Two-sided Heterogeneity and Trade*

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Abstract

This paper explores the relationships between buyers and sellers in international trade using a transaction-level trade dataset from Norway. Domestic exporters as well as foreign importers are explicitly identified in each transaction. The buyer-seller linked data point to the importance of the variation in the dispersion of buyer size for both aggregate and firm-level exports. The paper develops a model of trade with heterogeneous importers as well as heterogeneous exporters. Exporters must pay a fixed cost for each buyer they sell to, limiting the optimal number of buyer matches for each exporter. More productive firms are able to sell to smaller customers, and importers with higher levels of expenditure purchase from less productive exporters. Predictions from the model are tested using the export transaction data. The results confirm the importance of importer heterogeneity across destinations in determining the trade elasticity.

Keywords: Heterogeneous firms, exporters, importers.
JEL codes: F10, F12, F14.

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1 Introduction

The importance of exporter heterogeneity for both aggregate and firm-level outcomes is well-established. More recently, researchers have found comparable variation in size and performance across importers.[1] However, there has been far less work on the interaction of exporter and importer heterogeneity and the consequences for firm and aggregate exports.[2] This paper makes use of a novel dataset that links all Norwegian export transactions with importers in every market. We establish a set of stylized facts about sellers and buyers and develop a simple theoretical model with two-sided heterogeneity, specifically exporters with heterogeneous productivity and importers with heterogeneous demand. The model is able to match many of the stylized facts and generates additional testable implications about the response of exports to changes in foreign demand. We find that buyer-side heterogeneity plays an important role in the variation of exports across sellers and in the response to aggregate shocks.

We make use of unique data on Norwegian export transaction data from 2005-2010. For each trade transaction, the identities of both the exporter and the importer are available. For the first time, we can link a firm's export transactions to specific firms in every destination country and, at the same time, examine all of an importer's transactions with Norwegian firms. In Table 1, we see that there is substantial heterogeneity across importers and exporters in individual markets. The log of the ratio of the largest to the median buyer averages 8.4 in OECD countries and 4.6 in non-OECD destinations[3], while the top 10 percent of importers routinely account for more than 90 percent of the imports of Norwegian products. Similarly, the log of the ratio of the largest to the median exporter averages 8.7 in OECD countries and 4.6 in non-OECD destinations,[4] while the top 10 percent of exporters account for more as much as 97 percent of Norwegian exports to each market. While importer heterogeneity exists in every destination, there is substantial variation across markets as well in terms of both the number of buyers and the variation across buyers. The U.S. has high variation across buyers of Norwegian products while China has a more compressed distribution.

We also examine the importer-exporter relationship across exporters of different sizes. Larger sellers reach more customers and have more dispersion in sales across buyers. In addition, there is negative assortativity among seller-buyer pairs. The larger is an exporter, the smaller is its average buyer in terms of seller contacts.

We develop a framework to match these stylized facts about buyers and sellers and to study

[1] See Bernard, Jensen, and Schott (2009).

[2] Exceptions are Blum, Claro, and Horstmann (2011) and Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) who examine exporter-importer pairs for individual pairs of countries.

[3] The largest buyer is more than 4000 (99) times bigger than the median buyer in OECD (non-OECD) countries.

[4] The largest exporter is more than 6000 (99) times bigger than the median exporter in OECD (non-OECD) countries.

the interaction of seller and buyer heterogeneity and the variation across countries by extending a straightforward heterogeneous exporter framework with horizontally differentiated products. Exporters have heterogeneous productivity and must pay a fixed cost to match with each buyer in each foreign market. Buyers themselves have heterogeneous expenditures whose dispersion varies across countries. Due to the presence of the buyer-specific fixed cost, not every exporter will sell to every buyer in a market. More productive firms will be able to profitably sell to smaller customers and importers with higher levels of expenditure will purchase from less productive exporters.

The model generates testable implications within and across destination markets. Higher fixed costs lead to fewer buyers per firm and lower exports. Holding a source country fixed, an increase in the number of destination country buyers leads to more buyers per exporter and higher sales per firm. The firm-level trade elasticity with respect to trade costs depends on the dispersion of both seller productivity and buyer expenditures, while the trade elasticity with respect to income depends on buyer dispersion exclusively. Furthermore, we get the intriguing result that the firm size distribution (e.g., export sales) is not informative of the productivity distribution in the economy. Rather, firm size distribution is determined by the distribution of buyers. *More* dispersion among importers gives *less* revenue dispersion among exporting firms. Our intuition for this result is that if dispersion among buyers is high, implying that there are many large buyers, then even small and low productivity firms will sell to them, thus compressing the distribution of exports.

We test the model using the panel matched trade transaction data from Norway and find confirmation for many of the model's predictions. Looking within firms and controlling for aggregate shocks, we find that a positive demand shock in a market increases exports, the number of buyers and exports to the largest buyer. As predicted by the model, exports to the marginal buyer are unchanged as they are pinned down by the fixed match cost. While the identity of the marginal buyer changes due to the shock, the purchases of the marginal buyer remain the same. More importantly, the responses vary systematically across markets depending on the dispersion of buyers. The demand shock elasticity is greater in markets with lower buyer heterogeneity. An implication of our work is therefore that the response of trade flows to trade liberalization may depend on demand side characteristics, which may differ both across regions and over time.

Relation to the Literature

This paper is related to several new streams of research on firms in international trade. Importing firms have been the subject of new work documenting their performance and characteristics. Bernard, Jensen, and Schott (2009), Castellani, Serti, and Tomasi (2010) and Muuls and Pisu (2009) show that the heterogeneity of importing firms rivals that of exporters for the US, Italy and Belgium respectively. Amiti and Konings (2007), Halpern, Koren, and Szeidl (2011) and Bøler, Moxnes and Ulltveit-Moe (2012) relate the importing activity of manufacturing firms to increases in productivity.

Papers by Rauch (1999), Rauch and Watson (2004), Antràs and Costinot (2011) and Petropoulou (2011) consider exporter-importer linkages. These papers adopt a search and matching approach to linking importers and exporters while in this paper we abstract from the micro-foundations of the bilateral exporter-importer trade cost to focus on the implications of buyer heterogeneity for firm and aggregate flows. Chaney (forthcoming) also has a search-based model of trade where firms must match with a contact in order to export to a destination.

