries, 2005-2008

	X	N^F	N^P	N^B	IM	X	N^F	N^P	N^B	IM
Distance	-1.945***	-1.294***	-1.510***	-1.339***	-0.311***	-2.241***	-1.342***	-1.492***	-1.432***	-0.553***
	(0.129)	(0.068)	(0.075)	(0.079)	(0.055)	(0.126)	(0.054)	(0.063)	(0.060)	(0.081)
GDP	1.140***	0.630***	0.625***	0.696***	0.381***	1.094***	0.572***	0.563***	0.646***	0.398***
	(0.030)	(0.015)	(0.017)	(0.017)	(0.019)	(0.034)	(0.017)	(0.020)	(0.019)	(0.022)
GDP per capita						0.272***	0.219***	0.212***	0.198***	0.038
						(0.065)	(0.026)	(0.029)	(0.030)	(0.046)
Common Language						0.217	0.382***	0.681***	0.389***	-0.299***
						(0.155)	(0.070)	(0.087)	(0.073)	(0.116)
Colony						1.147***	1.060***	0.847***	1.105***	-0.051
						(0.175)	(0.077)	(0.089)	(0.084)	(0.128)
RTA						-0.186	0.123	0.114	0.245**	-0.397**
						(0.223)	(0.101)	(0.106)	(0.105)	(0.167)
Country-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.561	0.697	0.677	0.681	0.221	0.602	0.765	0.748	0.757	0.231
Observations	1,482	1,482	1,482	1,482	1,482	1,466	1,466	1,466	1,466	1,466

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports estimates of the responses of aggregate bilateral exports and their various margin to trade enhancers/barriers based on two alternative specifications of the gravity equation:

$lnX_{cdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \rho_{ct} + v_{cdt}$

$lnX_{cdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \beta_3 lnGDPpc_{dt} + \beta_4 Common\ Language_{cd} + \beta_5 Colony_{cd} + \beta_6 RTA_{cdt} + \rho_{ct} + v_{cdt}$

where the dependent variable X_{cdt} is aggregate bilateral exports from country c to country d in year t or alternatively the number of exporting firms (N^F), the number of exported products (N^P), the number of buyers (N^B), and the actual intensive margin (IM); γ_{ct} is a set of exporting country-year fixed effect; and v_{ct} is the error term. The definition and source of the explanatory variables are as follows:

GDP: GDP PPP in common currency and constant prices, from the World Bank's World Development Indicators.

Distance: Distance between the countries' capital cities, from CEPII.

GDPpc: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.

Common Language: Binary indicator that takes the value of one if more than 9% of the population of both countries speaks the same official language, from CEPII.

Colony: Binary indicator that takes the value of one if countries had a colonial relationship in the past, from CEPII.

RTA: Binary indicator that takes the value of one if trading countries have a trade agreement, from CEPII and WTO.

Standard errors clustered by destination-year are reported below the estimated coefficients.

Table 4

Distribution of Outcomes across Exporters					
2005					

Costa Rica

	10	25	50	75	90	Average
Total Exports	1.20	5.55	34.55	321.52	2155.41	2172.65
Number of Buyers	1.00	1.00	2.00	6.00	14.00	6.89
Number of Destinations	1.00	1.00	2.00	3.00	6.00	2.91
Number of Products	1.00	1.00	2.00	6.00	14.00	5.89
Number of Buyers per Destination	1.00	1.00	1.00	2.00	3.00	1.81
Number of Buyers per Product	1.00	1.00	1.17	2.33	4.50	2.34
Average Exports per Buyer	0.90	3.39	13.77	67.66	283.63	169.73
Average Exports per Destination	1.01	4.17	19.28	121.91	559.64	346.34
Average Exports per Product	0.63	2.61	12.55	85.07	490.87	276.57
Average Exports per Destination, Product and Buyer	0.55	2.15	8.23	38.41	170.37	92.15

Ecuador

	10	25	50	75	90	Average
Total Exports	0.00	2.60	27.90	259.17	2758.71	4167.96
Number of Buyers	1.00	1.00	1.00	4.00	12.00	4.85
Number of Destinations	1.00	1.00	1.00	2.00	5.00	2.25
Number of Products	1.00	1.00	1.00	3.00	7.00	3.24
Number of Buyers per Destination	1.00	1.00	1.00	2.00	3.00	1.71
Number of Buyers per Product	1.00	1.00	1.00	2.00	5.00	2.52
Average Exports per Buyer	0.00	2.30	17.14	81.75	337.87	353.56
Average Exports per Destination	0.00	2.50	23.24	141.22	758.23	777.02
Average Exports per Product	0.00	1.50	15.24	126.03	917.76	1987.56
Average Exports per Destination, Product and Buyer	0.00	1.36	11.73	60.00	233.01	288.86

Uruguay

	10	25	50	75	90	Average
Total Exports	1.49	4.88	27.68	242.53	1763.42	1762.67
Number of Buyers	1.00	1.00	1.00	4.00	13.00	6.91
Number of Destinations	1.00	1.00	1.00	3.00	7.00	2.89
Number of Products	1.00	1.00	2.00	4.00	10.00	4.39
Number of Buyers per Destination	1.00	1.00	1.00	1.56	3.00	1.60
Number of Buyers per Product	1.00	1.00	1.00	2.00	4.35	2.18
Average Exports per Buyer	1.38	4.00	16.07	60.24	228.83	138.15
Average Exports per Destination	1.41	4.20	19.24	101.07	494.51	264.67
Average Exports per Product	0.86	2.95	14.04	87.51	464.58	308.24
Average Exports per Destination, Product and Buyer	0.79	2.56	10.62	42.43	157.81	99.04

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

Exports are in thousands of dollars.

Table 5

Decomposition of Firm-Destination Exports						
	2005			**2005-2008**		
All Countries						
	N^P	N^B	IM	N^P	N^B	IM
Total Exports	0.092***	0.122***	0.836***	0.144***	0.146***	0.773***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)
Firm Fixed Effects	Yes	Yes	Yes	No	No	No
Firm-Destination Fixed Effects	No	No	No	Yes	Yes	Yes
Year Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	18,281	18,281	18,281	84,887	84,887	84,887
Costa Rica						
	N^P	N^B	IM	N^P	N^B	IM
Total Exports	0.135***	0.131***	0.797***	0.150***	0.119***	0.792***
	(0.004)	(0.003)	(0.004)	(0.006)	(0.005)	(0.007)
Firm Fixed Effects	Yes	Yes	Yes	No	No	No
Firm-Destination Fixed Effects	No	No	No	Yes	Yes	Yes
Year Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	7,745	7,745	7,745	33,383	33,383	33,383
Ecuador						
	N^P	N^B	IM	N^P	N^B	IM
Total Exports	0.046***	0.087***	0.892***	0.114***	0.147***	0.790***
	(0.002)	(0.003)	(0.003)	(0.008)	(0.008)	(0.010)
Firm Fixed Effects	Yes	Yes	Yes	No	No	No
Firm-Destination Fixed Effects	No	No	No	Yes	Yes	Yes
Year Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	4,949	4,949	4,949	27,615	27,615	27,615
Uruguay						
	N^P	N^B	IM	N^P	N^B	IM
Total Exports	0.123***	0.185***	0.777***	0.173***	0.208***	0.703***
	(0.004)	(0.005)	(0.006)	(0.008)	(0.008)	(0.010)
Firm Fixed Effects	Yes	Yes	Yes	No	No	No
Firm-Destination Fixed Effects	No	No	No	Yes	Yes	Yes
Year Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	5,587	5,587	5,587	23,889	23,889	23,889

