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The Buyer Margins of Firms' Exports*

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Abstract

We use detailed data on exporters from Costa Rica, Ecuador and Uruguay as well as on their buyers to show that: aggregate exports are disproportionally driven by few multi-buyers exporters; and each multi-buyer exporter's foreign sales of any product in a given destination are in turn accounted for by a dominant buyer. We propose an analytically solvable multi-country model of endogenous selection in which dominant exporters, dominant products and dominant buyers emerge in parallel as multi-product sellers with heterogeneous technologies compete for buyers with heterogeneous needs. The model not only provides an explanation of the existence of dominant buyers but also makes specific predictions on how the relative importance of dominant buyers should vary across export destinations depending on their market size and accessibility. We show that these predictions are borne out by our data and discuss their welfare implications in terms of gains from trade.

Keywords: Firm heterogeneity, taste heterogeneity, import-export relations, competition, selection.

J.E.L. Classification: F12, F14.

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1 Introduction

Few firms engage in exporting. Most of those that do sell only a small number of products to a small number of buyers in a small number of destinations. However, the small group of exporters selling a lot of products to a lot of buyers in a lot of destinations accounts for a dominant share of aggregate exports. Analogously, only a small fraction of dominant products accounts for the bulk of sales by *each* of those dominant exporters, and only a small fraction of dominant buyers accounts for the bulk of each dominant exporter's sales in any given destination. While the facts concerning dominant exporters and dominant products are well known (see, e.g., Bernard et al., 2007; Mayer and Ottaviano, 2007; Bernard et al., 2012; Mayer et al., 2014), those on dominant buyers have so far remained largely unexplored.[1]

We document these facts using detailed information on exporters from Costa Rica, Ecuador and Uruguay as well as on their buyers. As explaining the existence of dominant buyers calls for new theories in which heterogeneous sellers interact with heterogeneous buyers, we then propose a simple analytically solvable multi-country model of endogenous selection in which dominant exporters, dominant products and dominant buyers emerge in parallel as multi-product sellers with heterogeneous technologies compete for buyers with heterogeneous needs. The model not only provides an explanation of the existence of dominant buyers but also makes specific predictions on how the relative importance of dominant buyers should vary across destinations depending on their market size and geography. We finally show that these predictions are indeed borne out by our data and discuss their welfare implications in terms of gains from trade.

In so doing, we make two distinct contributions to the theory and the empirics of international trade with heterogeneous firms. As for theory, on the demand side our model introduces buyer heterogeneity by merging the 'representative consumer approach' to product differentiation (Chamberlin, 1933; Spence, 1976; Dixit and Stiglitz, 1977) with the 'ad-

[1] We discuss the related literature below.

dress (or characteristics) approach' (Hotelling, 1929; Lancaster, 1966 and 1979).[2] 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] As in the representative approach, in our model consumers demand varieties of a horizontally differentiated product ('love of variety'). However, as in the address approach, they prefer different versions of those varieties. Taste heterogeneity is introduced by assuming that different versions of the same variety can be described as points in a characteristics space. Consumers' preferences are defined over all potential versions, and each consumer has her own ideal version ('address') in the characteristics space. Aggregate preferences for within-variety diversity arise from the dispersion of ideal points over the characteristics space and, for a given price vector, a version's demand is defined by the mass of consumers preferring that version over the others. In particular, for each variety there is a measure of ideal versions that, in the wake of Salop (1979), are located around a circle with consumers 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 version of each differentiated variety as long as this is available in her ideal version. Due to love of variety, the consumer demands all and only the varieties available in her ideal version.[4] A crucial feature of our model that drives its empirically relevant comparative statics is that demand exhibits variable elasticity as in Ottaviano et al. (2002).

On the supply side, firms are monopolistically competitive. Following Mayer et al. (2014), we assume that each firm first chooses in which country to enter as well as which variety

[2]See Anderson et al. (1991) for a discussion of the pros and cons of different approaches to product differentiation.

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

[4]Helpman (1981) adopts a 'pure' address model. There is only one differentiated product and the fact that a consumer has her own ideal version of that product rules out 'love for variety' across versions. Anderson et al. (1991) determine the formal conditions under which address (and discrete choice) models can give rise to aggregate 'love for variety' across versions of the same product when individual preferences for ideal versions are aggregated at the product level. In this respect, though our demand system violates those conditions, our approach 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).

and which version of that variety to produce. This defines its 'core variety' and the 'core version' of that variety. Then, again upon entry, the firm randomly draws its efficiency in producing that version. This defines the firm's 'core competence'. After having discovered its core competence, the firm may also decide to produce non-core varieties, serve non-core customers or export to foreign markets but in all three cases it faces additional costs of 'proliferation', 'adaptation' or 'exportation' respectively. This implies that in equilibrium more efficient firms produce more varieties, serve more customers and export to more destinations. Moreover, the number of varieties sold and customers served as well as the distribution of sales across varieties sold and customer served change across destinations depending on the toughness of local competition. In particular, tougher competition forces firms to sell fewer varieties. These are the ones closer to the 'core variety' for which the proliferation cost is lower. In addition, due to variable demand elasticity, tougher competition makes firms skew the sales of the varieties they keep on producing towards the core ones. Analogously, tougher competition also forces firms to focus on their 'core versions', hence on their 'core buyers', for which the adaptation cost is lower. Due to variable elasticity, it also makes firms skew their sales towards the core buyers. As a result, consumers whose ideal versions were initially further away from the firms' core versions are not served anymore with the corresponding varieties disappearing from their consumption baskets. This implies a welfare loss in terms of foregone product variety that is, however, compensated by the availability of new varieties supplied by new firms as the distance between the core and ideal versions of the new varieties is shorter than the distance between the core and ideal versions of disappeared varieties. Thanks to the compression of markups, to the selection of firms, varieties and versions, and to the reallocation of expenditure shares towards core versions, tougher competition also reduces prices. For all these reasons, average utility increases with the toughness of competition. While the predictions on varieties are analogous to those in Mayer et al. (2014), those on buyers are novel. These are the predictions we bring to the data.

As for the empirics of international trade, 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 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 rather than buyer information.[5] Blum et al. (2010 and 2012), Eaton et al. (2013), Monarch (2014), and Monarch and Schmidt-Eisenlohr (2016) do make use of data that identify the buyers, but for different purposes than ours. 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 exploring their impacts on aggregate export dynamics. Monarch (2014) utilizes data on US importers and Chinese exporters to uncover the frictions associated with changing exporting partners. Monarch and Schmidt-Eisenlohr (2016) also exploit US import data to estimate the value of long-term trade relationships for certain countries. Closer to our paper, Bernard et al. (2017) use export information from Norway to study the impact of foreign buyers' size heterogeneity on aggregate trade elasticity.[6] However, differently from our paper, their analysis does not deepen the investigation of the firm-product level and does not cover the distributions of sales across buyers.[7]

Also related to our analysis are a number of recent studies that examine the relationships

[5]In Arkolakis (2010) consumers with identical tastes may end up consuming different CES bundles of differentiated varieties 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.

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

[7]Our paper is also related to McCalman (2018) who introduces demand side heterogeneity by relaxing the assumption of homotheticity and therefore allowing expenditure shares to depend on buyers' income levels in addition to relative prices.

between buyers and sellers in given pairs of countries within specific sectors. Macchiavello (2010) exploits data on trade relationships between Chilean wine exporters and UK wine distributors to show how the age and the order of these relationships relate to prices, survival rates, marketing costs, and distributor characteristics.[8] Using transaction-level export data from Mexico, Sugita et al. (2014) analyze how US and Mexican firms match in the textile and apparel sectors. Kamal and Sundaram (2015) exploit customs data on transactions between US importers and Bangladeshi exporters along with information on the geographic location of the latter to investigate whether business networks among trading firms - as proxied by geographical proximity - affect exporter-importer matches. All these papers, however, do not investigate how the cross-country variation in the toughness of competition affects the distribution of firm export sales across buyers, which is the key focus of our analysis.

The rest of the paper is organized as follows. After introducing the dataset, Section 2 presents our facts on the buyers margin of exports and multi-buyer exporters. Section 3 introduces the model, derives its predictions on how the relative importance of buyers is affected by the toughness of competition, and discusses its welfare implications. Section 4 brings those predictions to the data. Section 5 concludes.

2 Exporters and Buyers

Aggregate exports are concentrated in the hands of few dominant exporters selling several products to several markets (see, e.g., Bernard et al, 2007; Mayer and Ottaviano, 2007) and a small fraction of dominant products accounts for the bulk of sales of any of those dominant exporters (see, e.g., Mayer et al., 2014). In this section, we show that exporters with a large pool of foreign buyers are a crucial component of the group of dominant exporters.

In so doing, we rely on three datasets consisting of highly disaggregated annual firm export data for three different countries, Costa Rica, Ecuador and Uruguay, over the period

[8] In the same vein, Macchiavello and Morjaria (2014) provide evidence on the importance of reputation in buyer-seller relationships based on data from the Kenyan rose export sector.

2005-2008. These customs data are reported at the exporter-product-country-importer level, providing information on the value and the quantity (weight) shipped of each product (6-digit HS level) by each exporter to each importer in each destination country.[9] They virtually cover the whole population of exporting firms for our three countries.[10]

2.1 Buyers in International Trade

A snapshot of our dataset is presented in Table 1. This table reports aggregate export indicators for the three countries over our sample period. In 2008, Uruguay had more than $2,000$ exporters that sold approximately $3,000$ products to approximately $12,000$ buyers in 160 countries for almost USD 6 billion. In Ecuador, a larger number of exporting firms, around $4,000$, sold a similar total number of products to a similar number of buyers in a slightly smaller set of 151 destinations for USD 19 billion. Finally, in Costa Rica, $2,700$ exporters sold around $4,000$ products to almost $15,000$ buyers in 143 countries to generate total foreign sales over USD 8.5 billion.

The role of buyers in aggregate exports can be examined by extending the approach proposed by Arkolakis and Muendler (2011) to include the *buyer scope*. Consider a country exporting to some destination. Let 'extensive margin' refer to the number of exporters, 'product scope' to the average number of unique exporter-product combinations per exporter, 'buyer scope' to the average number of unique exporter-product-buyer combinations per unique exporter-product combination, and 'intensive margin' to average exports per unique exporter-product-buyer combination.[11] Then, by definition, aggregate exports are equal to

[9] Original data are reported at the HS-10 digit level. We have aggregated these data to a common HS-6 digit level to ensure consistency across countries and over time.

[10] 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 were 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 those from the Statistical Office never exceeds 1% over the period under analysis.

[11] Both scopes are equal or greater than one as long as some exporters export more than one product to the destination and have more than one buyer for some of their products in that destination.

the product of intensive margin, product scope, buyer scope and intensive margin.[12]

Table 2 presents the results of this decomposition. When looking at the three countries together in 2005, the extensive and intensive margins account on average for 44% and 47% of aggregate exports respectively. The remaining 9% is evenly split between the product and buyer scopes. This hides some variation across countries as the product scope has more weight in Costa Rica (7%) and Uruguay (6%) while the buyer scope is more important in the latter (6%). These magnitudes are remarkable as the decomposition allows the number of buyers to contribute only at the firm-product level within destination. Moreover, the buyer scope is larger than the product scope for two out of three countries. A similar pattern arises when the decomposition is performed over time (2005-2008). In this case, the extensive and intensive margins account on average for 16% and 79% of aggregate exports respectively, while the contribution of the buyer scope is consistently larger than that of the product scope (3% vs. 2% on average across countries with a peak of 8% vs. insignificant for Uruguay).