Our work is also related to the literature on exports and heterogeneous trade costs initiated by Arkolakis (2009, 2010). In these papers, the exporter faces a rising marginal cost of reaching additional (homogeneous) customers. In our framework, buyers themselves are heterogeneous in their expenditures, but in equilibrium exporting firms face rising costs per unit of exports as they reach smaller importers.

Our paper is most closely related to the nascent literature using matched importer-exporter data. Blum, Claro, and Horstmann (2011) and Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) match individual trade transactions to specific importers and exporters. Blum, Claro, and Horstmann (2011) examine characteristics of trade transactions for the exporter-importer pairs of Chile-Colombia and Argentina-Chile while Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) consider Colombian exports to the United States. Blum, Claro, and Horstmann (2011) find, as we do, that small exporters typically sell to large importers and small importers buy from large exporters. Their focus is on the role of import intermediaries in linking small exporters and small customers. Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) develop a model of search and learning to explain the dynamic pattern of entry and survival by Colombian exporters and to differentiate between the costs of finding new buyers and to maintaining relationships with existing ones. In contrast to those papers, we focus on the role of importer heterogeneity across destinations and its implications for trade.

2 Data

The data employed in this paper are generated from Norwegian transaction-level customs data from 2005-2010. The data have the usual features of transaction-level trade data in that it is possible to create annual flows of exports by product, destination and year for all Norwegian exporters. However, in addition, this data has information on the identity of the buyer for every transaction in every destination market. Special care has been taken to link transactions not only across exporters but also across buyers. As a result we are able to see exports of each seller at the level of the buyer-product-destination-year. Our data include the universe of Norwegian merchandise exports, and we observe export value and quantity. In 2005 total Norwegian merchandise exports amounted to USD 41 billions, equal to around 18 percent of Mainland Norway GDP.[5] Exports were undertaken by 18,023 sellers, who sold 5,154 products to 68,052 buyers across 205 destinations.

3 Buyer Margin of Trade

In this section we begin to explore the matched exporter-importer data. We first decompose exports to a country into intensive and extensive margins where we extend the usual extensive margins of firms, i.e. sellers, and products to include the number of buyers. We then consider the customer margin response to the standard gravity variables of distance to, and GDP, of the destination market. Next we examine the margins of trade within the firm.

3.1 Market level

To examine the role of buyers in the variation of exports across countries, we decompose total exports to country j, x_j, into the product of the number of trading firms, f, the number of traded products, p, the number of buyers, b, the density of trade, d, i.e. the fraction of all possible firm-product-buyer combinations for country j for which trade is positive, and the average value of trade, $\bar{x}$. Hence,

$$x_j = f_j p_j b_j d_j \bar{x}_j$$

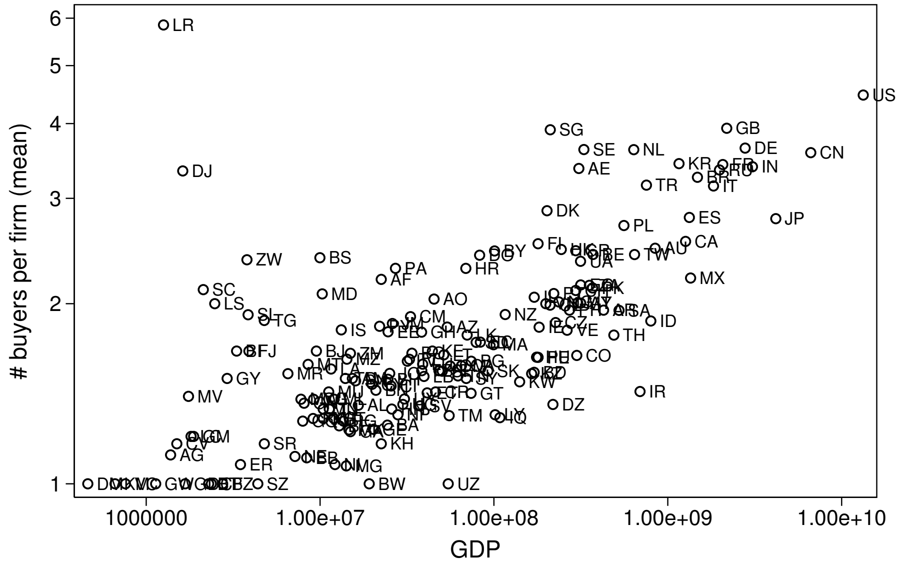
where $d_j = o_j/(f_j p_j b_j)$, o_j is the number of firm-product-buyer observations for which trade with country j is positive and $\bar{x_j} = x_j/o_j$, the intensive margin, is average value per observation with positive trade. In order to decompose the impact of the different margins of trade on total exports, we regress the logarithm of each component of country-level exports on the logarithm of total exports to a given market in 2006, e.g. lnf_j, against lnx_j. Given that OLS is a linear estimator and its residuals have an expected value of zero, the coefficients for each set of regressions sum to unity, with each coefficient representing the share of overall variation in trade explained by the respective margin.

The results, shown in Table 2, confirm and extend previous findings on the importance of the extensive and intensive margins of trade. The sum of the four extensive margins, firms, products, buyers and density, accounts for two thirds of the variation in Norwegian exports across countries. While it has been shown in a variety of contexts that the number of firms and products increases as total exports to a destination increase, these results show the equal importance of the number of importing buyers in total exports. In fact, the buyer margin is as large or larger than the firm or product margins.

It is well documented that the total value of exports, the number of exporting firms and the number of exported products are all systematically related to market characteristics. Figure 1 plots

[5]Mainland Norway GDP refers to national GDP excluding the oil and gas sector.

Figure 1: Average numbers of buyers per seller versus market size.