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports estimates of the equations: (1) $lnM_{fcd} = \alpha_0 + \alpha_1 lnX_{fcd} + \gamma_{fc} + \varepsilon_{fcd}$ for a given year (here 2005) and (2) $lnM_{fcdt} = \alpha_0 + \alpha_1 lnX_{fcdt} + \delta_{fcd} + \tau_t + \mu_{fcdt}$ for the entire sample period (2005-2008), where M corresponds to the following export margins: the number of exported products (N^P), the number of buyers (N^B), and average exports per product and buyer that actually register trade (IM). Figures do not add up to one along the rows because we present the contribution of the actual intensive margin (IM) instead of the theoretical intensive margin, i.e., average exports per product and buyer, where the denominator is the set of all their potential combinations; γ_{fc} is a set of exporting firm (from a given country) fixed effects, δ_{fcd} is a set of exporting firm (-country)–destination fixed effects, and τ_t denotes year fixed effects. Robust standard errors are reported below the estimated coefficients in the left panel (2005) and standard errors clustered by firm-destination are reported below the estimated coefficients in the right panel (2005-2008).

Table 6

Response of Firm-Destination Exports, their Margins, and Sales' Concentration to Trade Enhancers/Barriers
Sample: All Exporting Countries, 2005-2008

	X	N^P	N^B	IM	SMB	X	N^P	N^B	IM	SMB
Distance	-0.469***	-0.202***	-0.191***	-0.185***	-0.010***	-0.487***	-0.206***	-0.218***	-0.185***	-0.011***
	(0.052)	(0.017)	(0.018)	(0.030)	(0.002)	(0.081)	(0.029)	(0.028)	(0.044)	(0.003)
GDP	0.265***	0.074***	0.120***	0.134***	0.007***	0.243***	0.068***	0.114***	0.119***	0.004***
	(0.019)	(0.008)	(0.009)	(0.010)	(0.001)	(0.025)	(0.009)	(0.010)	(0.014)	(0.001)
GDP per capita						-0.000	-0.002	-0.013	0.017	0.008***
						(0.045)	(0.016)	(0.016)	(0.028)	(0.002)
Common Language						-0.209**	-0.052	-0.119***	-0.103	-0.016***
						(0.086)	(0.035)	(0.030)	(0.069)	(0.006)
Colony						0.335***	0.166***	0.203***	0.082	0.002
						(0.097)	(0.037)	(0.044)	(0.076)	(0.006)
RTA						0.259**	0.093**	0.069	0.144**	0.014*
						(0.125)	(0.041)	(0.044)	(0.071)	(0.007)
Firm-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.706	0.618	0.454	0.758	0.793	0.707	0.621	0.460	0.758	0.793
Observations	81,531	81,531	81,531	81,531	81,531	79,644	79,644	79,644	79,644	79,644

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
The table reports estimates of the responses of firm-destination exports and their various margin to trade enhancers/barriers based on two alternative specifications of the gravity equation:

$lnX_{fcdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \rho_{fct} + v_{fcdt}$

$lnX_{fcdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \beta_3 lnGDPpc_{dt} + \beta_4 Common\ Language_{cd} + \beta_5 Colony_{cd} + \beta_6 RTA_{cd} + \rho_{fct} + v_{fcdt}$

where the dependent variable X_{fcdt} is exports from firm f in country c to country d in year t or alternatively the number of exported products (N^P), the number of buyers (N^B), the actual intensive margin (IM), and the share of the main buyer (SMB); γ_{fct} is a set of firm (-exporting country)-year fixed effect; and v_{fcdt} is the error term The definition and source of the explanatory variables are as follows:

GDP: GDP PPP in common currency and constant prices, from the World Bank's World Development Indicators.
Distance: Distance between the countries' capital cities, from CEPII.
GDPpc: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.
Common Language: Binary indicator that takes the value of one if more than 9% of the population of both countries speaks the same official language, from CEPII.
Colony: Binary indicator that takes the value of one if countries had a colonial relationship in the past, from CEPII.
RTA: Binary indicator that takes the value of one if trading countries have a trade agreement, from CEPII and WTO.
All regression involving *SMB* include the (natural logarithm of the) number of buyers as a control variable.
Standard errors clustered by destination-year are reported below the estimated coefficients.

Table 7

Table 7

Decomposition of Firm-Product-Destination Exports								
	2005				**2005-2008**			
	All Countries							
	N^B	X/N^B	UV	Q/N^B	N^B	X/N^B	UV	Q/N^B
Total Exports	0.074***	0.926***	0.011***	0.915***	0.108***	0.892***	0.158***	0.734***
	(0.001)	(0.001)	(0.004)	(0.004)	(0.002)	(0.002)	(0.008)	(0.007)
Firm-Product Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Product-Destination Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	52,956	52,956	52,956	52,956	259,131	259,131	259,131	259,131
	Costa Rica							
	N^B	X/N^B	UV	Q/N^B	N^B	X/N^B	UV	Q/N^B
Total Exports	0.069***	0.931***	0.037***	0.894***	0.080***	0.920***	0.223***	0.698***
	(0.001)	(0.001)	(0.005)	(0.005)	(0.003)	(0.003)	(0.011)	(0.010)
Firm-Product Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Product-Destination Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	26,596	26,596	26,596	26,596	119,523	119,523	119,523	119,523
	Ecuador							
	N^B	X/N^B	UV	Q/N^B	N^B	X/N^B	UV	Q/N^B
Total Exports	0.070***	0.930***	0.141***	0.790***	0.124***	0.876***	0.091***	0.784***
	(0.002)	(0.002)	(0.009)	(0.009)	(0.006)	(0.006)	(0.013)	(0.013)
Firm-Product Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Product-Destination Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	10,829	10,829	10,829	10,829	74,267	74,267	74,267	74,267
	Uruguay							
	N^B	X/N^B	UV	Q/N^B	N^B	X/N^B	UV	Q/N^B
Total Exports	0.094***	0.906***	-0.177***	1.083***	0.171***	0.829***	0.046***	0.783***
	(0.002)	(0.002)	(0.006)	(0.006)	(0.005)	(0.005)	(0.008)	(0.009)
Firm-Product Fixed Effects	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Product-Destination Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	15,531	15,531	15,531	15,531	65,341	65,341	65,341	65,341

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports decomposition of firm-product-destination exports in their various margins. By definition, firms' exports of a given product to a given country are the product of the number of buyers (N^B) and average exports per buyer (X/N^B), which in turn can be decomposed in average unit values (UV) and average quantity (weight) per buyer (Q/N^B). Hence, exports of product p from firm f in country c to country d in year t can be expressed as follows: $lnX_{fcpdt} = lnN^B_{fcpdt} + ln\left(\frac{X_{fcpdt}}{N^B_{fpcdt}}\right)$, with $ln\left(\frac{X_{fcpdt}}{N^B_{fcpdt}}\right) = lnUV_{fcpdt} + ln\left(\frac{Q_{fpcdt}}{N^B_{fcpdt}}\right)$. Regressions of the right-hand side variables on the left-hand side variable thus additively decompose firm-product-destination exports into the extensive margins (number of buyers) and the intensive margin (average exports per buyer). In particular, we estimate the following equations: (1) $lnM_{fcpd} = \alpha_0 + \alpha_1 lnX_{fcpd} + \gamma_{fcp} + \varepsilon_{fcpd}$ for a given year (here 2005) and (2) $lnM_{fcpd} = \alpha_0 + \alpha_1 lnX_{fcpd} + \delta_{fcdp} + \tau_t + \mu_{fcpdt}$ for the entire sample period (2005-2008), where M corresponds to the export margins identified above, γ_{fcp} is a set of exporting firm (from a given country)-product fixed effects, δ_{fcpd} is a set of exporting firm (-country)product-destination fixed effects, and τ_t denotes year fixed effects.. Robust standard errors are reported below the estimated coefficients in the left panel (2005) and standard errors clustered by firm-product-destination are reported below the estimated coefficients in the right panel (2005-2008).