Table 3 describes the distribution of export outcomes across firms in the three sample countries with an emphasis on the role of buyers. For parsimony, we focus on 2005 but similar patterns emerge for all years in the sample. We consider the following export outcomes: the numbers of buyers, destinations and products; the numbers of buyers per destination and per product; average exports per buyer, per destination and per product; and average exports per destination-product-buyer. For each outcome the first seven columns report key percentiles while the eighth reports the average. The table shows that the median (average) Costa Rican exporter sells 2 (5.9) products to 2 (6.9) buyers in 2 (2.9) destinations for USD $35,000$ $(2,173,000)$. The median (average) Ecuadorian exporter sells 1 (3.2) products to 1 (4.9) buyers in 1 (2.3) destinations for USD $28,000$ $(4,168,000)$. The median (average) Uruguayan exporter sells 1 (4.4) products to 1 (6.9) buyers in 1 (2.9) destinations for USD $28,000$ $(1,763,000)$. Importantly, the percentiles reveal a remarkable heterogeneity in terms

[12]See Appendix A.3 for a formally description of this decomposition.

of the number of buyers: most exporters trade with a limited number of foreign buyers and only few of them serve a wide range of buyers: while exporters in the top decile serve more than ten buyers in all three countries, at least half of the exporters serve no more than two buyers.

This concentration in the distribution of the *number* of buyers across firms is visualized in Figures 1 and 2. These figures depict the distributions of exporters over the number of buyers for each country in our sample (Figure 1) as well as at different aggregation levels pooling across countries (Figure 2). In particular, Figure 1 shows that single-buyer firms represent between 40% (Costa Rica) to 57% (Ecuador) of exporters and that the distributions are very similar across our three countries. Figure 2 reveals that concentration is more pronounced at finer levels of disaggregation with around 50% of the exporters selling to just one foreign buyer when all destination countries and products are pooled together. This percentage rises to around 60% for firm-destination combinations and around 80% for firm-destination-product combinations.

2.2 Multi-Buyer Exporters

While exporters selling several products to several buyers in several destinations are very few, they still account for large shares of aggregate exports. This can be seen comparing the shares of exporters and aggregate exports (Figure 3) that are accounted for by either single-buyer or multi-buyer exporters. The share of exporters with multiple buyers never exceed 30%, whereas the share of those with only one buyer can reach almost 80%. In contrast, the share of single-buyer exporters in aggregate exports is always below 20%, whereas that of multi-buyer exporters can reach almost 90%. In short, multi-buyer exporters account for a small fraction of the number of exporters but a large fraction of aggregate exports. Hence, shedding light on the behavior of multi-buyer exporters seems to be crucial for understanding a key driver of aggregate exports.

This dominance of multi-buyer exporters can be assessed more precisely by regressing firms' exports on a binary indicator that takes the value of 1 if the exporter is multi-buyer in at least one product-destination combination and 0 otherwise along with extensive margin variables (numbers of destination-product combinations and buyers) and different sets of fixed effects as controls. This binary indicator captures the conditional 'export premium' of being multi-buyer. The estimation results are reported in Table 4. The estimated coefficient on the multi-buyer indicator is positive, significant and similar across countries both in the cross section (2005) and when pooling across years (2005-2008). Specifically, in the cross section, the estimate implies that multi-buyer firms export between 70% and 167% more than single-buyer firms. This multi-buyer export premium is remarkable given that we control for both the number of product-destinations and the number of buyers. When pooling across years, estimation suggests that exports by multi-buyer exporters grow on average 13% more than those by single-buyer exporters. The estimates of the multi-buyer premium remain virtually the same when additionally conditioning by HS2 digit sector(-year) and destination(-year) fixed effects (see lower panel of Table 4).[13]

3 A Model of Multi-Buyer Exporters

Explaining the evidence presented in the previous section calls for a model that features heterogeneous multi-product sellers serving heterogeneous buyers in various destination countries. In order to better highlight the interaction between sellers' and buyers' heterogeneity, we start presenting the conceptual framework in closed economy. We will then extend it to the open economy where also countries' heterogeneity will come into play.

[13]Tables reporting these and other estimates of the multi-buyer premium when controlling separately for the number of products and the number of destinations (instead of the number of product-destination pairs) as well as those obtained when changing the level of aggregation to firm-country and firm-country-product and adding correspondingly more demanding fixed effects (such as firm-product and firm-destination in addition to industry-year fixed effects and destination-year fixed effects) are available from the authors upon request. In these tables, the multi-buyer premium remains positive and significant and qualitatively similar to the estimates in Table 4.

3.1 Buyer Heterogeneity

There are L consumers with preferences defined over a homogeneous good and a continuum of horizontally differentiated *varieties* indexed by $i \in I$. Each consumer is endowed with a unit of labor that she inelastically supplies to the market so that L represents not only the mass of consumers but also total labor supplied. Each consumer is also endowed with $\overline{y}$ units of the homogeneous good. Each variety comes itself in *versions* with different characteristics and consumers differ in terms of their tastes for these versions.

Taste heterogeneity across consumers is introduced by assuming that a variety's versions can be described as points ('addresses') in a characteristics space.[14] Each consumer has an 'ideal' version of the variety and derives utility only from the consumption of that version. Hence, if her ideal version is not available, the consumer does not demand the variety at all. The consumer's tastes are then defined by the set of ideal versions she demands of the different varieties. Specifically, we consider a consumer z whose set of ideal versions is $I_z \subset I$. Her utility function is given by

$$U_z = y_z + \alpha \int_{i \in I_z} q_z(i) di - \frac{\gamma}{2} \int_{i \in I_z} \left[q_z(i)\right]^2 di - \frac{\eta}{2} \left[\int_{i \in I_z} q_z(i) di \right]^2 \tag{1}$$

where y_z is consumption of the homogeneous good, $q_z(i)$ is consumption of a variety i with a version in I_z, $\gamma > 0$ measures 'love for variety', $\alpha > 0$ and $\eta > 0$ measure the preference for the differentiated good with respect to the homogeneous good. The initial endowment $\overline{y}$ of the homogeneous good is assumed to be large enough for its equilibrium consumption to be strictly positive.

The characteristics space of a variety's versions is assumed to be represented by a circle

[14] While our model with heterogeneous tastes for final goods has a strong business-to-consumer ('B-to-C') flavor, assuming perfectly competitive intermediaries with the same addresses as consumers would allow for a straightforward business-to-business ('B-to-B') reinterpretation. The alternative of modeling buyers as firms with homogeneous 'tastes' for intermediate goods but heterogeneous productivity has been explored by Bernard, Moxnes and Ullveit-Moe (2017) in the case of CES demand. The CES assumption, however, rules out the relationships between toughness of competition and sales concentration that our model will uncover in this section and our empirical analysis will document in Section 4.

C with each point along C corresponding to the ideal version ('address') of some consumer. The circle has circumference 1 and consumers are uniformly distributed around it so that there are L consumers sharing any given ideal version. Versions are indexed in a clockwise manner starting from noon and arranged across varieties so that consumer z's ideal version of any variety is indexed z with $z \in [0, 1]$. The right hand panel of Figure 4 provides a visual representation of the characteristics space C_i for a given variety i with version z indexed clockwise from noon 0 to midnight 1.[15] The left hand panel provides, instead, a visual representation of the entire product space I, emphasizing varieties h, i and j, each with its own circular characteristics space, as well as consumer z's address and ideal set I_z.[16]

3.2 Seller Heterogeneity

Labor is the only input. It can be employed in the production of the homogeneous good by a perfectly competitive sector facing constant returns to scale with unit labor requirement equal to 1. This good is chosen as numeràire and its price is set to one by choice of units. The assumptions on technology and market structure then imply that also the wage is equal to 1.

Labor can also be employed in the production of the differentiated varieties by a monopolistically competitive sector. In this sector there is a large mass of potential entrants. Each of them can produce multiple varieties and multiple versions of these varieties but it has first to develop a 'core version' of a 'core variety' together with its production process. This requires sinking an entry cost f targeted at a specific address z of a specific variety i in the characteristics space, i.e. at a specific point $(i, z) \in I$. Only after sinking this cost, the

[15] We work with a continuum of versions (i.e. with a continuum distribution of consumers' ideal points) rather than a discrete number of them as it is analytically convenient and leads to more elegant expressions. As we will discuss in Section 3.2, this will not be associated with strategic interaction between firms as any decision by a firm controlling a continuum of versions of a discrete number of varieties does not affect market aggregates.

[16] 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. See Helpman (1985) for additional details.

entrant discovers the marginal cost c associated with the core version z of its core variety i. This cost is determined as the realization of a random draw from a continuous distribution with cumulative density

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

This corresponds to the case in which marginal productivity $1/c$ is Pareto distributed with shape parameter $k \geq 1$ over the support $[1/c_M, \infty)$.[17] As k rises, density is skewed towards the upper bound of the support c_M.

The marginal cost draw c for the core version of its core variety defines the entrant's 'core competence'. However, once c has been drawn, the entrant may also decide to offer a countable set of non-core varieties as well as countable sets of non-core versions of its core and non-core varieties.[18] This faces, however, additional costs as it draws the entrant away from its core competence. The ensuing loss of efficiency is modelled in terms of a 'competence ladder'. Specifically, let $n = \{0, ..., \infty\}$ index the countable varieties the entrant may decide to produce in increasing order of distance from its core variety (indexed $n = 0$) in the product space I. Then, let $m \in [0, 1]$ index the versions of a variety the entrant may decide to produce in increasing order of their clockwise arc distance from the core version along the circle C, with $m = 0$ denoting the core version and $m = 1$ denoting the farthest version away from the core one.[19] Finally, let $v^n(m, c)$ denote the marginal cost of version m of variety n for the entrant with core marginal cost c. Falling efficiency as the entrant moves away from its core competence can be captured by assuming that $v^n(m, c)$ is an increasing function of

[17] The distributional assumption (2) yields, up to an additive shift, a Pareto distribution for firm size and product sales that fits empirical patterns rather well. See Mayer et al (2014).

[18] Countability implies that the entrant may produce only a zero-measure subset of varieties. As in Mayer et al (2014), this is imposed to remove cannibalization among varieties as well as strategic interaction among entrants, thus preserving a monopolistically competitive environment no matter how many varieties each entrant produces.

[19] Although m is a continuous variable, cannibalization is not an issue within variety as its different versions do not compete for the same consumers (who demand only their ideal version). See Dhingra (2012) for a study of cannibalization effects in a demand system similar to ours. The implications of abstracting from those effects are also discussed in Mayer et al (2014).

both n and m. For analytical convenience, we assume $v^n(m,c) = e^{\omega n + \vartheta m} c$ where $\omega > 0$ and $\vartheta > 0$ respectively measure the difficulty of introducing additional varieties and versions of these varieties as the entrant moves away from its core competence.[20] We will refer to ω as the 'proliferation cost' associated with broadening the range of varieties and to ϑ as the 'adaptation cost' associated with broadening the range of versions.[21]

3.3 Seller Selection

The assumptions on preferences and technology imply that the equilibrium of the model is symmetric in that at all addresses in the characteristics space all entrants and producers face the same demand conditions, and all consumers face the same supply conditions.[22] There are, however, differences across consumers in terms of the specific versions they consume of the available varieties, and difference across producers in terms of the varieties and versions they supply.

Specifically, on the demand side, due to symmetry the measure of the set I_z of varieties available at any given address z is the same for every $z \in [0,1]$ and we denote this common measure by N. Utility maximization then implies that also the inverse demand of a variety i is the same at all addresses $z \in [0,1]$ and equals

$$p(i) = \alpha - \gamma q(i) - \eta Q \tag{3}$$

[20] Under our assumption that a consumer's only demands her ideal version m, the burden of adaptation falls on the producer. Alternatively, one could assume that the producer does not provide any adaptation and, instead, the consumer incurs a utility loss when consuming a non-adapted version. This may be captured by 'discounting' the corresponding quantity consumed ('quality adjustment'): if the producer supplies a given quantity q^p of the non-ideal version at variable cost cq^p to the consumer, the latter's utility is the same as the one associated with a quantity $q^p/e^{\omega n + \vartheta m}$ of her ideal version where $1/e^{\omega n + \vartheta m}$ is the discount factor. In this case the consumer substitutes ideal and non-ideal versions. Due to monopolistic competition, price discrimination and multiplicative adaptation costs or quality adjustment, solving the producer's profit maximization problem reveals that the two alternative modelling options lead to isomorphic results.