Note: 2006 data, log scales. GDP in \$1000 from Penn World Table 7.1 (cgdp×pop).

the the average number of customers per firm against destination market GDP. The larger is the market size, the greater is the number of buyers for each Norwegian exporter. We examine how this new extensive margin of trade responds to distance to markets and market size (measured by GDP), by estimating the following gravity model,

$$y_j = \beta_0 + \beta_1 \ln GDP_j + \beta_2 \ln Dist_j + \epsilon_j$$

where y_j is either total exports, number of firms exporting to a market (sellers), number of buyers of Norwegian exports in the market, average number of buyers per seller, and average exports to each buyer (all in logs).

Total exports, number of firms exporting to a market (sellers) as well as number of buyers in a market (buyers) are all significantly negatively related to distance and positively associated with market size, as shown in Table 3. Moreover, the number of buyers per seller and average exports per buyer are significantly negatively associated with distance and positively associated with GDP.

3.2 Firm level

Having considered the role of buyers in aggregate exports, we now turn to the firm level. Exports of firm m to country j can be decomposed

$$x_{mj} = p_{mj} b_{mj} d_{mj} \bar{x}_{mj}$$

where $d_{mj} = o_{mj}/(p_{mj}b_{mj})$, o_{mj} is the number of product-buyer observations for which trade with country j is positive and $\bar{x}_{mj} = x_{mj}/o_{mj}$. In order to decompose the impact of the various margins of trade on firms' total exports to a market, we proceed as we did with the aggregate exports, and regress the log of each of the components of firm level exports on the log of total firm exports, while also including firm and country fixed effects. We do this for a given year, here chosen to be 2006, and the results are reported in Table 4. The findings are in line with previous results on the importance of the extensive and intensive margins of trade within firms. Decomposing firm-level exports, the number of buyers is positively and significantly associated with firm-country exports even after including country and firm fixed effects. The buyer margin is equal in magnitude to the product margin of firm-level trade that has been the subject of a large new round of both theoretical and empirical research. The extensive margins of products and buyers together account for one third of the variation in Norwegian exports across countries within the firm.

We next consider a simple gravity model at the firm-country level to examine how the number of customers and average exports per customer for the firm respond to distance and GDP,

$$y_{mj} = \alpha_m + \beta_1 \ln Dist_j + \beta_2 \ln GDP_j + \epsilon_{mj}$$

where y_{mj} is either export value for firm m to destination j, or the number of buyers per firm, or average export value per firm-buyer, all in logs.

The results in Table 5 show that both the number of customers and average exports per customer are significantly related to all the gravity variables in the expected direction. The number of buyers responds more to distance than average exports per buyer. The magnitude on the other gravity variables is comparable for the extensive and intensive margins.

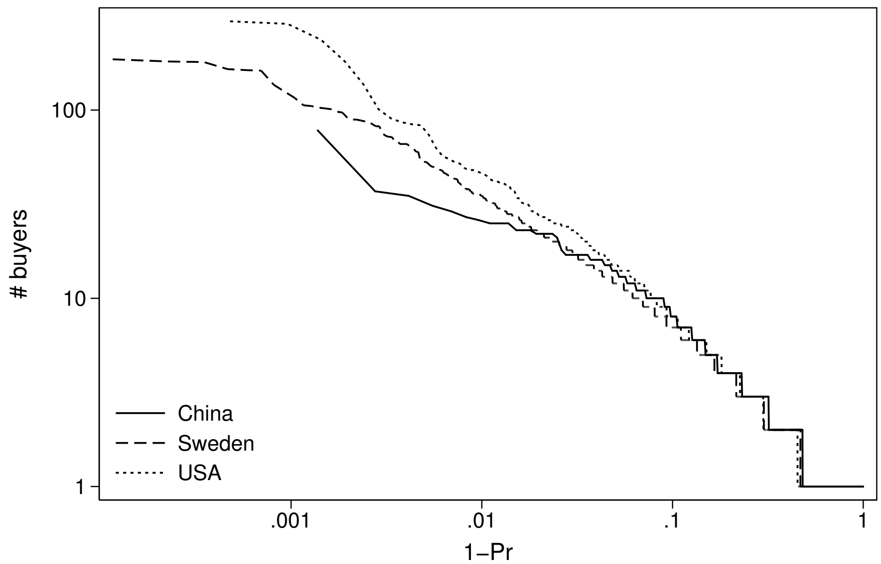
4 Exporters and Importers

While the prior results establish the relevance of the buyer dimension as a margin of trade, we develop a model of international trade to more formally examine the role of buyer-seller relationships in trade flows. Before presenting the model, we document a set of facts on the heterogeneity of buyers and sellers and their relationships, which will guide our theory and subsequent empirical specification.

Fact 1: The populations of sellers and buyers of Norwegian exports are both characterized by extreme concentration. The top 10 percent sellers account for 98 percent of Norwegian aggregate exports. At the same time, the top 10 percent buyers are almost as dominant, and account for 96 percent of the purchase of Norwegian exports.

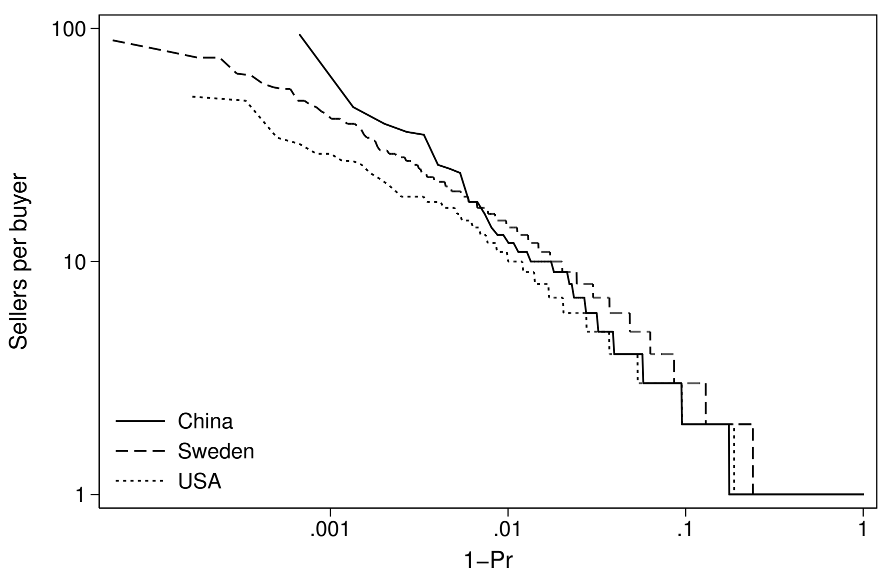
Fact 2: The distributions of buyers per firm and exporters per buyer are approximately Pareto. Figure 2 shows that the inverse cumulative distribution functions (CDF) of buyers per firm for

Figure 2: Inverse CDF for the number of buyers per firm.