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<div align="center">

Table 8

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Response of Firm-Product-Destination Exports and their Margins to Trade Enhancers/Barriers
Sample: All Exporting Countries, 2005-2008

	X	N^B	X/N^B	UV	Q/N^B	X	N^B	X/N^B	UV	Q/N^B
Distance	-0.358***	-0.142***	-0.216***	0.022***	-0.237***	-0.315***	-0.142***	-0.174***	0.021***	-0.194***
	(0.056)	(0.018)	(0.041)	(0.006)	(0.038)	(0.065)	(0.022)	(0.047)	(0.007)	(0.045)
GDP	0.235***	0.081***	0.153***	0.001	0.153***	0.240***	0.080***	0.160***	-0.006**	0.166***
	(0.016)	(0.009)	(0.012)	(0.002)	(0.012)	(0.022)	(0.010)	(0.016)	(0.003)	(0.016)
GDP per capita						-0.042	-0.019	-0.022	0.031***	-0.053
						(0.041)	(0.014)	(0.033)	(0.007)	(0.033)
Common Language						0.036	-0.041	0.078	0.014	0.064
						(0.068)	(0.029)	(0.057)	(0.017)	(0.055)
Colony						0.049	0.113***	-0.063	-0.006	-0.058
						(0.099)	(0.043)	(0.078)	(0.022)	(0.078)
RTA						0.135	0.055	0.080	0.010	0.070
						(0.100)	(0.034)	(0.070)	(0.015)	(0.070)
Firm-Product-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.873	0.567	0.883	0.922	0.961	0.872	0.569	0.882	0.921	0.961
Observations	248,583	248,583	248,583	248,583	248,583	242,738	242,738	242,738	242,738	242,738

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
The table reports estimates of the responses of firm-product-destination exports and their various margin to trade enhancers/barriers based on two alternative specifications of the gravity equation:

$lnX_{fcpdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \rho_{fcpt} + v_{fcpdt}$

$lnX_{fcpdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \beta_3 lnGDPpc_{dt} + \beta_4 Common\ Language_{cd} + \beta_5 Colony_{cd} + \beta_6 RTA_{cdt} + \rho_{fcpt} + v_{fcpdt}$

where the dependent variable X_{fcpdt} is exports of product p from firm f in country c to country d in year t or alternatively, their margins: the number of buyers (N^B) and average exports per buyer (X/N^B) as well as average unit value (UV) and average quantity (weight) per buyer (Q/N^B); γ_{fcpt} is a set of firm (-exporting country)-product-year fixed effect; and v_{fcpdt}.is the error term The definition and source of the explanatory variables are as follows:

GDP: GDP PPP in common currency and constant prices, from the World Bank's World Development Indicators.
Distance: Distance between the countries' capital cities, from CEPII.
GDPpc: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.
Common Language: Binary indicator that takes the value of one if more than 9% of the population of both countries speaks the same official language, from CEPII.
Colony: Binary indicator that takes the value of one if countries had a colonial relationship in the past, from CEPII.
RTA: Binary indicator that takes the value of one if trading countries have a trade agreement, from CEPII and WTO.
Standard errors clustered by destination-year are reported below the estimated coefficients.

Table 9

Response of the Concentration of Sales across Buyers to Trade Enhancers/Barriers and Toughness of Competition
Measure of Sales' Concentration: Share of the Main Buyer
Sample: All Exporting Countries, 2005-2008

	All Products				Differentiated Products			
Distance	-0.008***	-0.009***			-0.006**	-0.007*		
	(0.002)	(0.003)			(0.003)	(0.004)		
GDP	0.005***	0.004***	0.002***	0.001*	0.006***	0.005***	0.004***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita		0.004		0.005**		0.003		0.004
		(0.002)		(0.002)		(0.003)		(0.003)
Common Language		-0.011***				-0.010**		
		(0.004)				(0.004)		
Colony		0.000				0.005		
		(0.005)				(0.005)		
RTA		0.007				0.006		
		(0.006)				(0.007)		
Number of Exporters			0.009***	0.009***			0.007***	0.007***
			(0.002)	(0.002)			(0.002)	(0.002)
Freeness of Trade			0.001**	0.002***			0.001	0.001*
			(0.001)	(0.001)			(0.001)	(0.001)
Firm-Product-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.856	0.856	0.857	0.857	0.848	0.847	0.848	0.848
Observations	248,583	242,738	233,175	233,175	168,069	163,545	156,899	156,899

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports estimates of the responses of the share of the main buyer to trade enhancers/barriers and the toughness of competition for both all products and differentiated products and based on the following alternative specifications:

$lnSMB_{fcpdt} = \beta_0 + \beta_1 lnD_{cd} + \beta_2 lnGDP_{dt} + \rho_{fcpt} + \nu_{fcpdt}$

$lnSMB_{fcpdt} = \beta_0 + \beta_2 lnD_{cd} + \beta_3 lnGDP_{dt} + \beta_4 lnGDPpc_{dt} + \beta_5 Common\ Language_{cd} + \beta_6 Colony_{cd} + \beta_7 RTA_{cdt} + \rho_{fcpt} + \nu_{fcpdt}$

$lnSMB_{fcpdt} = \beta_0 + \beta_1 lnGDP_{dt} + \beta_2 lnN_{cdt}^{F-f} + \beta_3 lnFT_{cdt} + \rho_{fcpt} + \nu_{fcpdt}$

$lnSMB_{fcpdt} = \beta_0 + \beta_1 lnGDP_{dt} + \beta_2 lnN_{cdt}^{F-f} + \beta_3 lnFT_{cdt} + \beta_4 lnGDPpc_{dt} + \rho_{fcpt} + \nu_{fcpdt}$

where the dependent variable SMB_{fcpdt} is the share of the main buyer in sales of product p from firm f in country c to country d in year t; γ_{fcpt} is a set of firm (-exporting country)-product-year fixed effect; and ν_{fcpdt}.is the error term The definition and source of the explanatory variables are as follows:

GDP: GDP PPP in common currency and constant prices, from the World Bank's World Development Indicators.

Distance: Distance between the countries' capital cities, from CEPII.

GDPpc: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.

Common Language: Binary indicator that takes the value of one if more than 9% of the population of both countries speaks the same official language, from CEPII.

Colony: Binary indicator that takes the value of one if countries had a colonial relationship in the past, from CEPII.

RTA: Binary indicator that takes the value of one if trading countries have a trade agreement, from CEPII and WTO.

N^{F-f} : Number of other firms from the three sample countries exporting the same HS-2 product to the same destination in the same year as a proxy of toughness of competition, from our dataset.

FT: HS2-country level freeness of trade indicator computed from gravity equation estimates (see Mayer, Melitz, and Ottaviano, 2011).

All regression include the (natural logarithm of the) number of buyers as a control variable.

Standard errors clustered by destination-year are reported below the estimated coefficients.