[21] The model embeds Mayer et al (2014) when ϑ goes to infinity and serving non-core customers bears no differential cost. It also embeds Melitz and Ottaviano (2008) when, in addition, ω goes to infinity and producing non-core products is prohibitively expensive.

[22] We impose symmetry early on to streamline the presentation. A detailed discussion of how symmetry emerges in equilibrium can be found in Carballo et al (2013).

where $q(i)$ is the quantity demanded of variety i, $p(i)$ is its price, and $Q = \int_0^N q(i)di$ is the total quantity demanded of all varieties at any given address. As there are L consumers at each address, their combined demand is

$$Q(i) = Lq(i) = L\left[\frac{\alpha}{\eta N + \gamma} - \frac{p(i)}{\gamma} + \frac{\eta N}{\eta N + \gamma}\frac{\overline{p}}{\gamma}\right] \tag{4}$$

where $\overline{p} = (1/N)\int_0^N p(i)di$ is the average price of all varieties available at any given address. For variety i to be demanded at all at any given address, price must be low enough to satisfy

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

where $p_{\max} \leq \alpha$ represents the price level at which demand (4) at the address is driven to zero ('choke price'). Lower $p_{\max}$ implies higher price elasticity of demand and this may be driven by a larger measure ('number') of varieties available at the address or by their lower average price $\overline{p}$.

On the supply side, the profit an entrant with core marginal cost c earns from version m of its variety n is then maximized for output level equal to

$$q^n(m,c) = \frac{L}{2\gamma}\left(p_{\max} - e^{\omega n + \vartheta m}c\right) \tag{6}$$

with corresponding price, markup, revenue and profit

$$p^n(m,c) = \frac{1}{2}\left(p_{\max} + e^{\omega n + \vartheta m}c\right) \tag{7}$$

$$\mu^n(m,c) = \frac{1}{2}\left(p_{\max} - e^{\omega n + \vartheta m}c\right) \tag{8}$$

$$r^n(m,c) = \frac{L}{4\gamma}\left[\left(p_{\max}\right)^2 - \left(e^{\omega n + \vartheta m}c\right)^2\right] \tag{9}$$

$$\pi^n(m,c) = \frac{L}{4\gamma}\left(p_{\max} - e^{\omega n + \vartheta m}c\right)^2 \tag{10}$$

The entrant will produce at all only if it can make non-negative profit at least on the core version of its core variety ($m = n = 0$). Given (10), this is the case if and only if $ce^{\omega n+\vartheta m} \leq p_{\max}$ for $n = m = 0$, i.e. if and only if $c \leq p_{\max}$. Accordingly, the 'choke price' (5) determines a threshold that the core marginal cost c must not exceed for the firm to be able to sell at least the core version of its core variety. We call this threshold the 'cutoff cost' and we denote it by c_D. We then have $c_D = p_{\max}$ and thus

$$c_D = \frac{1}{\eta N + \gamma} (\gamma\alpha + \eta N\overline{p}) \tag{11}$$

where we have used the definition in (5). By (11), the cutoff cost at any given address decreases with the number of varieties available at the address while it increases with their average price.

3.4 Buyer Range and Buyer Mix

As long as its core marginal cost c does not exceed c_D, the entrant may also decide to supply additional non-core varieties (indexed $n > 0$). However, it will supply only those from which non-negative profit can be earned at least on their core version (indexed $m = 0$). Given (10), these are varieties such that $n \leq n(c)$ where

$$n(c) = \max\{n \mid ce^{\omega n} \leq c_D\} + 1 \tag{12}$$

is the entrant's 'product range'. By (12), the product range decreases with the adaptation cost ω while it increases with the cutoff cost c_D. It also decreases with the firm's core marginal cost c so that lower cost producers have a wider product range.

Of the varieties in this product range the firm will again produce only versions generating non-negative profit. For a given $n \leq n(c)$, (10) implies that these are versions such that

$m \leq m(c,n)$ where

$$m(c,n) = \frac{1}{\vartheta}\left[\ln\left(\frac{c_D}{c}\right) - \omega n\right] \tag{13}$$

is the variety's 'buyer range'. By (13), for a given variety, the buyer range decreases with the proliferation cost ω and the adaptation cost ϑ while it increases with the cutoff cost c_D. It also decreases with the core marginal cost c and distance n from the core so that lower cost producers and, for each producer, varieties closer to the core have a wider buyer range.

Analogously, we call 'product mix' and 'buyer mix' of a producer the distributions of performance measures across its product and buyer ranges respectively. Due to the 'competence ladder', these distributions are not uniform. In particular, results (6)-(10) imply that lower marginal cost $e^{\omega n+\vartheta m}c$ is associated with lower price as well as larger output, revenue, markup and profit. Hence, lower cost producers (lower c) quote lower prices, command larger markups, and achieve larger output, revenue and profit for the core version of the core variety ($m = n = 0$). Moreover, for any producer, version m is cheaper, sells more and is more profitable for varieties closer to the core variety (lower n). Lastly, for variety n of any producer, versions closer to the core version (lower m) are cheaper, sell more and are more profitable. This generates a ranking in performance across a producer's varieties and the versions of each variety it supplies, which maps into a ranking of customers whereby 'core buyers' (who purchase core versions of core varieties) absorb more output, account for larger revenue and generate more profit for the producer than non-core buyers. These differences between buyers are larger when the core cutoff cost is smaller as (6), (9) and (10) imply that $q^n(m,c)/q^n(m',c)$, $r^n(m,c)/r^n(m',c)$ and $\pi^n(m,c)/\pi^n(m',c)$ are decreasing functions of c_D for $m < m'$ and given n: the negative impact of tougher competition on output, revenue and profit is less severe for versions closer to the producer's core competence. Analogously, for given m, the negative impact of tougher competition (smaller c_D) on output, revenue and profit is less severe for varieties closer to the producer's core competence.

A final implication of results (6), (9), (10), (12) and (13) is that lower cost producers (lower c) are bigger in terms of output, larger in terms of revenue, more profitable, and have richer product and buyer ranges.

3.5 Free Entry Equilibrium

Due to free entry, in equilibrium the expected profit for an entrant at any address has to match the sunk entry cost. Due to symmetry, this requires

$$\sum_{n=0}^{\infty}\left\{\int_0^1\left[\int_0^{c_D e^{-\omega n-\vartheta m}}\pi^n(m,c)dG(c)\right]dm\right\}=f \tag{14}$$

where, anticipating the cost cutoff c_D, the term between square brackets is the (ex ante) profit an entrant expects to earn on version m of variety n; the terms between curly brackets is the (ex ante) profit an entrant expects to earn on all versions of variety n; and the outer integral gives the (ex ante) profit an entrant expects to make from all versions of all varieties. Due to the law of large numbers, these (ex ante) expected values equal the (ex post) average realizations.

Given (2) and (10), equation (14) can be solved for the unique equilibrium core cutoff cost value

$$c_D^* \equiv \left(\Theta\frac{\gamma\Phi}{L\Omega}\right)^{\frac{1}{k+2}} \tag{15}$$

with

$$\Phi \equiv 2\left(k+2\right)\left(k+1\right)\left(c_M\right)^k f,\ \Theta \equiv \frac{1-e^{-k\vartheta}}{k\vartheta},\ \Omega \equiv \frac{1}{1-e^{-k\omega}}$$

These bundling parameters can be interpreted as follows. As it increases with the entry cost f and the highest possible marginal cost draw c_M, $\Phi > 0$ measures the technological barriers to efficient entry. As it decreases in the proliferation cost ω, $\Omega \geq 1$ measures the ease of proliferation through the introduction of non-core varieties. In equilibrium the average number of varieties per producer equals Ω. As it decreases in the adaptation cost ϑ, $\Theta \in (0,1)$ measures the ease of adaptation through customized non-core versions of any given variety.

In equilibrium the average share of consumers per variety equals Θ.[23] Expression (15) then shows that higher entry barriers as well as higher proliferation and adaptation costs increase the equilibrium cost cutoff c_D^* whereas larger market size (higher L) and stronger 'love of variety' (lower γ) reduce c_D^*.[24]

Note that, when adaptation is costless ($\vartheta = 0$), consumer heterogeneity is immaterial ($\Theta = 1$) and (15) becomes the cutoff cost expression in the multi-product firm model by Mayer et al. (2014). When, in addition, the introduction of non-core varieties is prohibitively costly (infinite ω), producers supply only core products ($\Omega = 1$) and (15) boils down to the analogous expression in the single-product model by Melitz and Ottaviano (2008). For infinite ω and positive ϑ, consumer heterogeneity is not immaterial but only single-product firms are active and only some of them sell to all consumers.[25]

To complete the characterization of the equilibrium, we also have to determine the number of producers N that sell to any given consumer. By symmetry, this is also the number of producers whose core competence coincides with the consumer's address in the characteristics space. To determine N, we use $G_D^n(m,c) \equiv G(c)/G(c_D e^{-\omega n - \vartheta m})$ to denote the conditional core marginal cost distribution of producers having the core version of their variety n at distance m from the consumer's ideal version of that variety:

$$G_D^n(m,c) = \left[c/\left(c_D e^{-\omega n - \vartheta m}\right)\right]^k .$$

Then (7) can be used together with $p_{\max} = c_D$ to write the price of the consumer's ideal version bought from one of those producers as

$$p^n(m,c) = \frac{1}{2}\left(c_D + e^{\omega n + \vartheta m} c\right) .$$

[23]From this viewpoint, in the terminology of Arkolakis (2010) Θ would be called average 'market penetration'.

[24]Ω and Θ also decrease in k. As with larger k firms with high marginal production costs become more frequent, both the average number of varieties per firm and the average share of consumers per variety fall.

[25]Even a small cost of adaptation is enough to prevent some firms (the least productive ones) from serving all consumers: $\Theta < 1$ for $\vartheta > 0$.

The average price the consumer pays can thus be rewritten as

$$\overline{p} \equiv \int_0^1 \left[\int_0^{c_D e^{-\omega n - \vartheta m}} p^n(m,c) dG_D^n(m,c) \right] dm = \frac{2k+1}{2(k+1)} c_D$$

which, due to symmetry, is the same for all varieties. Finally, substituting this result in (5) together with $p_{\max} = c_D$ allows us to solve the resulting equation for the number of sellers per consumer, which in equilibrium becomes

$$N^* = \frac{2(k+1)\gamma}{\eta} \frac{\alpha - c_D^*}{c_D^*} \tag{16}$$

This is also the equilibrium number of producers with core competence coinciding with any consumer's address in the characteristics space while the associated number of entrants is $N_E^* = G(c_D^*)N^* = (c_D^*/c_M)^k N^*$.

Finally, the unique equilibrium core cutoff cost (15) also uniquely determines welfare as measured by indirect utility

$$U^* = 1 + \frac{1}{2\eta} (\alpha - c_D^*) \left(\alpha - \frac{k+1}{k+2} c_D^* \right) \tag{17}$$

As this is a decreasing function of c_D^*, a reduction in the equilbrium core cutoff cost leads to higher welfare. This is due to lower price as lower cutoff cost prevents higher cost firms from selling and forces firms that eventually sell to retrench towards their core competence. The resulting tougher selection of sellers, products and buyers allows for savings in terms of proliferation costs and also adaptation costs as the average distance between buyers' and firms' addresses is smaller.