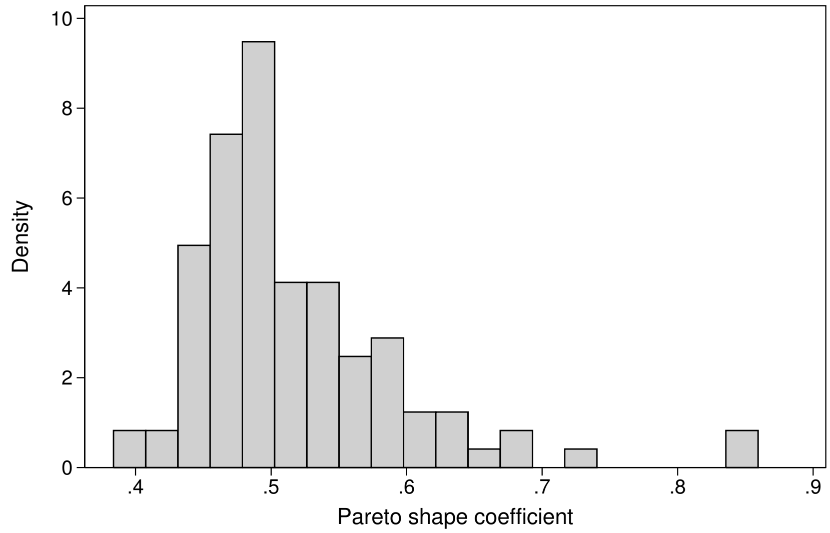
Note: 2006 data, log scales. Horizontal axis is Pr(# buyers > x). The estimated regression slopes for China, Sweden and the U.S. are -0.88 (s.e. 0.008), -0.87 (s.e. 0.002) and -0.95 (s.e. 0.004) respectively.

Figure 3: Inverse CDF for the number of firms per buyer.



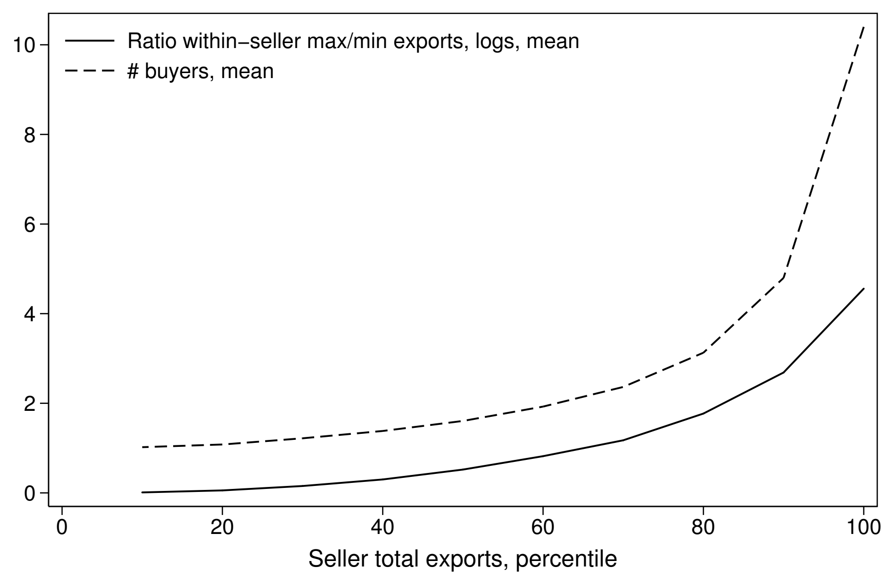
Note: 2006 data, log scales. Horizontal axis is Pr(# firms > x). The estimated regression slopes for China, Sweden and the U.S. are -0.49 (s.e. 0.006), -0.57 (s.e. 0.002) and -0.46 (s.e. 0.003) respectively.

Figure 4: Heterogeneity of importer expenditure across markets.



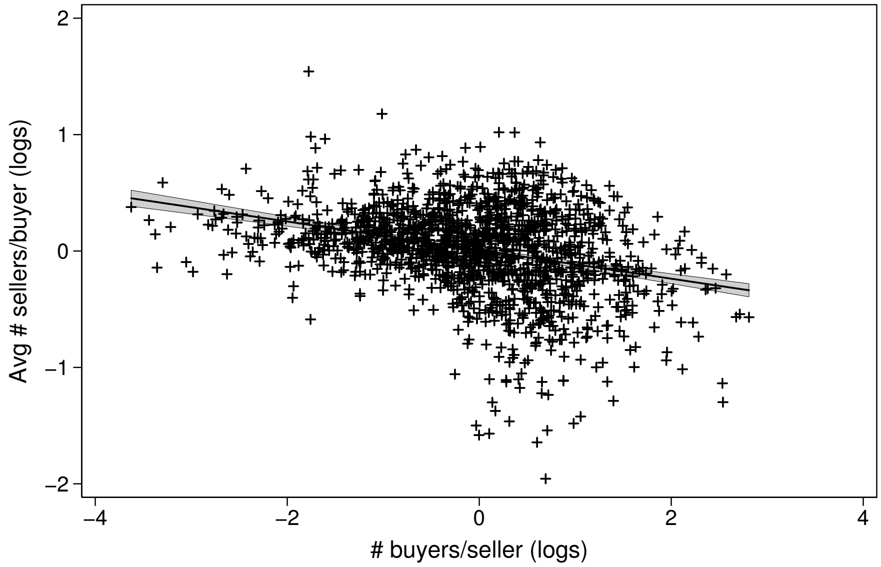
Note: 2006 data. The figure shows the density of Pareto shape coefficient, based onbuyer expenditure of Norwegian exports in different markets. The shape coefficients are computed by regressing the empirical inverse cumulative distribution function on buyer expenditure, both in logs, for each country; the resulting slope coefficient is (the negative of) the Pareto slope coefficient. Only markets with more than 50 buyers are included.