Table 10

Response of the Concentration of Sales across Buyers to Trade Enhancers/Barriers and Toughness of Competition
Alternative Measures of Sales' Concentration
Sample: All Exporting Countries, 2005-2008

All Products								
	B1/BL	HI	TI	CV	B1/BL	HI	TI	CV
Distance	-0.319***	-0.011**	-0.126***	-0.062***				
	(0.079)	(0.004)	(0.035)	(0.017)				
GDP	0.315***	0.005***	0.096***	0.044***	0.087***	0.002	0.055***	0.025***
	(0.030)	(0.001)	(0.015)	(0.007)	(0.017)	(0.001)	(0.016)	(0.008)
GDP per capita	0.025	0.005*	0.017	0.012	0.070**	0.006**	0.040	0.024
	(0.046)	(0.003)	(0.033)	(0.016)	(0.035)	(0.002)	(0.032)	(0.016)
Common Language	0.036	-0.012***	0.004	-0.013				
	(0.101)	(0.005)	(0.064)	(0.033)				
Colony	0.019	-0.000	0.011	0.017				
	(0.128)	(0.006)	(0.114)	(0.057)				
RTA	0.203*	0.009	-0.095	-0.041				
	(0.120)	(0.008)	(0.067)	(0.031)				
Number of Exporters					0.200***	0.012***	0.088***	0.045***
					(0.042)	(0.003)	(0.025)	(0.012)
Freeness of Trade					0.030***	0.002***	0.024**	0.012**
					(0.010)	(0.001)	(0.010)	(0.005)
Firm-Product-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.678	0.901	0.698	0.687	0.765	0.902	0.706	0.695
Observations	54,504	242,738	54,064	54,069	52,589	233,175	52,165	52,170

Differentiated Products								
	B1/BL	HI	TI	CV	B1/BL	HI	TI	CV
Distance	-0.321***	-0.009*	-0.101**	-0.049**				
	(0.095)	(0.005)	(0.041)	(0.021)				
GDP	0.364***	0.006***	0.089***	0.041***	0.120***	0.003***	0.052***	0.024**
	(0.037)	(0.001)	(0.017)	(0.008)	(0.025)	(0.001)	(0.019)	(0.010)
GDP per capita	-0.033	0.004	0.013	0.011	0.038	0.005*	0.042	0.026
	(0.056)	(0.004)	(0.039)	(0.020)	(0.043)	(0.003)	(0.036)	(0.018)
Common Language	0.116	-0.010**	-0.013	-0.019				
	(0.119)	(0.005)	(0.075)	(0.037)				
Colony	-0.207	0.004	0.165	0.091				
	(0.147)	(0.007)	(0.142)	(0.070)				
RTA	0.273	0.008	-0.067	-0.027				
	(0.169)	(0.010)	(0.061)	(0.029)				
Number of Exporters					0.182***	0.009***	0.070**	0.037**
					(0.049)	(0.003)	(0.029)	(0.015)
Freeness of Trade					0.020	0.002*	0.021*	0.010*
					(0.013)	(0.001)	(0.011)	(0.006)
Firm-Product-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.681	0.894	0.718	0.707	0.777	0.894	0.730	0.720
Observations	32,121	163,545	31,852	31,854	30,687	156,899	30,431	30,433

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports estimates of the responses of alternative measures of sales' concentration across buyers within given firm-product-destinations to trade enhancers/barriers and the toughness of competition for both all products and differentiated products and based on the following alternative specifications:

$$lnSC_{fcpdt} = \beta_0 + \beta_2 lnD_{cd} + \beta_3 lnGDP_{dt} + \beta_4 lnGDPpc_{dt} + \beta_5 Common\ Language_{cd} + \beta_6 Colony_{cd} + \beta_7 RTA_{cdt} + \rho_{fcpt} + v_{fcpdt}$$

$$lnSC_{fcpdt} = \beta_0 + \beta_1 lnGDP_{dt} + \beta_2 lnN_{cdt}^{F-f} + \beta_3 lnFT_{cdt} + \beta_4 lnGDPpc_{dt} + \rho_{fcpt} + v_{fcpdt}$$

where the dependent variable SC_{fcpdt} is one of the following measures of concentration of sales of product p from firm f in country c to country d in year t across their buyers: the ratio of the sales to the main buyer to the sales to the least important buyer (B1/BL), the Herfindahl Index (HI), the Theil Index (TI), and the coefficient variation; γ_{fcpt} is a set of firm (-exporting country)-product-year fixed effect; and v_{fcpdt} is the error term

The definition and source of the explanatory variables are as follows:

GDP: GDP PPP in common currency and constant prices, from the World Bank's World Development Indicators.

Distance: Distance between the countries' capital cities, from CEPII.

GDPpc: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.

Common Language: Binary indicator that takes the value of one if more than 9% of the population of both countries speaks the same official language, from CEPII.

Colony: Binary indicator that takes the value of one if countries had a colonial relationship in the past, from CEPII.

RTA: Binary indicator that takes the value of one if trading countries have a trade agreement, from CEPII and WTO.

N^{F-f}: Number of other firms from the three sample countries exporting the same HS-2 product to the same destination in the same year as a proxy of toughness of competition, from our dataset.

FT: HS2-country level freeness of trade indicator computed from gravity equation estimates (see Mayer, Melitz, and Ottaviano, 2011).

Regressions involving HI, TI, and CV include the (natural logarithm of the) number of buyers as a control variable.

Standard errors clustered by destination-year are reported below the estimated coefficients.

Table 11

Response of Price Dispersion to Trade Enhancers/Barriers and Toughness of Competition
Alternative Measures of Price Dispersion
Sample: All Exporting Countries, 2005-2008

All Products						
	PM-Pm	CV	SD	PM-Pm	CV	SD
Distance	-0.054*	-0.147***	-0.126***			
	(0.029)	(0.023)	(0.028)			
GDP	0.078***	0.113***	0.111***	0.042***	0.070***	0.071***
	(0.012)	(0.015)	(0.016)	(0.009)	(0.015)	(0.014)
GDP per capita	0.037	0.039	0.085**	0.019	0.091***	0.047*
	(0.025)	(0.028)	(0.033)	(0.021)	(0.032)	(0.026)
Common Language	0.030	0.003	0.006			
	(0.052)	(0.058)	(0.064)			
Colony	0.083	0.100	0.119			
	(0.066)	(0.076)	(0.083)			
RTA	0.145*	0.044	0.097*			
	(0.074)	(0.042)	(0.055)			
Number of Exporters				0.133***	0.122***	0.114***
				(0.031)	(0.023)	(0.024)
Freeness of Trade				0.021***	0.043***	0.042***
				(0.006)	(0.008)	(0.008)
Firm-Product-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.775	0.779	0.913	0.786	0.916	0.786
Observations	54,504	53,445	53,445	52,589	51,567	51,567

Differentiated Products						
	PM-Pm	CV	SD	PM-Pm	CV	SD
Distance	-0.088**	-0.139***	-0.126***			
	(0.040)	(0.028)	(0.035)			
GDP	0.116***	0.116***	0.117***	0.062***	0.071***	0.072***
	(0.018)	(0.016)	(0.017)	(0.013)	(0.014)	(0.014)
GDP per capita	0.029	0.004	0.043	0.017	0.046	0.014
	(0.030)	(0.024)	(0.031)	(0.028)	(0.030)	(0.024)
Common Language	0.079	0.041	0.058			
	(0.064)	(0.063)	(0.070)			
Colony	0.027	0.009	-0.032			
	(0.082)	(0.081)	(0.083)			
RTA	0.164*	0.061	0.121*			
	(0.091)	(0.050)	(0.068)			
Number of Exporters				0.171***	0.125***	0.105***
				(0.038)	(0.028)	(0.028)
Freeness of Trade				0.030***	0.044***	0.041***
				(0.009)	(0.011)	(0.010)
Firm-Product-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R²	0.763	0.767	0.916	0.776	0.919	0.775
Observations	32,121	31,719	31,719	30,687	30,305	30,305