3.6 Open Economy

In the open economy consumers have different addresses not only in the characteristics space but also in the geographical space. Specifically, consider an arbitrary number of countries, indexed $l = 1, ..., J$, each of them replicating the structure of the closed economy discussed so far. Countries differ in terms of size and geography. We use L_l to denote the population ('size') of country l and $\tau_{hl} > 1$ to denote the 'iceberg' trade cost for exports from country h to country l. Internal trade is, instead, free ($\tau_{ll} = 1$). This implies that, for a producer in country h with core marginal cost c, the *delivered* marginal cost of selling version m of variety n to a consumer in country l is $\tau_{hl} e^{\omega n + \vartheta m} c$.

Exploiting again within-country symmetry, let p_l denote the price threshold for positive demand by any consumer in country l. Then, the 'choke price' for the consumer is

$$p_l = \frac{1}{\eta N_l + \gamma} \left(\gamma \alpha + \eta N_l \overline{p}_l \right), \tag{18}$$

where N_l is the number of (domestic and foreign) sellers to the consumer in country l while $\overline{p}_l$ is their average (delivered) price. Assuming market segmentation, the profit a producer in country h makes by selling version m of variety n to consumers in country l is

$$\pi_{hl}^{n}(m, c) = \frac{L_l}{4\gamma} \left(c_{hl} - e^{\omega n + \vartheta m} c \right)^2, \tag{19}$$

where $c_{hl} = p_l / \tau_{hl}$ is the cost cutoff for positive sales from h to l. As the producer sells only if profit is non-negative, its product range in country l is

$$n_{hl}(c) = \max \left\{ n \mid \tau_{hl} e^{\omega n} c \leq c_{ll} \right\} + 1$$

where, due to free internal trade, $c_{ll} = p_l$ is the cost cutoff for domestic sales in country l. Analogously, its buyer range in country l is

$$m_{hl}(c, n) = \frac{1}{\vartheta} \left[\ln \left(\frac{c_{ll}}{\tau_{hl} c} \right) - \omega n \right].$$

Hence, both the product range and the buyer range are decreasing functions of the trade cost. This implies that, all the rest given, only producers with low enough core marginal cost export, supplying more varieties and serving more consumers in the domestic than in the export markets.

Also the product mix and the buyer mix are affected by the trade cost. Output sold and associated revenue for version m of variety n evaluate to

$$q_{hl}^{n}(m,c) = \frac{L_l}{2\gamma}\left(c_{ll} - \tau_{hl}e^{\omega n+\vartheta m}c\right) \tag{20}$$

and

$$r_{hl}^{n}(m,c) = \frac{L_l}{4\gamma}\left[\left(c_{ll}\right)^2 - \left(\tau_{hl}e^{\omega n+\vartheta m}c\right)^2\right] \tag{21}$$

respectively while profit equals

$$\pi_{hl}^{n}(m,c) = \frac{L_l}{4\gamma}\left(c_{ll} - \tau_{hl}e^{\omega n+\vartheta m}c\right)^2.$$

As these expressions decrease as c_{ll} decreases and at a faster rate for larger n and m, ceteris paribus both the product mix and the buyer mix are more skewed in countries with lower domestic cutoff cost. As in the closed economy, the negative impact of tougher competition on output, revenue and profit is less severe for varieties and versions closer to the producer's core competence.

Due to free entry, expected profits of entrants have to be zero in equilibrium. Given (2) and (19), this implies

$$\sum_{l=1}^{J}\rho_{hl}L_l c_{ll}^{k+2} = \Theta\frac{\gamma\Phi}{\Omega} \qquad h = 1,...,J. \tag{22}$$

where $\rho_{hl} \equiv \tau_{hl}^{-k} < 1$ is a measure of the 'freeness' of trade from country h to country l that varies inversely with the trade cost τ_{hl}. The free entry conditions (22) yield a system of J equations that can be solved for the equilibrium domestic cutoff costs in the J countries using Cramer's rule. The resulting equilibrium domestic cutoff for country l is

$$c_{ll}^{*} \equiv \left(\Theta \frac{\gamma \phi}{L_l \Omega} \frac{\sum_{h=1}^{J} |C_{hl}|}{|\mathcal{P}|} \right)^{\frac{1}{k+2}} \tag{23}$$

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 $|C_{hl}|$ is the cofactor of its ρ_{hl} element. Expression (23) shows that, as in the closed economy, domestic cutoffs are determined by local market size: ceteris paribus the domestic cutoff cost is lower in a larger country. However, cross-country differences in cutoffs also arise from differences in $\sum_{h=1}^{J} |C_{hl}| \,/\, |\mathcal{P}|$, which is an inverse measure of geographical centrality ('market accessibility'). Thus, ceteris paribus central countries have lower domestic cutoff cost.[26] For sellers, lower cutoff cost leads to more skewed product and buyer mix.

As in the closed economy, (18) can be used to relate the core cutoff cost with the mass of sellers in country l:

$$N_l^{*} = \frac{2(k+1)\gamma}{\eta} \frac{\alpha - c_{ll}^{*}}{c_{ll}^{*}}. \tag{24}$$

Then, given a positive mass of entrants $N_{E,h}^{*}$ in country h, there will be $N_{hl}^{*} = G(c_{hl}^{*})N_{E,h}^{*} = G(c_{ll}^{*}/\tau_{hl})N_{E,h}^{*}$ producers in h selling on average Ω varieties to a fraction Θ of consumers in country l. Once the domestic cost cutoff and the number of sellers in each country are obtained from (23) and (24) respectively, the corresponding mass of entrants can be found solving the system $N_l^{*} = \sum_{l=1}^{J} N_{hl}^{*}$ for $h = 1, ..., J$.

Finally, the domestic cutoff in each country also uniquely determines its welfare as mea-

[26]When trade costs are prohibitively large, (23) boils down to the closed economy result (15).

sured by indirect utility

$$U_l^* = 1 + \frac{1}{2\eta}\left(\alpha - c_{ll}^*\right)\left(\alpha - \frac{k+1}{k+2}c_{ll}^*\right) \tag{25}$$

As U_l^* is a decreasing function of c_{ll}^*, central countries benefiting from a large local market enjoy higher welfare than peripheral countries with a small local market. As in the closed economy, welfare gains arise from lower price as lower cutoff cost prevents higher cost firms from selling and forces the remaining sellers to refocus on their core competence. Tougher selection of sellers, products and buyers saves on proliferation and adaptation costs as the average distance between buyers' and firms' addresses falls.

4 Toughness of Competition and Sales Concentration: Empirical Evidence

The model developed in the previous section is consistent with the empirical findings highlighted in Section 2. In particular, a few exporters selling multiple products to multiple buyers in multiple destinations account for relatively large shares of their countries' exports and, noteworthy, a relatively small set of main buyers is responsible for substantial fractions of *each* firm's foreign sales. It also generates additional predictions on how this importance of dominant buyers is affected by the toughness of competition in the destination countries. In this section we precisely estimate these relationships, thereby contrasting the implications of our theoretical model with the data.

4.1 Linking Theory and Empirics

In order to evaluate whether the relationships between toughness of competition and sales concentration uncovered in the model are present in the data, we first need to be more precise about them. To do this, first consider a variety n exported from country h to country l by a firm with core marginal cost c and two buyers of the variety in country l with 'addresses' m and $m' > m$ so that the former buyer is closer to the firm's core competence. By (21), the export sales ratio between the two buyers is

$$\frac{r^n_{hl}(m,c)}{r^n_{hl}(m',c)} = \frac{(c_{ll})^2 - \left(\tau_{hl} e^{\omega n + \vartheta m} c\right)^2}{(c_{ll})^2 - \left(\tau_{hl} e^{\omega n + \vartheta m'} c\right)^2} > 1 \tag{26}$$

as the exporter raises more revenue from the core buyer than from the non-core buyer. Moreover, the elasticity of the export sales ratio to the cutoff cost evaluates to

$$\frac{\partial \ln\left(\frac{r^n_{hl}(m,c)}{r^n_{hl}(m',c)}\right)}{\partial \ln c_{ll}} = -\frac{2\left(c_{ll}\tau_{hl}e^{\omega n}c\right)^2\left(e^{2\vartheta m'} - e^{2\vartheta m}\right)}{\prod\limits_{m \in \{m,m'\}}\left[(c_{ll})^2 - \left(\tau_{hl}e^{\omega n + \vartheta m}c\right)^2\right]} < 0 \tag{27}$$

where the sign is granted by $m < m'$. Accordingly, tougher competition (lower c_{ll}) raises the export sales ratio of m to m'.[27]

As (27) holds for any m and any $m' > m$, it has several parallel implications for the exporter's buyer mix that we can test with our data at the exporter-product-destination level. First, if m is the main (dominant) buyer and m' is any other buyer, then (27) implies that tougher competition increases the main buyer's sales share. Second, if m is the the most important (main) buyer and m' is the least important one, then (27) implies that tougher competition increases the export sales ratio between them. Third, if m and m' map all buyers, then (27) implies that tougher competition increases the concentration and the coefficient of variation of export sales across buyers.

The main challenge in testing these predictions is how to capture the 'toughness of competition' across destination countries. To tackle this issue we rely on the model's association of lower c_{ll} with larger market size and better market accessibility. Then, as our model embeds Mayer et al. (2014) as a special case, we can follow their strategy proxying market size by

[27]We prefer not to emphasize the effect of trade barriers/enhancers τ_{hl} on the buyer mix of exporters as this comparative statics result is very sensitive to the specification for the trade cost across different versions of the same variety. Mayer et al. (2014) make the same point with respect to core and non-core varieties.

GDP and market accessibility what they call 'freeness of trade'. This is a country-HS2-level indicator that corresponds to the contribution of barriers/enhancers to trade as obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects.[28]

We test our hypothesis of the positive relationship between the toughness of competition at destination and the concentration in export sales by estimating the following specification:

$$\begin{aligned} log\big(Concentration_{iknhl}(t)\big) &= \beta_1 \times log\big(Toughness\ of\ Competition_{khl}(t)\big) \\ &+ \beta_2 \times (Trade\ Costs_{hl}) + \lambda_{in}(t) + \varepsilon_{inhl}(t) \end{aligned} \tag{28}$$

where i, n and k index the firm, the product and the sector respectively, h and l refer to the origin and destination countries respectively, and t denotes the year. We introduce firm-product-year fixed effects through $\lambda_{in}(t)$ in order to control for time-varying unobserved factors such as firm productivity and firm-product competences.

We choose the share of the main buyer for firm i in destination l and product n as our baseline measure of the skewness of the buyer mix. This measure exists for the entire support of the distribution of the number of buyers. In contrast, some of the other potential measures (such as the ratio of the sales of the main buyer to the sales to other buyers) are only computable for exports with more than one buyer. Moreover, we normalize the share of the main buyer by the share that each buyer would have if export sales were evenly distributed across all buyers. This normalization is made to control for the fact that the same share of the main buyer may imply different degrees of concentration depending on the firm's number of buyers. Accordingly, the minimum value for the normalized share of the main buyer is one when the firm has only one buyer. Figure 5 presents non-parametric

[28] See Appendix A.4 for additional details.

estimates of the distribution of the normalized share of the main buyer in logs, both for each exporting country and when pooling them together. This figure highlights, as expected, the concentration of firms' exports on few buyers and, in addition, the pronounced similarity of distributions across the three countries. All our results remain qualitatively the same when we use the raw, non-normalized share of the main buyer as dependent variable.