Figure 5: Number of buyers & buyer dispersion per exporter.



Note: 2006 data. The figure shows the # buyers and log(max/min) ratio for a given firm-destination combination, and then averaged across all firm-destinations within a percentile range (0-10, 11-20, etc). The percentiles are referring to firm-destination level exports. The max/min ratio is the maximum relative to the minimum export value, for a given firm-destination.

Figure 6: Matching buyers and sellers across markets.



Note: 2006 data. The figure shows all possible values of the number of buyers per Norwegian firm in a given market, a_j, on the x-axis, and the average number of Norwegian connections among these buyers, $b_j(a_j)$, on the y-axis. Both variables are in logs and demeaned, i.e. we show $\ln b_j(a_j) - \ln \bar{b}_j(a_j)$, where $\bar{b}_j(a_j)$ is the average number of Norwegian connections among all buyers in market j. The fitted regression line and 95% confidence intervals are denoted by the solid line and gray area. The slope coefficient is -0.13 (s.e. 0.009).

exporters serving the Chinese, Swedish and the US market are approximately Pareto.[6] The average number of buyers per seller is higher in the US market, 4.5, than in either the Chinese or the Swediosh markets, where there are only 3.6 buyers per exporter (Table 1). Figure 3 shows the distribution of sellers per buyer for the same export markets. Again the distributions are approximately Pareto. The average number of sellers per buyer in China, Sweden and the US is 1.7, 1.9 and 1.6, respectively.

Fact 3: Dispersion of importer expenditure varies across countries. While the distributions of importer expenditure is approximately Pareto in every country, there is substantial heterogeneity across countries. Figure 4 shows the density of Pareto shape coefficients across countries, where the shape coefficients are calculated based on the buyer expenditure (of Norwegian exports) distribution in each country. The median shape parameter is 0.44, and the standard deviation is 0.06.[7]

Fact 4: Larger sellers reach more customers and have more dispersion in across-buyer exports. Figure 5 shows that the more a firm exports, the more buyers it reaches. The difference in exports to the smallest and the largest buyers is much greater for larger exporters.

[6] We have chosen Sweden and the US as they are among the main destinations of Norwegian exports. While China is not (yet) a major export market for Norwegian firms, the growth in exports to the Chinese market surpassed most other destinations during the last decade.

[7] Only markets with more than 50 buyers are included. This amounts to 102 export destinations and 97 percent of Norwegian exports.

Fact 5: There is negative assortative matching among sellers and buyers. We characterize sellers according to their number of buyers, and buyers according to the number of sellers they purchase from. We find that the larger a seller, the smaller its average buyer in terms of seller contacts. Figure 6 provides an overview of seller-buyer relationships. The figure shows all possible values of the number of buyers per Norwegian firm in a given market, a_j, on the x-axis, and the average number of Norwegian connections among these buyers, $b_j(a_j)$, on the y-axis. Both variables are in logs and demeaned.[8] A point with the coordinates, (0.2,-0.2), means that among the customers of exporters with 20% more customers than average, their average number of Norwegian connections is 20% smaller than average. The fitted regression line is -0.13, so a 10 percent increase in number of customers is associated with a 1.3 percent decline in average connections among the customers.[9] Interestingly, social networks typically feature positive assortative matching, that is, highly connected notes tend to attach to other highly connected nodes, while negative correlations are usually found in technical networks such as servers on the Internet (Jackson and Rogers, 2007).[10]

5 The Model

5.1 Basic Setup

In this section, we develop a trade model with networks of heterogeneous sellers and buyers. As in Melitz (2003), firms (sellers) within narrowly defined industries produce with different efficiencies.[11] We think of these firms as producers of intermediates as in e.g. Ethier (1979). Departing from Melitz (2003), we assume that intermediates are purchased by *final goods producers* (buyers), who bundles inputs into final goods that in turn are sold to consumers. Final goods producers also produce with different efficiencies, giving rise to heterogeneity in their firm size, as well as a sorting pattern between sellers and buyers in equilibrium. The key ingredient in our model is heterogeneity in size both among sellers and buyers. We formally model this as two-sided heterogeneity in productivity, but size heterogeneity could potentially arise from other sources, e.g. differences in endowments among buyers and differences in quality among sellers. The significant testable implications from such alternative models would be identical to the current model.

We let the model be guided by the descriptive evidence and stylized facts on sellers and buyers and their relationship as presented above. In particular, buyer and seller productivities are Pareto

[8] I.e. we show $\ln b_j(a_j) - \ln \bar{b}_j(a_j)$, where $\ln \bar{b}_j(a_j)$ is the average number of Norwegian connections among all buyers in j.

[9] Using the median number of connections instead of the average number of connections as the dependent variable also generates a significant and negative slope coefficient. In appendix F, we show that the elasticity is informative of a structural parameter of the model.

[10] In the friendship network among prison inmates considered by Jackson and Rogers (2007), the correlation between a node's in-degree and the average in-degree of its neighbors is 0.58. The correlation in our data is -0.31. Serrano and Boguna (2003) find evidence of negative sorting in the network of trading *countries*; i.e. highly connected countries, in terms of trading partners, tend to attach to less connected countries.

[11] Or, unit costs are homogeneous but quality is heterogeneous. The two interpretations of the model are isomorphic.

distributed, which will give rise to high levels of concentration in trade, both on the supply and demand side, as well as Pareto distributed degree distributions (number of customers per firm and number of firms per customer), consistent with Facts 1 and 2. Due to the presence of a buyer-seller match specific fixed cost, buyers are more likely to connect to larger exporters, as larger exporters are more efficient and/or produce higher quality goods, consistent with Fact 4. This in turn leads to negative sorting, so that well-connected exporters on average connect to customers that are less connected, consistent with Fact 5.