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

The table reports estimates of the responses of alternative measures of price dispersion within given firm-product-destinations to trade enhancers/barriers and the toughness of competition for both all products and differentiated products and based on the following alternative specifications:

$$lnPD_{fcpdt} = \beta_0 + \beta_2 lnD_{cd} + \beta_3 lnGDP_{dt} + \beta_4 lnGDPpc_{dt} + \beta_5 Common\ Language_{cd} + \beta_6 Colony_{cd} + \beta_7 RTA_{cdt} + \rho_{fcpt} + \nu_{fcpdt}$$

$$lnPD_{fcpdt} = \beta_0 + \beta_1 lnGDP_{dt} + \beta_2 lnN_{cdt}^{F-f} + \beta_3 lnFT_{cdt} + \beta_4 lnGDPpc_{dt} + \rho_{fcpt} + \nu_{fcpdt}$$

where the dependent variable PD_{fcpdt} is one of the following measures of dispersion of prices of product p sold by firm f in country c to country d in year t across their buyers: the ratio of the maximum to the minimum price, the coefficient of variation, and the standard deviation; γ_{fcpt} is a set of firm (-exporting country)-product-year fixed effect; and ν_{fcpdt} is the error term The definition and source of the explanatory variables are as follows:

GDP: GDP PPP in common currency and constant prices, from the World Bank's World Development Indicators.
Distance: Distance between the countries' capital cities, from CEPII.
GDPpc: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.
Common Language: Binary indicator that takes the value of one if more than 9% of the population of both countries speaks the same official language, from CEPII.
Colony: Binary indicator that takes the value of one if countries had a colonial relationship in the past, from CEPII.
*RTA*: Binary indicator that takes the value of one if trading countries have a trade agreement, from CEPII and WTO.
N^{F-f}: Number of other firms from the three sample countries exporting the same HS-2 product to the same destination in the same year as a proxy for toughness of competition, from our dataset.
FT: HS2-country level freeness of trade indicator computed from gravity equation estimates (see Mayer, Melitz, and Ottaviano, 2011).
Standard errors clustered by destination-year are reported below the estimated coefficients.

Aggregate Bilateral Exports

Number of Exporters

Number of Products

Number of Buyers

Intensive Margin
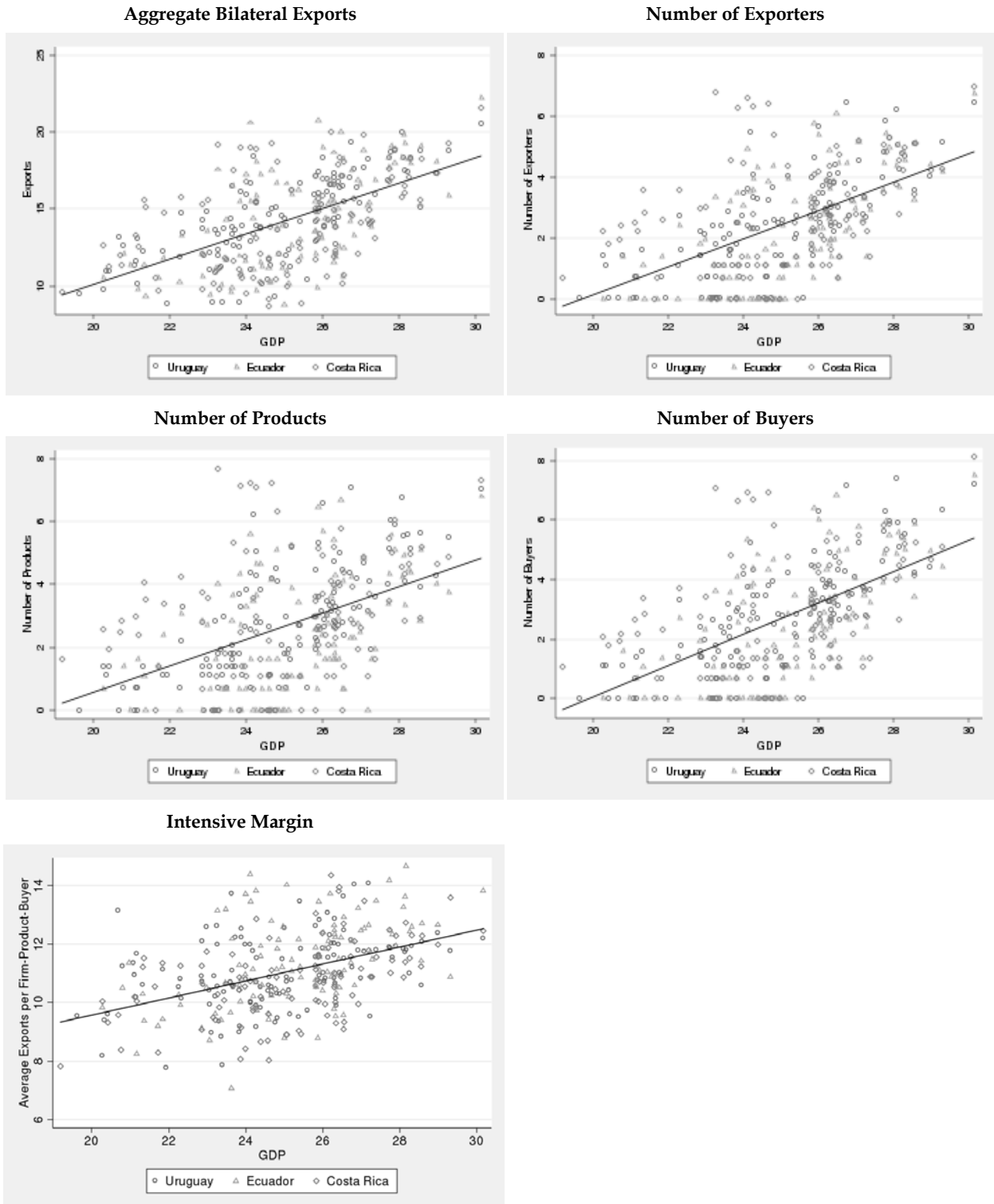
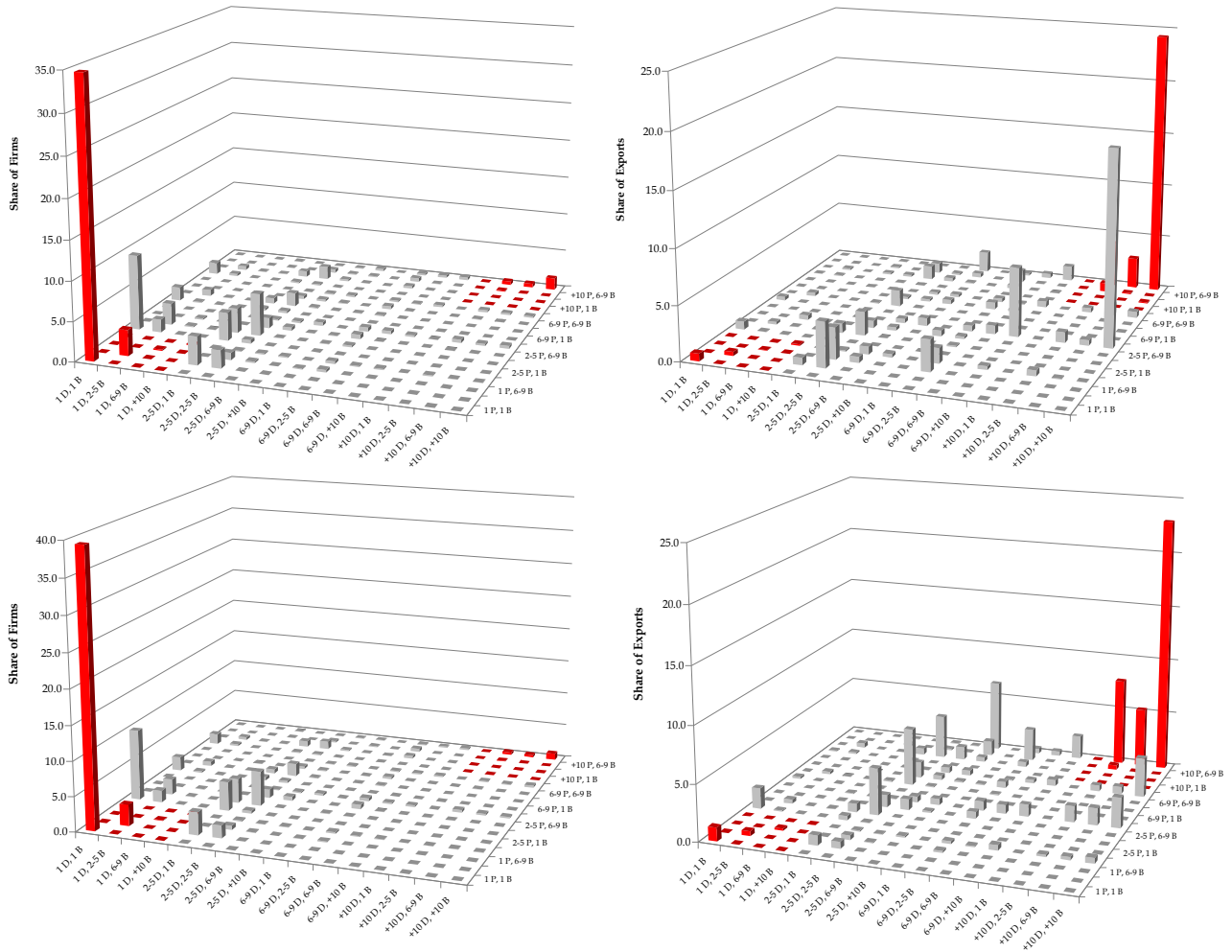Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
The figures are scatterplots showing the relationship between aggregate bilateral exports, the number of exporting firms, the number of products, and the number of buyers, and the size the destination's market as proxied by its GDP. All variables are expressed in natural logarithms. GDP is PPP expressed in common currency and constant prices. Data come from the World Bank's World Development Indicators.