As mentioned above, our measures of the toughness of competition are GDP in destination l and the freeness of trade in industry k and destination l. Based on our testable implications, we expect these measures to have a positive impact on the normalized main buyer share, i.e. $\beta_1 > 0$ in our specification (28). Finally, we proxy trade costs by standard gravity variables such as distance and indicators of contiguity and trade agreements (RTA) between pairs of countries (See A Appendix-Data for a precise definition and sources of all explanatory variables). All estimated coefficients reported are standardized to account for differences across scales in all the variables considered in the empirical analysis.

4.2 Results

Columns (1) to (4) in the upper panel of Table 5 show estimates of specification (28), using the normalized main buyer shares as dependent variable and the measures of the toughness of competition as main explanatory variables, obtained on pooled export flows from Costa Rica, Ecuador and Uruguay over the period 2005-2008.[29] In all specifications, we include firm-product-year fixed effects to account for firm-product factors that vary over time and we cluster standard errors at origin-destination and sector-destination.[30] In Column (1) only two key covariates are considered: GDP and freeness of trade. All estimated coefficients are

[29]We have also estimated our baseline equation using the share of the main buyer normalized by the median share. The results from this exercise confirm our findings and are available upon request.

[30]Since our main explanatory variable 'freeness of trade' is estimated, it might be of some concern that our standard errors are not bootstrapped. Following Efron and Tbshirani (1994), we also estimated all our specifications bootstrapping the standard errors, using 300 repetitions and defining the resampling cluster at the firm level. Reassuringly, all our results still hold with bootstrapped standard errors. Furthermore, the bootstrapped standard errors are smaller than those in the reported estimation where standard errors are two-way clustered at origin-destination and sector-destination. That is why we decided to keep the estimates based on the more demanding specification as our benchmark while making those with bootstrapped standard errors available from the authors upon request.

highly significant and have the predicted positive sign. In Column (2), we introduce GDP per capita to control for taste differences across countries tied to product quality and consumer income (as in McCalman, 2016). The estimated coefficient on this new variable is not statistically significant and those of GDP and freeness of trade are unaffected. In Columns (3) and (4), we include the battery of bilateral gravity controls and drop freeness of trade to avoid collinearity. The estimated coefficients on GDP remains positive and significant. Columns (5) to (8) in the upper panel of Table 5 present the same set of regressions where the dependent variable is the raw main buyer share instead of its normalized version. The motivation for doing so is twofold. First, these estimations show that our results do not depend on the normalization choice. Second, one might be concerned that the positive relation between the normalized main buyer share and market size could be generated by exporter-buyer matches with stochastic transaction values as long as larger markets were associated with a larger number of draws. This statistical benchmark, however, would not be able to generate the positive relation between the toughness of competition and the raw main buyer share as more draws would positively affect only the denominator of the raw share.[31]

The results reported in Table 5 thus provide strong empirical support to the testable predictions derived from our theoretical model.[32] Furthermore, we exploit the fact that we have data for three different countries to evaluate the model's predictions for each of them. The toughness of competition has again a positive and significant effect on sales concentration in each of our sample countries, with some heterogeneity in the size of the effects across countries.[33]

In Table 6, we estimate variants of specification (28) that incorporate different sets of

[31]We also estimated all our benchmark specifications in the 2005 cross section of our data. As in Table 5, the results reveal a positive and significant relation between the toughness of competition and both the normalized and the raw main buyer shares. Tables are available from the authors upon request.

[32]Estimates are also qualitatively similar when we use the normalized and the raw shares of the main buyer rather than their logs or we run cross-sectional regressions for the other years of our sample. These results are available from the authors upon request.

[33]Results are available from the authors upon request.

conditioning fixed effects. In all cases, the toughness of competition (as captured by GDP, and freeness of trade) has a positive effect on the normalized main buyer share. This is true even under the most demanding specification including both firm-product-year and origin-destination-year fixed effects to control not only for time-varying firm-product factors but also for time-varying origin-destination factors such as average transport costs or tariffs. Note that (origin-)destination-year fixed effects directly absorb the influence of several of the covariates that belong to the initial specification including GDP, distance, contiguity, and trade agreements. In particular, the presence of destination-year fixed effects implies that our results do not depend on the market size of destination countries as this is absorbed by these fixed effects.

In addition, we re-estimate our baseline specification using alternative clusterings of standard errors to account for potential correlation across different dimensions in our data. Specifically, we cluster standard errors by firm-destination, firm, destination-year, and destination. The results of these alternative estimations are reported in Table 7. These results confirm that the toughness of competition has a positive and significant effect on the share of sales going to the main buyer.

4.3 Robustness

Our theoretical model predicts that firms will concentrate their sales on their main buyer when competition is stronger. We have shown that this prediction finds empirical support when the toughness of competition is captured through GDP and freeness of trade. We now check how robust this finding is to changes in our estimation strategy.

First, we consider alternative measures of the sales concentration in order to show that our results do not hinge upon using the (normalized) main buyer share. Based on our discussion in Section 4.1, some natural alternative concentration measures are: the export sales ratio of the most important buyer to the least important buyer (B1/BL); the Herfindahl Index of export sales' concentration (HI), and the coefficient of variation of export sales (CV).[34] Table 8 reports estimates of (28) when using these three alternative measures. The estimation results confirm that the toughness of competition is associated with more concentration of sales towards the main buyers.

Second, so far we estimated the impact of the toughness of competition on the concentration of the values of sales. However, using equation (20), we can show that the model also predicts $\partial \ln \left(q_{hl}^{n}(m,c)/q_{hl}^{n}(m',c)\right)/\partial \ln c_{ll} < 0$ where m correspond to the core buyer and m' is larger than m, so that the toughness of competition should have the same impact on the concentration of quantities sold. We thus re-estimate our baseline specification and variants thereof based on the alternative concentration measures using quantities sold instead of their values. Table 9 reports the corresponding results, which support the model's prediction that competition is also associated with increased quantity concentration.

Third, according to our model, the impact of the toughness of competition on the concentration of export sales should be amplified by adaptation costs ($\partial^2 \ln \left(r_{hl}^{n}(m,c)/r_{hl}^{n}(m',c)\right)/\partial \ln c_{ll} \partial \vartheta < 0$). Given that adaptation costs can be expected to be positively related to product differentiation, the model then predicts that the toughness of competition should have a stronger impact for differentiated products. We investigate this prediction as an additional check that our mechanism is indeed at work. In doing so, we rely on the product classification proposed by Rauch (1999). Specifically, we interact our measure of toughness of competition with a binary indicator identifying each product type in the Rauch classification. The corresponding results reported in Table 10 support the prediction of the model: across all specifications the toughness of competition has the strongest impact for differentiated products, being smaller for referenced-priced products and only marginally significant or not significant at all for homogeneous products.

Fourth, another concern might be that some of our results are driven by flows that have only one buyer or other factors that affect the distribution of sales across buyers such as

[34] As all these measures increase with the degree of concentration, we expect a positive impact of competition on them.

vertical integration and trade intermediaries (in particular, large trading companies). We therefore proceed to re-estimate specification (28) on samples that: (i) exclude export flows with a single buyer; (ii) exclude export flows that correspond to vertically integrated firms as identified using information from the WorldBase dataset (see Alfaro and Cheng, 2012); (iii) exclude products for which intermediaries are more prevalent as determined based on data from Ahn et al. (2011) (specifically, we drop products with share of intermediaries above the median); and (iv) combine (i), (ii) and (iii) simultaneously. Estimates of the baseline specification on these alternative samples are shown in Table 11. These estimates confirm that tougher competition is associated with a larger normalized main buyer share.[35]

Finally, results are also similar when: (a) we change the aggregation level to firm-destination instead of firm-destination-product; (b) we compute the freeness of trade at a more disaggregated 4-digit HS level; (c) we exclude flows associated with trade in capital and intermediate goods and with trade in consumer goods; and (d) we include country-year random effects to control for within destination-correlation (Wooldridge, 2006).[36]

5 Conclusion

We have used detailed data on exporters from Costa Rica, Ecuador and Uruguay as well as on their buyers to show that: aggregate exports are disproportionally driven by few multi-buyers exporters; and each multi-buyer exporter's foreign sales of any product are in turn accounted for by few dominant buyers. We have then proposed an analytically

[35]As an alternative, we tackle the issue of intermediaries and large trading companies by removing from our sample all firms with many partners, many products, or many destinations, either as an exporters or as an importer. The rationale is that intermediaries and large trading companies tend to be in the upper tail of the distribution in terms of the number of trade relationships. The results of using this restricted sample confirm all of our findings and are available from the authors upon request.

[36]A set of tables with these robustness checks are available from the authors upon request. Given the sectoral concentration of our sample countries' foreign sales, it could be that our estimates are mainly driven by sectors that are particularly important for countries' aggregate exports sales (such as oil products for Ecuador, electronic circuits and data processing equipment products for Costa Rica, and animal and vegetable products for Uruguay). To assess whether this is the case, we dropped firm-product-destination-year flows for those origin country-sector combinations. All our findings turned out to be robust to dropping these observations. A table with this additional check is also available upon request.

solvable multi-country model of endogenous selection in which dominant exporters, dominant products and dominant buyers emerge in parallel as multi-product sellers with heterogeneous technologies (i.e., with different 'core competences' in specific product varieties and in specific versions of those varieties) compete for buyers with heterogeneous needs (i.e. with different 'ideal versions' of specific product varieties). We have shown that the model makes specific predictions on how the relative importance of dominant buyers should vary across export destinations depending on the toughness of their competitive enviroment as determined by market size and market accessibility. We have finally shown that our data provide empirical support to these predictions.

In addition to its positive predictions, our model has interesting normative implications. In particular, in the model tougher competition raises welfare as it *also* allows for a better match between consumers' ideal versions and firms' core competences. To better understand how this welfare effect materializes, it is useful to compare our model with the one by Helpman (1981) when larger market size drives tougher competition. In Helpman's model there is no firm heterogeneity, there is only one product variety 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 version of the product variety. Hence, available versions 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 version is zero and she has to make do with the closest available version, suffering a utility loss that increases with the distance of that version from her ideal one. However, as in a larger market there are more firms, the distances between available versions are shorter and, thus, the average distance between a consumer's ideal version and the closest available version 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 versions. On both counts, average utility is higher in a larger market.[37]

Differently, in our model a consumer demands several differentiated varieties, has an ideal version of each differentiated product variety and does not consume any other version (i.e. the utility loss associated with the consumption of any non-ideal version is prohibitive). On the production side, firms are heterogeneous and each of them has its own core version of the varieties it supplies. This core version corresponds to the ideal version of some consumers and can also be transformed in the ideal versions of other consumers by paying an additional adaptation cost that increases with the distance between the firm's core version and the other consumers' ideal versions. As the market gets larger, more firms enter and produce. The resulting tougher competition forces existing producers to focus on their core versions. Consumers whose ideal versions were initially further away from the firms' core versions are not served anymore and the corresponding varieties disappear from their consumption baskets. This welfare loss in terms of product variety is, however, compensated by new varieties supplied by new firms. Due to within-product selection, the distance between the core and ideal versions of the new products is shorter than the distance between the core and ideal versions of disappeared varieties. This is a novel channel through which tougher competition improves welfare. In addition, as in Mayer et al. (2014), tougher competition also reduces prices thanks to the compression of markups, to the selection of firms, varieties and versions, and to the reallocation of expenditure shares towards core versions. For all these reasons, average utility grows with the toughness of competition as market size increases.[38]

In this respect our findings also speak to the recent literature on measuring the welfare

[37]In address models the mismatch between buyers and sellers arises from the impossibility for the latter to exactly cover all the heterogenous 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 (2014) for a survey stressing the make-or-buy decisions of multinationals.

[38]If horizontally differentiated intermediates were introduced as in Helpman (1985), another reason why welfare would be higher when competition is tougher would be that the it would allow intermediate and final producers to be better matched.

gains from trade with heterogeneous agents (see, e.g., Arkolakis et al., 2012; Costinot and Rodriguez-Clare, 2014; Melitz and Redding, 2015; Arkolakis et al., 2017) as this literature has so far typically focused on models in which sellers are heterogeneous but buyers are not (see Bernard et al., 2017, on this specific point).