Each country i is endowed with L_i total hours worked, and the labor market is characterized by perfect competition, so that hourly wages are identical across workers. In each country there are three sectors of production: a homogeneous good sector characterized by perfect competition, and a traded intermediate good sector and a non-traded final goods sector, both characterized by monopolistic competition. Workers are employed in the production of the homogenous good as well as the production of the intermediates.[12] As is common in the literature, we assume that the homogeneous good is freely traded, produced under constant returns to scale with one hour of labor producing w_i units of the homogeneous good. Normalizing the price of this good to 1 sets the wage rate in country i to w_i.

Consumers. Buyers derive utility from consumption of a homogeneous good and a continuum of differentiated final goods. Specifically, upper level utility is Cobb-Douglas between the homogeneous good and differentiated good with a differentiated good expenditure share μ, and lower level utility is CES across differentiated final goods with an elasticity of substitution $\sigma > 1$.

Intermediates. Intermediates are produced under constant returns to scale using only labor, by a continuum of firms, each producing one variety of the differentiated input. Firms are heterogeneous in productivity z, and firms' productivity is a random draw from a Pareto distribution with support $[1, \infty]$ and shape parameter $\gamma_s > \sigma - 1$, so that $F(z) = 1 - z^{-\gamma_s}$.[13]

Final goods producers. Final goods are produced by a continuum of firms, each producing one variety of the final good. Their production technology is CES over all intermediate inputs available to them,

$$\tilde{z}(\upsilon) \left(\int_{\Omega_j(\upsilon)} q(\omega)^{(\sigma-1)/\sigma} \, d\omega \right)^{\sigma/(\sigma-1)},$$

where productivity for distributor υ is denoted by $\tilde{z}(\upsilon)$, which is drawn from a distribution $\tilde{G}(\tilde{z})$, $q(\omega)$ is purchases of intermediate variety ω and $\Omega_j(\upsilon)$ is the set of varieties available for distributor υ in country j (to be determined). To save on notation, the elasticity of substitution among intermediates is identical to the elasticity of substitution among final goods, both denoted by $\sigma > 1$.

[12] Adding workers to the final goods sector would only add more complexity to the model, without generating new insights.

[13] As is well known, the Pareto distribution is a good approximation of the U.S. firm size distribution (Luttmer (2007)Axtell (2001)) although the results here raise the question of whether this is due to underlying the productivity distribution or the expenditure distribution of buyers.

Differences in productivity $\tilde{z}$ give rise to differences in total spending on intermediates, which we denote by E. To show key relationships in the model as cleanly as possible, we often express them in terms of E instead of $\tilde{z}$. The relationship between them is derived in Appendix Section C.

Relationship specific investments. Intermediate producers sell to an endogenous measure of final goods producers, and they incur a match-specific fixed cost for each buyer they choose to sell to. Hence, meeting buyers and setting up supplier contracts are associated with a cost that is not proportional to the value of the buyer-seller transaction. These costs may typically be related to the search for suppliers, bureaucratic procedures, contract agreements and costs assoricated with sellers customizing their output to the requirements of particular buyers.[14] Formally, we model this as a match specific fixed cost f_{ij}, paid in terms of labor from the home country, which may vary according to seller country i and buyer country j.

There is an exogenous measure of *potential* buyers and sellers, N_{bj} and N_{sj}, in each market j. As there is no free entry, the production of intermediates and final goods leaves a rent, and for simplicity we follow Chaney (2008) and assume that consumers in each country derive income not only from labor, but also receive dividends from a global mutual fund. Consumers own w_i shares of the fund, and profits are redistributed to them in units of the nuḿeraire good. Total worker income Y_i is then $w_i\left(1+\pi\right)L_i$, where π the dividend per share of the global mutual fund.

Variable trade barriers. Intermediates are traded internationally, and firms face a standard iceberg trade costs $\tau_{ij}\geq 1$, so that τ_{ij} must be shipped from country i in order for one unit to arrive in country j.[15]

Sorting functions. Due to the presence of the match-specific fixed cost, a given seller in i will find it optimal to export only to buyers in j with total expenditure on intermediates, E, higher than a lower bound $\underline{E}_{ij}$. Hence, we introduce the equilibrium sorting function $\underline{E}_{ij}\left(z\right)$, which is the lowest possible expenditure level a firm in i with productivity z is willing to sell to. We solve for $\underline{E}_{ij}\left(z\right)$ in Section 5.2. Symmetrically, we define $\underline{z}_{ij}\left(E\right)$ as the lowest efficiency seller a buyer with expenditure E can buy from. By construction, $\underline{z}_{ij}\left(E\right)$ is the inverse of $\underline{E}_{ij}\left(z\right)$, i.e. $E=\underline{E}_{ij}\left(\underline{z}_{ij}\left(E\right)\right)$.

Pricing. As intermediates and final goods markets are characterized by monopolistic competition, prices are a constant mark-up over marginal costs. For intermediate producers, this yields a pricing rule $p_{ij}=\overline{m}\tau_{ij}w_i/z$, where $\overline{m}\equiv\sigma/\left(\sigma-1\right)$ is the mark-up.[16] For final goods, the pricing rule becomes $\tilde{p}_j=\overline{m}P_j\left(E\right)/\tilde{z}\left(E\right)$, where $P_j(E)$ is the ideal price index for intermediate inputs facing a distributor with expenditure E in market j (defined below). Note that the restriction of identical

[14] Kang and Tan (2009) provide examples of such relationship-specific investments and analyze under what circumstances firms are more likely to make these types of investments. For example, a newly adopted just-in-time (JIT) business model by Dell required that its suppliers prepare at least three months buffering in stock. However, Dell did not offer any guarantee on purchasing volumes due to high uncertainty in final product markets.

[15] We normalize $\tau_{ii}=1$ and impose the common triangular inequality, $\tau_{ik}\leq\tau_{ij}\tau_{jk}\ \forall\ i,j,k$.