Figure 2
Cumulative Distribution of the Number of Buyers and the Share of the Main Buyer and
the Respective Kernel Estimates at Different Levels of Aggregation
All Countries, 2005
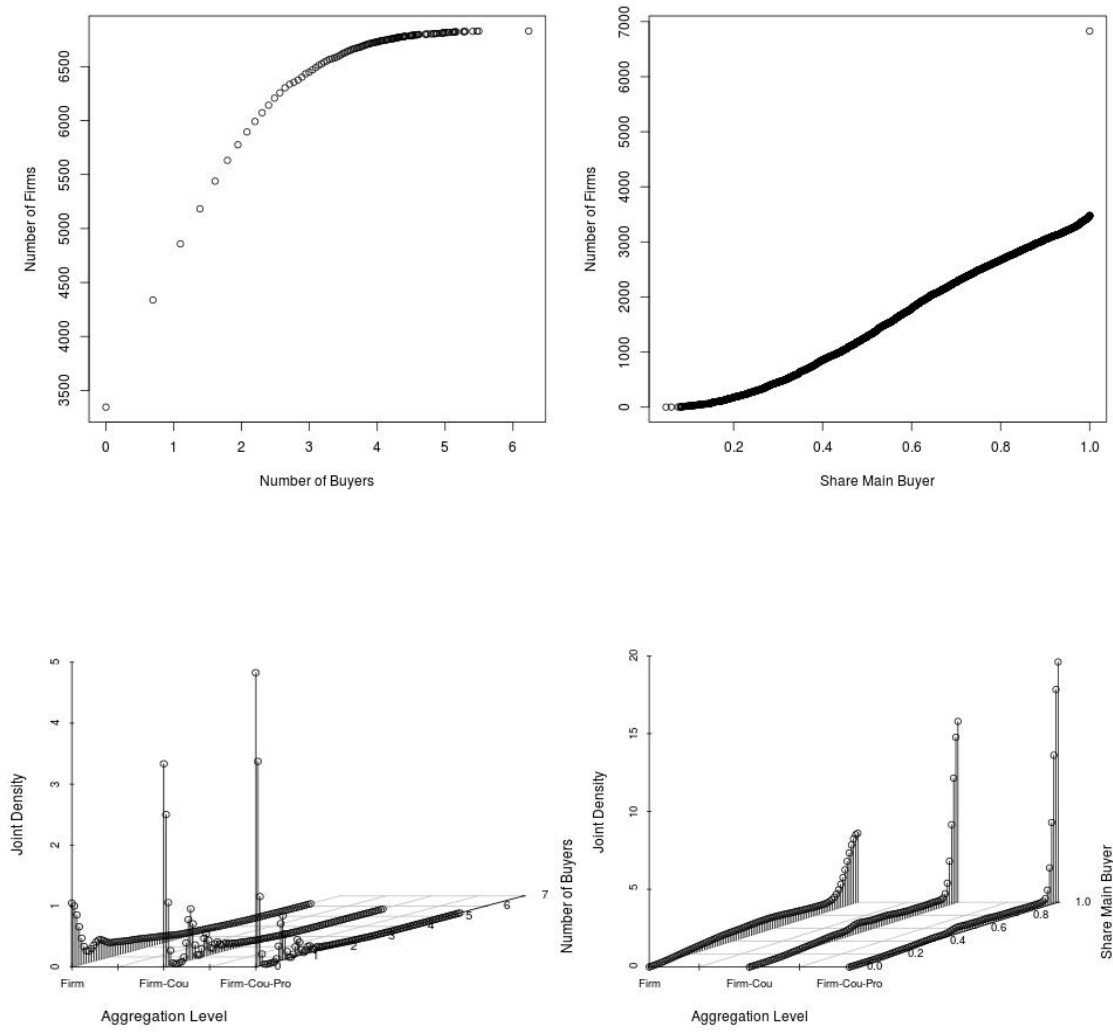
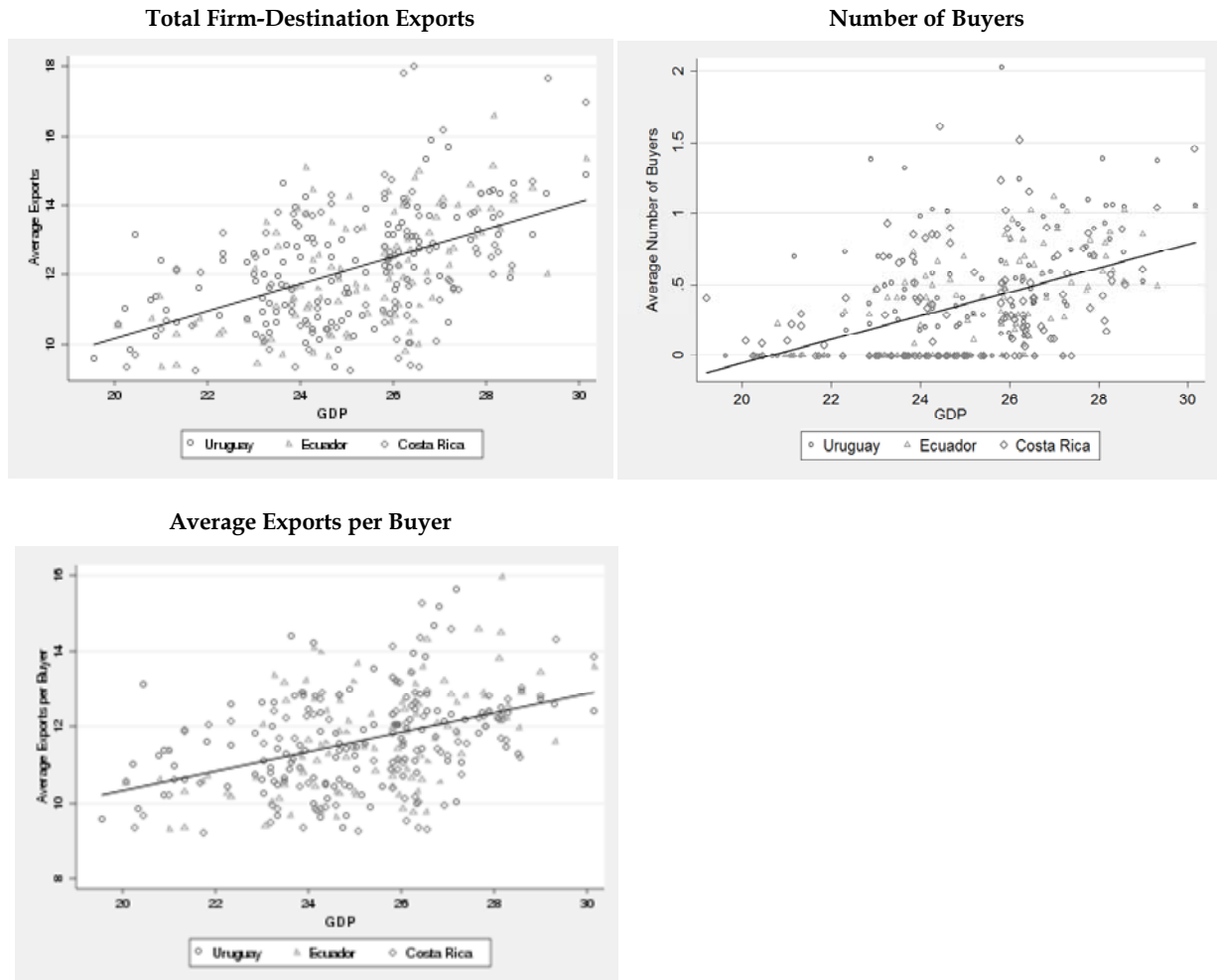Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