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6 Tables

Table 1

Aggregate Export Indicators 2005-2008				
	Costa Rica			
	2005	**2006**	**2007**	**2008**
Total Exports	5,794	6,960	8,276	8,678
Number of Exporters	2,667	2,808	2,896	2,753
Number of Destinations	138	133	150	143
Number of Products	3,737	4,039	4,253	4,117
Number of Buyers	13,257	14,387	15,020	14,705
	Ecuador			
	2005	**2006**	**2007**	**2008**
Total Exports	9,265	12,400	12,817	19,494
Number of Exporters	2,223	3,052	3,370	3,962
Number of Destinations	127	143	147	151
Number of Products	2,238	2,579	3,081	3,086
Number of Buyers	8,769	11,311	11,782	12,243
	Uruguay			
	2005	**2006**	**2007**	**2008**
Total Exports	3,420	3,984	4,515	5,969
Number of Exporters	1,940	1,997	2,088	2,130
Number of Destinations	140	149	154	160
Number of Products	2,873	2,874	2,872	3,039
Number of Buyers	11,034	11,829	12,071	11,959

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA. The table reports aggregate statistics for each country in our sample over the period 2005-2008.

Exports are in millions of U.S. dollars.

Table 2

Decomposition of Bilateral Trade Flows				
	2005			
	All	**Costa Rica**	**Ecuador**	**Uruguay**
Firm	0.436***	0.439***	0.385***	0.550***
	(0.022)	(0.024)	(0.042)	(0.021)
Product Scope	0.049***	0.069***	0.028***	0.061***
	(0.005)	(0.008)	(0.010)	(0.010)
Buyer Scope	0.045***	0.041***	0.038***	0.062***
	(0.003)	(0.005)	(0.004)	(0.008)
Intensive Margin	0.470***	0.450***	0.548***	0.327***
	(0.017)	(0.020)	(0.026)	(0.027)
Country Fixed Effects	Yes	No	No	No
Observations	403	137	126	140
	2005-2008			
	All	**Costa Rica**	**Ecuador**	**Uruguay**
Firm	0.156***	0.195***	0.107***	0.214***
	(0.022)	(0.048)	(0.025)	(0.023)
Product Scope	0.021***	0.027*	0.019**	0.009
	(0.007)	(0.014)	(0.011)	(0.011)
Buyer Scope	0.031***	0.028***	0.028***	0.067***
	(0.004)	(0.007)	(0.005)	(0.009)
Intensive Margin	0.791***	0.749***	0.845***	0.727***
	(0.011)	(0.020)	(0.019)	(0.020)
Country Fixed Effects	No	Yes	Yes	Yes
Country Pair Fixed Effects	Yes	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,726	560	564	602

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

The table reports estimated coefficients of equations: (1) $\ln M_{hl} = \alpha_0 + \alpha_1 \ln X_{hl} + \gamma_c + \varepsilon_{hl}$ for a given year (here 2005) and (2) $\ln M_{hlt} = \alpha_0 + \alpha_1 \ln X_{hlt} + \delta_{hl} + \tau_t + \mu_{hlt}$ for the entire sample period (2005-2008) , where M corresponds to the following export margins: the number of exporting firms, the products scope, the buyers scope, and average exports per exporting firm, product and buyer that actually register trade. γ_c is a set of exporting country fixed effects, δ_{hl} is a set of country-pair fixed effects, τ_t denotes year fixed effects, and ε_{hl} and μ_{hlt} are the error terms, respectively.

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).

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 3

Distribution of Outcomes across Exporters - 2005								
	Costa Rica							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**Mean**
Total Exports	1.2	5.5	34.5	321.5	2155.4	6046.2	34567.4	2172.6
Number of Buyers	1.0	1.0	2.0	5.0	13.0	25.0	72.0	6.4
Number of Market	1.0	1.0	2.0	3.0	6.0	10.0	18.0	2.9
Number of Products	1.0	1.0	2.0	5.0	12.0	21.0	51.0	5.3
Number of Buyers per Market	1.0	1.0	1.0	2.0	4.0	7.0	18.0	2.3
Number of Buyers per Product	1.0	1.0	1.0	2.0	5.0	8.0	27.0	2.6
Number of Buyers per Market-Product	1.0	1.0	1.0	1.0	2.0	4.0	11.0	1.6
Exports per Buyer	0.5	2.2	11.6	58.0	290.7	742.9	4838.9	334.9
Exports per Market	0.9	4.0	22.4	139.5	728.3	1906.9	11038.2	747.9
Exports per Product	0.0	0.3	2.	18.	155.4	624.4	5526.0	403.0
Exports per Market-Product	0.0	0.4	3.	22.	145.8	456.	3042.0	235.9
Exports per Market-Product-Buyer	0.0	0.5	3.	19.	103.1	295.	1909.0	146.7
	Ecuador							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**Mean**
Total Exports	0.0	2.6	27.9	259.1	2758.7	7894.9	44982.6	4167.9
Number of Buyers	1.0	1.0	1.0	3.0	10.0	18.0	45.0	4.2
Number of Market	1.0	1.0	1.0	2.0	5.0	8.0	16.0	2.2
Number of Products	1.0	1.0	1.0	3.0	7.0	11.0	27.0	3.0
Number of Buyers per Market	1.0	1.0	1.0	2.0	4.0	7.0	14.0	2.1
Number of Buyers per Product	1.0	1.0	1.0	2.0	4.0	8.0	23.0	2.3
Number of Buyers per Market-Product	1.0	1.0	1.0	1.0	3.0	4.0	11.0	1.6
Exports per Buyer	1.4	9.1	34.8	125.9	529.0	1372.5	10113.3	971.9
Exports per Market	0.3	8.3	47.8	253.8	1454.8	3945.8	19592.0	1871.7
Exports per Product	0.0	0.3	3.7	37.5	358.0	1469.6	14220.9	1351.0
Exports per Market-Product	0.0	0.7	9.0	75.0	460.2	1353.7	9546.0	894.3
Exports per Market-Product-Buyer	0.1	1.7	14.5	72.0	288.0	780.4	7082.0	538.9
	Uruguay							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**Mean**
Total Exports	1.5	4.9	27.7	242.6	1768.6	7143.4	38456.7	1763.5
Number of Buyers	1.0	1.0	1.0	4.0	11.0	24.0	92.0	6.2
Number of Market	1.0	1.0	1.0	3.0	7.0	11.0	24.0	2.8
Number of Products	1.0	1.0	2.0	4.0	8.0	13.0	29.0	3.6
Number of Buyers per Market	1.0	1.0	1.0	2.0	5.0	8.0	19.0	2.3
Number of Buyers per Product	1.0	1.0	1.0	2.0	6.0	10.0	36.0	3.0
Number of Buyers per Market-Product	1.0	1.0	1.0	1.0	3.0	5.0	11.0	1.7
Exports per Buyer	2.6	9.6	36.1	126.9	441.2	957.0	4319.2	281.2
Exports per Market	2.1	7.8	38.0	202.4	922.0	2195.4	10790.4	612.0
Exports per Product	0.1	0.5	4.0	43.0	347.4	1121.3	11529.2	488.5
Exports per Market-Product	0.1	1.1	9.0	60.5	316.5	793.1	4720.0	262.8
Exports per Market-Product-Buyer	0.3	2.1	14.2	64.0	224.0	516.4	2457.5	153.4

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

The table reports summaries statistics where 10, 25, 50, 75 and 90 denotes the percentile of each variable.

Exports are in thousands of U.S. dollars.

Table 4

Multi-Buyer Premia Sample: Firm Level				
	2005			
	(1)	**(2)**	**(3)**	**(4)**
All	1.127***	0.517***	1.063***	0.619***
	(0.080)	(0.075)	(0.080)	(0.076)
Costa Rica	0.805***	0.434***	0.702***	0.471***
	(0.109)	(0.102)	(0.105)	(0.103)
Ecuador	1.730***	0.664***	1.668***	0.698***
	(0.161)	(0.144)	(0.173)	(0.153)
Uruguay	0.528***	0.290**	0.428***	0.341***
	(0.130)	(0.118)	(0.126)	(0.119)
Firm Characteristics	Yes	Yes	Yes	Yes
Origin Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	Yes	No	Yes
Destination Fixed Effects	No	No	Yes	Yes
	2005-2008			
	(1)	**(2)**	**(3)**	**(4)**
All	0.142***	0.144***	0.148***	0.147***
	(0.021)	(0.021)	(0.021)	(0.021)
Costa Rica	0.138***	0.147***	0.140***	0.160***
	(0.031)	(0.031)	(0.030)	(0.031)
Ecuador	0.172***	0.171***	0.188***	0.183***
	(0.037)	(0.037)	(0.039)	(0.040)
Uruguay	0.097**	0.116***	0.098**	0.110***
	(0.041)	(0.044)	(0.042)	(0.039)
Firm Characteristics	Yes	Yes	Yes	Yes
Origin Fixed Effects	Yes	Yes	Yes	Yes
Industry-Year Fixed Effects	No	Yes	No	Yes
Destination-Year Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	Yes	No	No	No

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

The table reports estimated coefficients of the multi-buyer premium where the dependent variable is firm i total exports in year t; the Multi-Buyer Premium is a binary indicator that takes the value of one if the firm has a firm-destination-product export flow with more than one buyer in year t and zero otherwise. Firm characteristics include the number of destination-product per year that firm serves and the number of buyers per year that the firm has. The number of destination-products is the total number of unique destination-product combinations in year t for firm i and the number of buyers is simply the total number of buyers of firm i's products.

Clustered standard errors at firm level are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 5

The Effect of Competition on Sales Concentration
Sample: All Exporting Countries, 2005-2008

	Normalized Main Buyer Share				Raw Main Buyer Share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	0.364***	0.360***	0.370***	0.376***	0.055***	0.045***	0.054***	0.044***
	(0.054)	(0.055)	(0.050)	(0.053)	(0.011)	(0.009)	(0.011)	(0.009)
Freeness of Trade	0.638***	0.643***			0.068***	0.078***		
	(0.091)	(0.095)			(0.017)	(0.020)		
GDP per capita		0.009		-0.011		0.019*		0.017
		(0.034)		(0.037)		(0.010)		(0.011)
Distance			-0.304***	-0.304***			-0.025	-0.026
			(0.088)	(0.088)			(0.021)	(0.023)
Contiguity			0.043	0.043			0.010	0.010
			(0.040)	(0.039)			(0.012)	(0.012)
RTA			0.067*	0.065*			0.013*	0.017**
			(0.034)	(0.036)			(0.007)	(0.008)
Firm-Product-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.403	0.403	0.402	0.402	0.803	0.803	0.805	0.805
Observations	233,175	233,175	233,175	233,175	233,175	233,175	233,175	233,175

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

The table reports standardized estimated coefficients (28) for all products. The dependent variables are the natural logarithm of the normalized main buyer share in sales of product n from firm i in country h to destination l in year t (Columns 1 to 4) and the natural logarithm of the raw main buyer share in sales of product n from firm i in country h to destination l in year t (Columns 5 to 8). Number of Exporters: Number of other firms from the three sample countries (Costa Rica, Ecuador, and Uruguay) exporting the same HS-2 product to the same destination in the same year. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. Specifications whose estimates are reported in Columns 5 to 8 include the number of buyers as an additional covariate (estimates not presented). See A Appendix - Data for details on the other explanatory variables. Standard errors clustered by origin-destination and sector-destination are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 6

The Effect of Competition on Sales Concentration
Sample: All Exporting Countries, 2005-2008
Robustness: Alternative Specifications

	(1)	(2)	(3)	(4)	(5)	(6)
GDP	0.241***	0.255***				
	(0.013)	(0.014)				
Freeness of Trade	0.406***	0.443***	0.401***	0.481***	0.664***	0.895***
	(0.024)	(0.026)	(0.040)	(0.075)	(0.058)	(0.134)
Firm-Year FE	Yes	Yes	Yes	Yes	No	No
Product-Year	Yes	No	Yes	No	No	No
Origin-Product-Year	No	Yes	No	Yes	No	No
Destination-Year	No	No	Yes	No	Yes	No
Origin-Destination-Year	No	No	No	Yes	No	Yes
Firm-Product-Year	No	No	No	No	Yes	Yes
Adjusted R2	0.323	0.347	0.330	0.362	0.434	0.446
Observations	233,175	233,175	233,175	233,175	233,175	233,175

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

The table reports standardized estimated coefficients alternative specifications of (28) for all products. The dependent variable is the natural logarithm of the normalized main buyer share in sales of product n from firm i in country h to destination l in year t. Number of Exporters: Number of other firms from the three sample countries (Costa Rica, Ecuador, and Uruguay) exporting the same HS-2 product to the same destination in the same year. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. See A Appendix - Data for details on the other explanatory variables.