[16] Due to constant returns to scale in production, the optimization problem of the firm of finding the optimal price and the measure of buyers to match to, simplifies to standard constant mark-up pricing, and a separate problem of finding the optimal measure of buyers.

elasticities of substitution across final and intermediate goods also implies that the mark-up $\bar{m}$ is the same in both markets.

Demand for intermediates. Given the production function of final goods producers specified above, and conditional on a match (z, E), firm-level intermediate exports from country i to j are

$$r_{ij}(z,E) = \left(\frac{p_{ij}(z)}{P_j(E)}\right)^{1-\sigma} E. \tag{1}$$

Using the Pareto assumption for seller productivity z, the price index can be written as

$$P_j(E)^{1-\sigma} = \frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\bar{m}\tau_{kj}w_k\right)^{1-\sigma} \underline{z}_{kj}(E)^{-\gamma_2}, \tag{2}$$

where $\gamma_2 \equiv \gamma_s - (\sigma - 1)$.

5.2 Equilibrium Sorting

Located in country i, and selling to market, j, an intermediate firm's net profits from a (z, E) match is $\pi_{ij}(z,E) = r_{ij}(z,E)/\sigma - f_{ij}$. Given the optimal price from Section 5.1, the problem of the firm is to determine the optimal measure of buyers to match to. This is equivalent to finding $\underline{E}_{ij}(z)$, the lowest expenditure buyer a firm with productivity z is willing to sell to. Hence, we find $\underline{E}_{ij}(z)$ by solving for $\pi_{ij}(z,E) = 0$. Inserting the demand equation (1) and a firm's optimal price, we can express $\underline{E}$ implicitly as

$$P_j(\underline{E})^{\sigma-1}\,\underline{E} = \sigma f_{ij}\left(\bar{m}\tau_{ij}w_i\right)^{\sigma-1} z^{1-\sigma}. \tag{3}$$

As the price index is also a function of $\underline{z}_{ij}(E)$, it is not straightforward to calculate equilibrium sorting. In the appendix, we show that the solution is:

$$\underline{z}_{ij}(E) = f_{ij}^{1/(\sigma-1)}\tau_{ij}w_i\Omega_j E^{-1/\gamma_s} \tag{4}$$

$$\underline{E}_{ij}(z) = f_{ij}^{\gamma_s/(\sigma-1)}\left(\tau_{ij}w_i\Omega_j\right)^{\gamma_s} z^{-\gamma_s}, \tag{5}$$

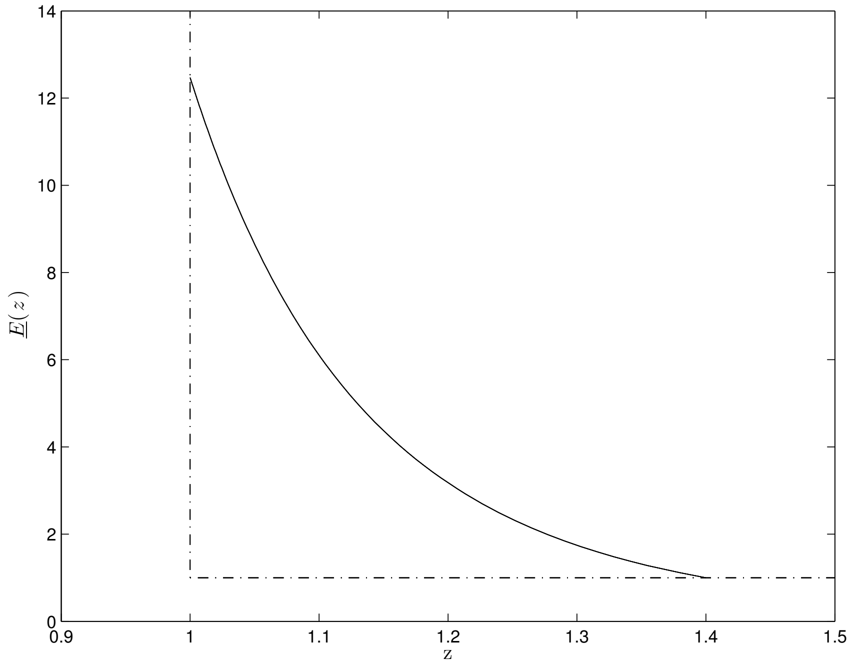
where

$$\Omega_j = \left(\sigma\frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{-\gamma_s} f_{kj}^{-\gamma_2/(\sigma-1)}\right)^{1/\gamma_s}. \tag{6}$$

We plot the matching function $\underline{E}_{ij}(z)$ in Figure 7. $\underline{E}_{ij}(z)$ is, not surprisingly, downward sloping in z, so that more efficient firms match with lower expenditure buyers, on the margin. A firm with efficiency z matches with lower expenditure buyers whenever variable or fixed trade costs (τ_{ij} and f_{ij}) are lower. Moreover, a firm also matches with lower expenditure buyers when trade costs from 3rd countries to j are higher (via Ω_j). Hence, Ω_j has a similar interpretation as the multilateral resistance variable in Anderson and van Wincoop (2004).

The slope of the matching function is determined by the degree of seller heterogeneity, γ_s, so a one percent increase in expenditure E leads to a weaker percent decline in the hurdle $\underline{z}_{ij}(E)$ when

Figure 7: Matching function.



heterogeneity is low, i.e. γ_s is high. This occurs as higher E enables buyers to meet more firms, and the number of new connections is increasing in γ_s (the heterogeneity effect).[17] More suppliers lead to a lower price index, and therefore the decline in the price index is also stronger when γ_s is high (the price index effect). This in turn means that $\underline{z}_{ij}(E)$ declines by less when γ_s is high, as the price index effect deters matches from taking place.[18]

5.3 Trade

Up to this point, we have not specified the distribution of final goods productivity $\tilde{G}(\tilde{z})$ nor the distribution of final goods expenditure, which we denote $G_i(E)$. In Appendix C, we show that if $\tilde{G}(z)$ is Pareto, then $G_i(E)$ is also Pareto, $G_i(E) = 1 - (E_{Li}/E)^{\gamma_b}$ with $\gamma_b > (\sigma - 1)/\gamma_s$.[19] The location parameter E_{Li} determines the minimum (and average) expenditure of buyers in the economy, while γ_b determines dispersion of buyer expenditure.