Figure 3
Distribution of Exporters and Exports across Number of Buyers per Product and Destinations
All Countries, 2005, All Products (Upper Panel) and Differentiated Products (Lower Panel)

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
Bars corresponding to the two extremes groups are highlighted in red. *B* stands for number of buyers, *D* denotes number of destinations, and *P* means number of products. The number of buyers corresponds to the maximum in each of these products or destinations.
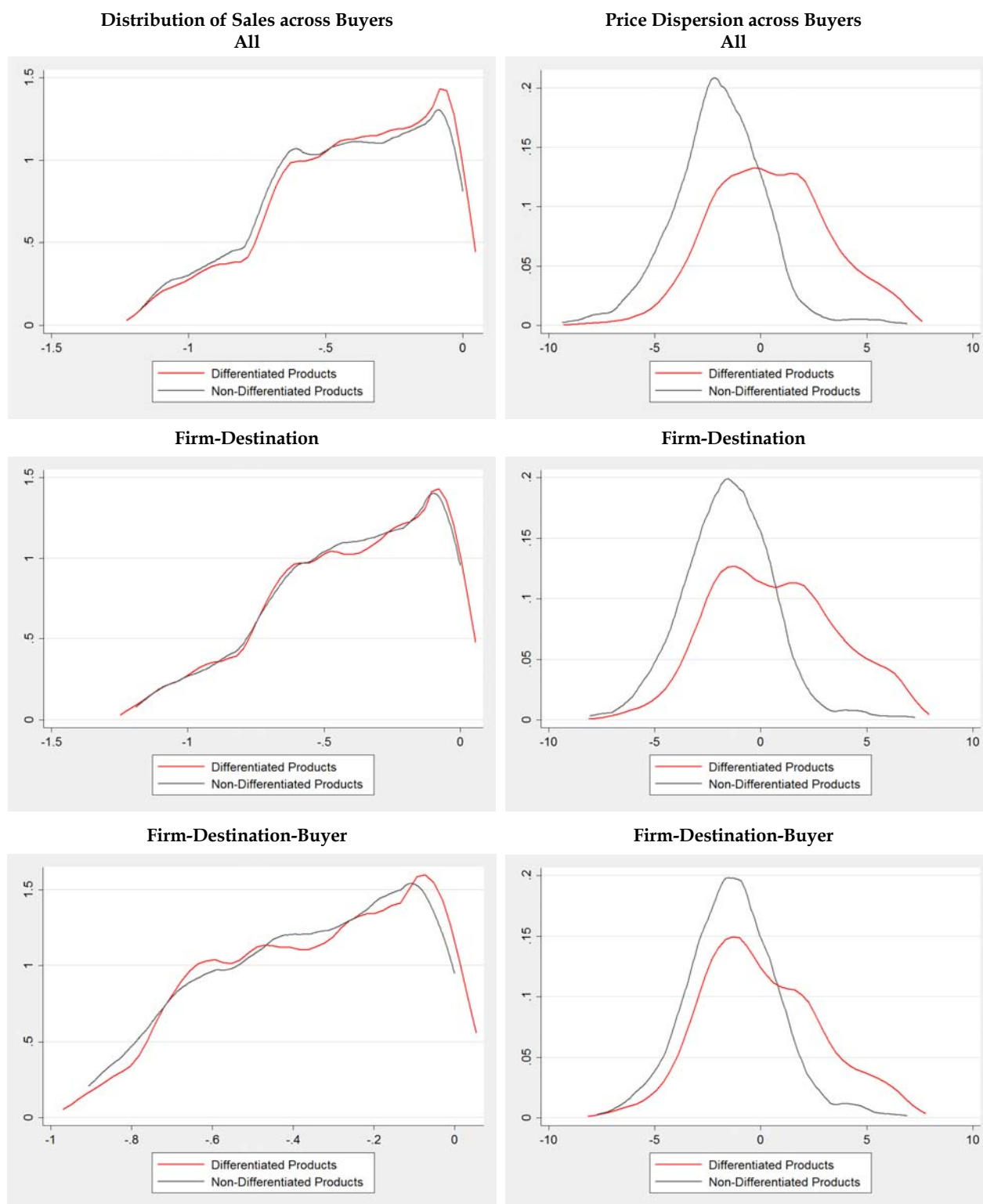
Figure 4
Firm-Destination Exports, Number of Buyers, Average Exports per Buyer, and Destination Size
All Countries, 2005