Standard errors clustered by origin-destination and sector-destination are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 7

The Effect of Competition on Sales Concentration
Sample: All Exporting Countries, 2005-2008
Robustness: Alternative Clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	0.364***	0.364***	0.364***	0.364***	0.370***	0.370***	0.370***	0.370***
	(0.023)	(0.028)	(0.054)	(0.080)	(0.021)	(0.028)	(0.050)	(0.071)
Freeness of Trade	0.638***	0.638***	0.638***	0.638***				
	(0.037)	(0.045)	(0.091)	(0.093)				
Distance					-0.304***	-0.304***	-0.304***	-0.304***
					(0.025)	(0.042)	(0.088)	(0.108)
Contiguity					0.043***	0.043**	0.043	0.043
					(0.014)	(0.019)	(0.040)	(0.043)
RTA					0.067***	0.067***	0.067*	0.067**
					(0.018)	(0.018)	(0.034)	(0.031)
Firm Cluster	Yes	No	No	No	Yes	No	No	No
Destination-Industry Cluster	No	Yes	No	No	No	Yes	No	No
Origin-Destination Cluster	No	No	Yes	No	No	No	Yes	No
Destination Cluster	No	No	No	Yes	No	No	No	Yes
Firm-Product-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.421	0.421	0.421	0.421	0.402	0.402	0.402	0.402
Observations	233,175	233,175	233,175	233,175	233,175	233,175	233,175	233,175

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

The table reports standardized estimated coefficients (28) for all products. The dependent variable is the natural logarithm of the normalized main buyer share in sales of product n from firm i in country h to destination l in year t. Number of Exporters: Number of other firms from the three sample countries (Costa Rica, Ecuador, and Uruguay) exporting the same HS-2 product to the same destination in the same year. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. See A Appendix - Data for details on the other explanatory variables.

Standard errors clustered as indicated are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 8

The Effect of Competition on Sales Concentration
Sample: All Exporting Countries, 2005-2008
Robustness: Alternative Concentration Measures

	B1/BL		HI		CV	
	(1)	(2)	(3)	(4)	(5)	(6)
GDP	0.543***	0.541***	0.158***	0.163***	0.204***	0.202***
	(0.050)	(0.043)	(0.019)	(0.018)	(0.016)	(0.015)
Freeness of Trade	0.608***		0.143***		0.158***	
	(0.113)		(0.040)		(0.033)	
Distance		-0.297***		-0.070		-0.063*
		(0.114)		(0.056)		(0.034)
Contiguity		0.010		0.029		0.009
		(0.045)		(0.025)		(0.013)
RTA		0.075**		-0.002		0.021
		(0.034)		(0.016)		(0.015)
Firm-Product-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.494	0.492	0.744	0.745	0.741	0.741
Observations	52,170	52,170	233,175	233,175	52,170	52,170

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

The table reports standardized estimated coefficients variants of (28) for all products. The dependent variable is the natural logarithm of one of the following measures of concentration of sales of product n from firm i in country h to destination l 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), and the coefficient variation (CV). Number of Exporters: the natural logarithm of the number of other firms from the three sample countries (Costa Rica, Ecuador, and Uruguay) exporting the same HS-2 product to the same destination in the same year. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. See A Appendix - Data for details on the other explanatory variables.

Standard errors clustered by origin-destination and sector-destination are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 9

The Effect of Competition on Sales Concentration Sample: All Exporting Countries, 2005-2008 Robustness: Weight Concentration Measures								
	MB SH		B1/BL		HI		CV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	0.360***	0.366***	0.535***	0.532***	0.156***	0.154***	0.156***	0.160***
	(0.053)	(0.049)	(0.046)	(0.039)	(0.013)	(0.012)	(0.020)	(0.018)
Freeness of Trade	0.642***		0.636***		0.138***		0.161***	
	(0.090)		(0.096)		(0.025)		(0.040)	
Distance		-0.306***		-0.304***		-0.063**		-0.083
		(0.087)		(0.101)		(0.027)		(0.058)
Contiguity		0.043		0.017		0.005		0.025
		(0.039)		(0.040)		(0.010)		(0.025)
RTA		0.068*		0.080**		0.017		0.002
		(0.035)		(0.034)		(0.012)		(0.018)
Firm-Product-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.402	0.402	0.488	0.486	0.843	0.843	0.736	0.736
Observations	233,175	233,175	233,175	233,175	52,170	52,170	52,170	52,170

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

The table reports standardized estimated coefficients variants of (28) for all products. The dependent variable is the natural logarithm one of the following measures of concentration of the quantities (weight) sold of product n by firm i in country h to destination l in year t across their buyers: the normalized main buyer share (NMBS), the ratio of the sales to the main buyer to the sales to the least important buyer (B1/BL), the Herfindahl Index (HI), and the coefficient variation (CV). Number of Exporters: the natural logarithm of the number of other firms from the three sample countries (Costa Rica, Ecuador, and Uruguay) exporting the same HS-2 product to the same destination in the same year. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. See A Appendix - Data for details on the other explanatory variables.

Standard errors clustered by origin-destination and sector-destination are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 10

The Effect of Competition on Sales Concentration
Sample: All Exporting Countries, 2005-2008
Robustness: Degree of Differentiation and Adaptation Cost

	Conservative		Liberal	
	(1)	(2)	(3)	(4)
GDP	0.365***	0.362***	0.365***	0.362***
	(0.055)	(0.056)	(0.055)	(0.055)
Differentiated	0.706***	0.708***		
× Freeness of Trade	(0.109)	(0.114)		
Referenced-priced	0.607***	0.609***		
× Freeness of Trade	(0.069)	(0.072)		
Homogeneous	0.136	0.138		
× Freeness of Trade	(0.096)	(0.096)		
GDP per capita		0.005		-0.079**
		(0.033)		(0.033)
Differentiated			0.697***	0.701***
× Freeness of Trade			(0.108)	(0.113)
Referenced-priced			0.681***	0.684***
× Freeness of Trade			(0.078)	(0.082)
Homogeneous			0.157*	0.160*
× Freeness of Trade			(0.089)	(0.089)
Firm-Product-Year FE	Yes	Yes	Yes	Yes
Adjusted R2	0.403	0.403	0.404	0.404
Observations	233,175	233,175	233,175	233,175

Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA. The table reports standardized estimated coefficients variants of (28) for all products. The dependent variable is the natural logarithm of the normalized main buyer share in sales of product n from firm i in country h to destination l in year t. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. The sets of goods have been defined using basic categories identified in the classification proposed by Rauch (1999) (conservative and liberal version). See A Appendix - Data for details on the other explanatory variables.

Standard errors clustered by origin-destination and sector-destination are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

Table 11

The Effect of Competition on Sales Concentration
Sample: All Exporting Countries, 2005-2008
Robustness: Alternative Samples

	Nb2		Non-Vi		Non-Intmd		All	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	0.535***	0.532***	0.117***	0.119***	0.360***	0.366***	0.164***	0.159***
	(0.046)	(0.039)	(0.016)	(0.015)	(0.053)	(0.049)	(0.015)	(0.014)
Freeness of Trade	0.636***		0.207***		0.642***		0.243***	
	(0.096)		(0.025)		(0.090)		(0.038)	
Distance		-0.304***		-0.097***		-0.306***		-0.077*
		(0.101)		(0.026)		(0.087)		(0.042)
Contiguity		0.017		0.017		0.043		0.027*
		(0.040)		(0.012)		(0.039)		(0.015)
RTA		0.080**		0.020*		0.068*		0.044***
		(0.034)		(0.011)		(0.035)		(0.012)
Firm-Product-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.447	0.427	0.422	0.403	0.428	0.407	0.450	0.432
Observations	52,170	52,170	228,276	228,276	134,852	134,852	27,479	27,479

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

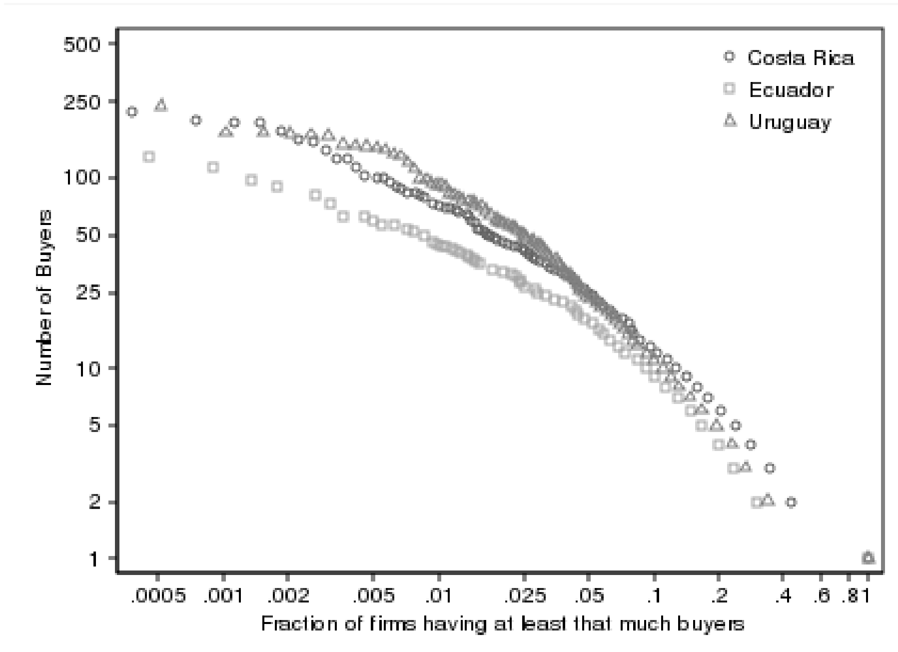
The table reports standardized estimated coefficients (28) for all products as obtained on three alternative samples: (i) export flows with at least two buyers at the firm-destination-product level (Nb2); (ii) export flows that are not among (vertically) related companies (Non-VI); (iii) exports flows in HS2 sectors where share of intermediaries is below the median according to results from Ahn et al (2011) (Non-Intmd); and (iv) combining all (i) to (iii) restrictions (All). The dependent variable is the natural logarithm of the normalized main buyer share in sales of product n from firm i in country h to destination l in year t. Number of Exporters: the natural logarithm of the number of other firms from the three sample countries (Costa Rica, Ecuador, and Uruguay) exporting the same HS-2 product to the same destination in the same year. Freeness of trade denotes a country-HS2-level measure obtained by estimating a standard gravity equation (in logs) with both exporter and importer fixed effects using worldwide bilateral trade data at the HS2 digit-level and purging the trade flows from these fixed effects. See A Appendix - Data for more details on the explanatory variables.

Standard errors clustered by origin-destination and sector-destination are reported below the estimated coefficients.

$***p < 0.01$, $**\ p < 0.05$, $*p < 0.10$

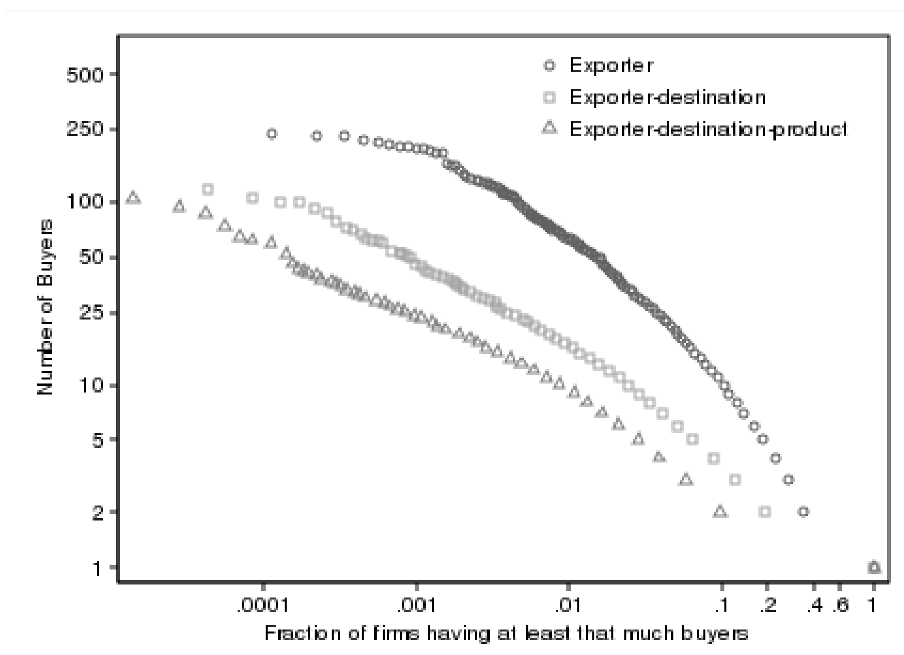
Figures

Figure 1: : Number of Buyers Distribution



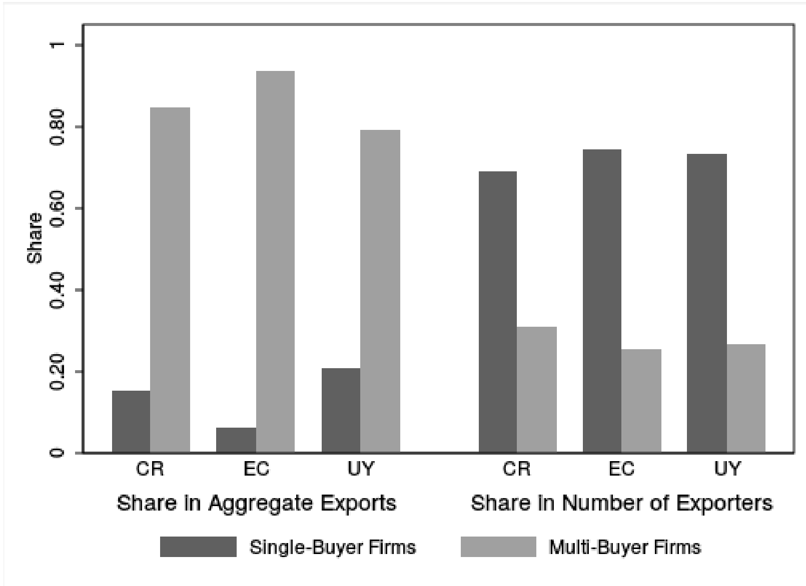
Source: Authors' calculations based on data from PROCOMER, SENAE, and DNA.

Figure 2: : Number of Buyers Distribution - Aggregation



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

Figure 3: : Multi-Buyers and Export and Firms Participation



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

Figure 4: : The Product Space with Taste Heterogeneity

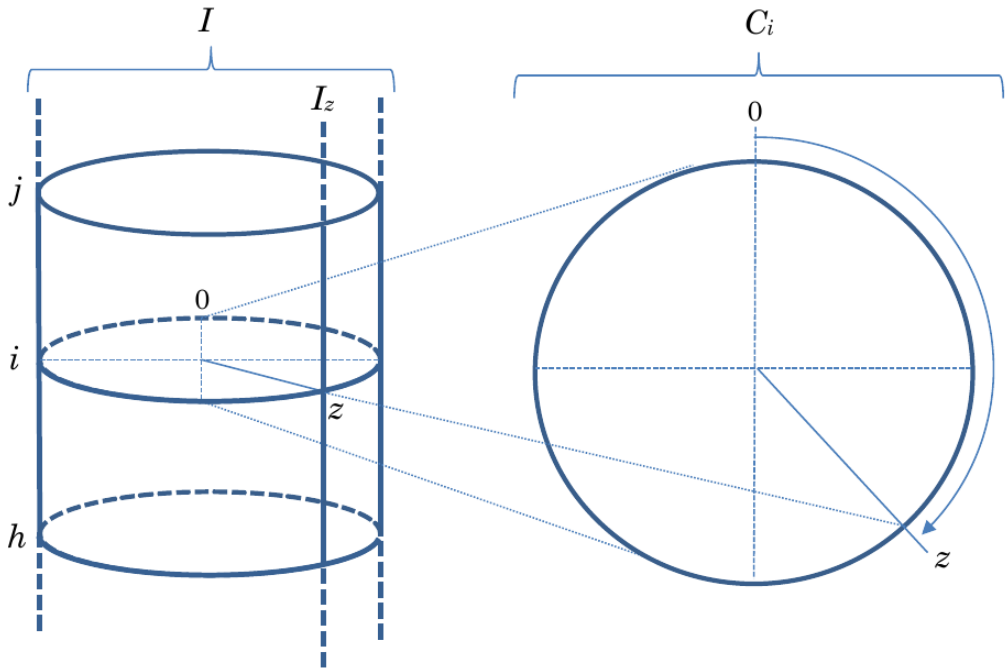
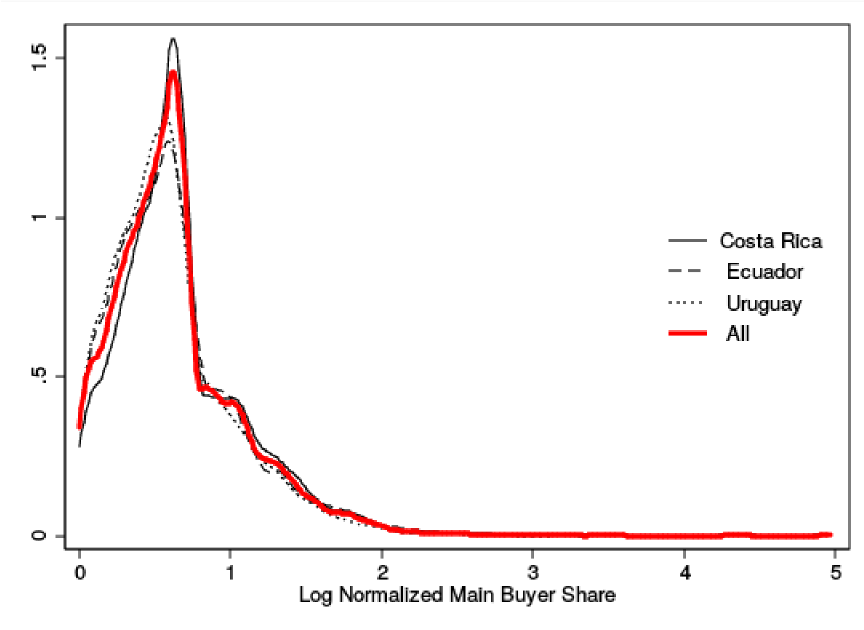


Figure 5: : Distribution of Normalized Main Buyer Share



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

The figure depicts kernel density estimates of the distribution of the normalized main buyer share for firms with more than one buyer in the pooled sample and for each country separatedly in 2005. The kernel used in the estimation is the Epanechnikov kernel and the bandwith is choosen to minimize the mean integrated squared error.

A Appendix

A.1 Buyer Data

The buyers of every single export transaction in our sample countries are recorded in the respective customs export declaration. Since this information is not numerically coded, we proceeed to homogeneize it before computing both the number of buyers and their shares for each firm-destination-product-year combination. In so doing, we first standarized common character strings in the buyer names. Second, we use probabilistic linking of buyers name combined with a clerical review of all matched-pairs and unmatched observations.

A.2 Explanatory Variables

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.
- GDP per capita: GDP PPP per capita in common currency and constant prices from the World Bank's World Development Indicators.
- Contiguity: Binary indicator that takes the value of one if countries share a border and zero otherwise, from CEPII.
- RTA: Binary indicator that takes the value of one if trading countries have a trade agreement and zero otherwise, from CEPII and WTO.
- Freeness of Trade: HS2-country level freeness of trade indicators computed from gravity equation estimates as explained in Mayer et al, 2014, from COMTRADE data. See section A.4 for details.

A.3 Exports Decomposition

The decomposition underlying Table 2 works as follows. Total exports X_{hl} from origin country h to destination country l can be expressed as

$$X_{hl} = N^*_{hl} \times \underbrace{\frac{\sum_{\psi \in \Psi^x_h} G_l(\psi, p)}{N^*_{hl}}}_{Product\,Scope} \times \underbrace{\frac{\sum_{\psi \in \Psi^x_h} G_l(\psi, p, \varphi)}{\sum_{\psi \in \Psi^x_h} G_l(\psi, p)}}_{Buyers\,Scope} \times \underbrace{\frac{X_{hl}}{\sum_{\psi \in \Psi^x_h} G_l(\psi, p, \varphi)}}_{Intensive\,Margin}$$

where N^*_{hl} is the number of firms exporting from h to l; ψ, p and φ are exporter, product and buyer identifiers repectively; Ψ^x_h is the set of exporters from h; $\sum_{\psi \in \Psi^x_h} G_l(\cdot)$ denotes the total number of unique combination of the arguments included in the G_l function. By construction, the buyer scope is

$$BuyScp = \sum_{\psi \in \Psi^x_h} G_l(\psi, p, \varphi) / \sum_{\psi \in \Psi^x_h} G_l(\psi, p) \geq 1$$

and, if all firms have only one buyer per product in destination l, then $BuyScp = 1$.

A.4 Freeness of Trade

To estimate the 'freeness of trade', we follow Mayer et al. (2014). Our model generates a gravity-like relation of bilateral exports with origin and destination countries' characteristics as well as their bilateral freeness

$$X_{hl} = \frac{\Omega\Theta}{2\gamma(k+2)\left(c_M\right)^k} N_{E,h}\rho_{hl}\left(c_{ll}\right)^{k+1} L_l. \tag{29}$$

that holds also within sector. This relation can be brought to data by running sector-by-sector regressions for each year in our sample

$$\ln X_{hl} = FE_h + \ln \rho_{hl} + FE_l + \varepsilon_{hl}$$

where FE_h is an origin fixed effect absorbing origin characteristics, FE_l is a destination fixed effect absorbing destination characteristics, and ε_{hl} is an error term. The bundle $\Omega\Theta/\left[2\gamma(k+2)\left(c_M\right)^k\right]$ is absorbed by the fixed effects. The regression produces an estimated ρ_{hl}, which we use as our estimate of the bilateral 'freeness of trade'.

The market accessibility of country l from country h is then computed as its multilateral trade freeness

$$\widehat{\ln \rho_{hl}} = \ln X_{hl} - \widehat{FE_h} - \widehat{FE_l}$$