Total Firm-Destination Exports

Number of Buyers

Average Exports per Buyer

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
The figures are scatterplots showing the relationship between average total firm-destination exports, average number of buyers across firms in given destinations, and average exports per buyer across firms in given destinations, and the size this destination's market as proxied by its GDP. All variables are expressed in natural logarithms. Data come from the World Bank's World Development Indicators.
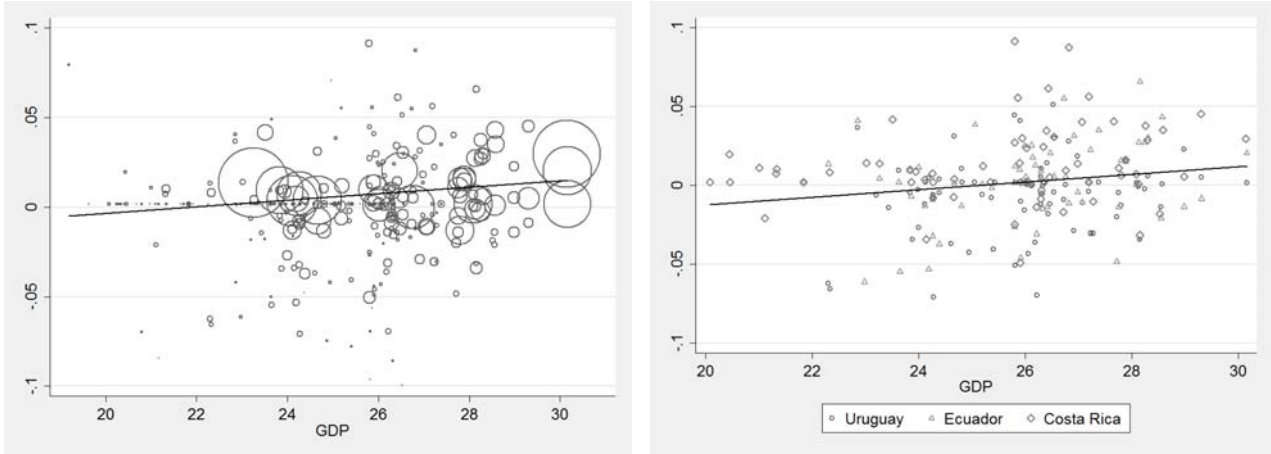
Figure 5
Distribution of Sales and Price Dispersion across Buyers at the Firm-Product-Destination Level
All Countries, 2005

Distribution of Sales across Buyers
All

Price Dispersion across Buyers
All

Firm-Destination

Firm-Destination

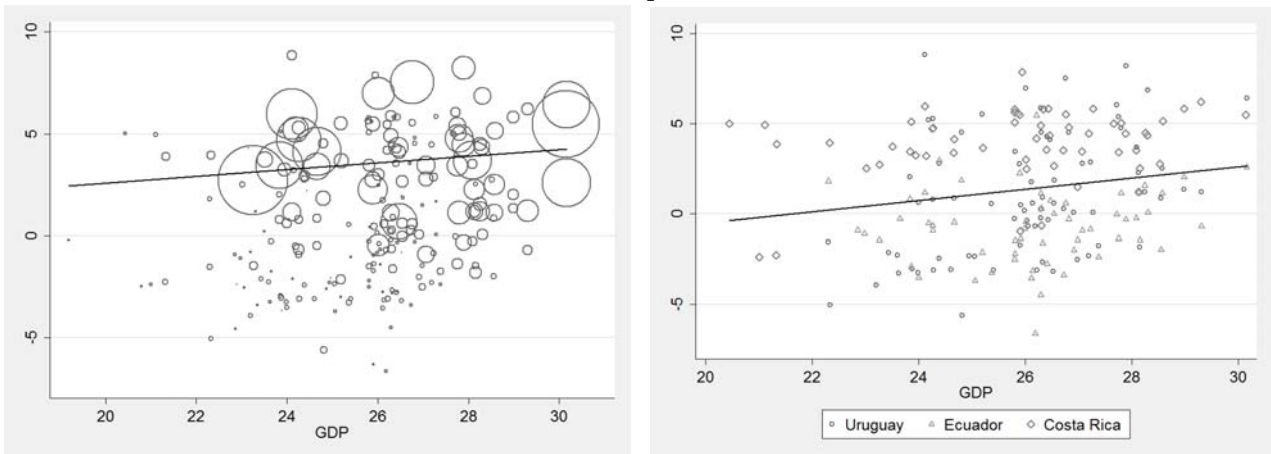**Firm-Destination-Buyer**

Firm-Destination-Buyer

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
The figures are kernel density estimates showing the distribution of the share of the main buyer and the standard deviation of the unit values across buyers for: (1) all firm-product-destinations; (2) only those firms' exports to a destination consisting of both differentiated and non-differentiated products; (3) only those firms' exports to buyers in given destinations consisting of both differentiated and non-differentiated products. The lowest and highest percentiles are excluded. All variables are expressed in natural logarithms.

Figure 6
Share of Main Buyer and Price Dispersion at the Firm-Product-Destination Level and Destination Size
All Countries, 2005
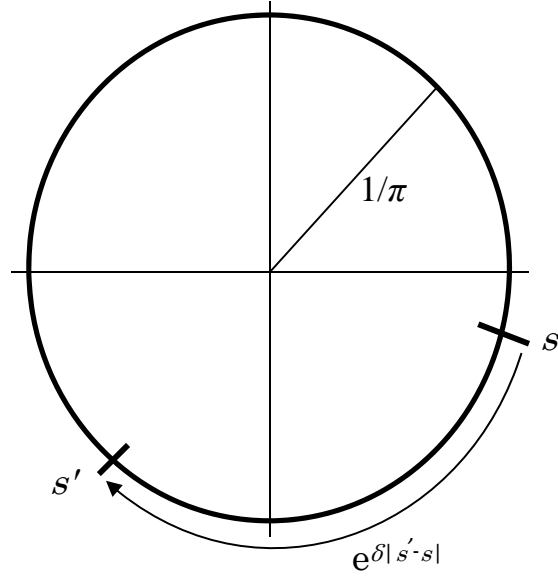**Share of Main Buyer**

Price Dispersion

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.
The figures are scatterplots showing the relationship between the average share of the main buyer and the average coefficient of variation of prices across firm-products in given destinations, and the size this destination's market as proxied by its GDP. In the left panel all destinations are considered. Each destination is weighted by the number of firm-product combinations with positive trade. In the right panel only destinations with more than 10 firm-product combinations with positive trade are considered. All variables are expressed in natural logarithms. In the case of the share of the main buyer, we account for the number of buyers (i.e., we present the residual of a regression of the share of the main buyer on the number of buyers). GDP is expressed in common currency and constant prices. Data come from the World Bank's World Development Indicators.

Figure 7
Characteristics Space of a Product
with Adaptation Cost

Appendix

Figure A1
Cumulative Distribution of the Number of Buyers and the Share of the Main Buyer and the Respective Kernel Estimates by Country, 2005

Costa Rica   **Ecuador**   **Uruguay**

Costa Rica   **Ecuador**   **Uruguay**