Because the lower support of our productivity and expenditure distributions is 1 and E_{Li} respectively, no firm (intermediate producer) can ever reach buyers (final goods producers) with expenditure lower than E_{Li}, and no buyer can ever match with firms with productivity less than 1. This is indicated by the dotted lines in Figure 7. An implication is that we have two types

[17]The measure of suppliers for a buyer with expenditure E is $L_{ij}(E) = N_{si}\int_{\underline{z}_{ij}(E)} dF(z) = N_{si}\underline{z}_{ij}(E)^{-\gamma_s}$, so the absolute value of the elasticity of L with respect to $\underline{z}_{ij}$ is increasing in γ_s.

[18]The price index effect cancels out with the heterogeneity effect, so that in sum, the elasticity of the measure of suppliers per buyer with respect to expenditure E is invariant to γ_s, see appendix.

[19]We need this restriction to ensure that firm-level export value is finite.

of buyers and sellers in our economy: (i) Sellers (buyers) that match with a subset of the buyers (sellers), and (ii) sellers (buyers) that match with every buyer (seller). Case (i) is characterized by $\underline{z}_{ij}(E) > 1$ and $\underline{E}_{ij}(z) > E_{Lj}$, or, equivalently, $E < f_{ij}^{\gamma_s/(\sigma-1)}(\tau_{ij}w_i\Omega_j)^{\gamma_s} \equiv \bar{E}_{ij}$ and $z < E_{Lj}^{-1/\gamma_s} f_{ij}^{1/(\sigma-1)} \tau_{ij}w_i\Omega_j \equiv \bar{z}_{ij}$, while case (ii) is characterized by $E \geq \bar{E}_{ij}$ and $z \geq \bar{z}_{ij}$. In words, very productive firms (with $z \geq \bar{z}_{ij}$) will meet even the smallest buyers in the market, so that changes in trade costs will not affect the set of buyers they are matched to. In our dataset, no exporter is selling to every buyer, and no customer is buying from every exporter. We therefore choose to focus on the more interesting case of type (i) buyers and sellers in the remaining part of this section.[20] In appendix Section E, we also show that for plausible parameter values, $\bar{z}_{ij}$ and $\overline{E}_{ij}$ are far in the right tail in the productivity and expenditure distributions, so that they have a negligible impact on firm-level and aggregate outcomes. In the remainder of the paper, we therefore proceed by setting $\bar{E}_{ij} \to \infty$ and $\bar{z}_{ij} \to \infty$.

Firm-level trade. Firm-level intermediate exports from country i to j, for a firm with productivity z, is $R_{ij}(z) = N_{bj}\int_{\underline{E}_{ij}(z)} r_{ij}(z,E)\,dG_j(E)$, where N_{bj} is the measure of buyers in country j. In the appendix, we show that exports for a type (i) firm ($z < \bar{z}_{ij}$) are

$$R_{ij}(z) \quad = \quad \kappa_1 N_{bj} f_{ij}^{1-\gamma_b\gamma_s/(\sigma-1)} E_{Lj}^{\gamma_b}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b}, \tag{7}$$

where κ_1 is a constant.[21] Finally, we can derive the optimal number of buyers in a similar fashion, which yields

$$B_{ij}(z) = N_{bj} f_{ij}^{-\gamma_b\gamma_s/(\sigma-1)} E_{Lj}^{\gamma_b}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b}. \tag{8}$$

We emphasize two properties of these expressions. First, the elasticity of exports (and the number of buyers) with respect to variable trade barriers is $\gamma_s\gamma_b$, so that the degree of both buyer and seller heterogeneity matters for the elasticity. In a standard model with no buyer heterogeneity, this elasticity is only related to the elasticity of substitution $(\sigma-1)$. Second, the elasticity of exports (and the number of buyers) with respect to expenditure in the destination market, E_{Lj}, is γ_b, whereas in a model with no buyer heterogeneity the elasticity is 1.[22] The intuition is that in markets with low heterogeneity (high γ_b), a positive shift in expenditure gives many new buyers, as more buyers are initially below $\underline{E}_{ij}(z)$ threshold, leading to a large increase in exports (and the number of buyers). We summarize this in the following proposition.

Proposition 1. *The firm-level elasticity of exports with respect to variable trade costs is $\gamma_s\gamma_b$, and the firm-level elasticity of exports with respect to destination country expenditure is γ_b.*

[20] We derive expressions for type (ii) firms in the appendix.

[21] $\kappa_1 = \frac{\gamma_b\sigma}{\gamma_2/\gamma_s+\gamma_b-1}$. Alternatively, we can express exports as a function of the hurdle $\underline{E}$, which yields $R_{ij}(z) = \kappa_1 N_{bj} f_{ij} E_{Lj}^{\gamma_b} \underline{E}_{ij}(z)^{-\gamma_b}$. We show the details of both calculations in the appendix.

[22] Higher E_{Lj} can arise due to e.g. wage or population growth or productivity growth among final goods producers, see appendix C.

In Section 6, we empirically test this prediction of the model, by exploiting cross-country differences in the degree of firm size heterogeneity. Also note that a higher match cost f_{ij} dampens both firm exports and the number of buyers, as expected.[23]

Finally, we can express the price index as a function of exogenous variables. Using equation (2) and the sorting function, given $E < \bar{E}_{ij}$, yields

$$P_j(E)^{1-\sigma} = E^{\gamma_2/\gamma_s} \bar{m}^{1-\sigma} \sigma^{-1} \Omega_j^{\sigma-1}. \tag{9}$$

The price index is decreasing in expenditure with an elasticity of $\gamma_2/\left[\gamma_s(\sigma-1)\right] > 0$, reflecting that larger buyers get access to a wider range of goods.

The Export Distribution. In a model without buyer heterogeneity, the export distribution inherits the properties of the productivity distribution, and with Pareto distributed productivities, the shape coefficient for the export distribution is simply $\gamma_s/(\sigma-1)$. In our model with buyer heterogeneity, dispersion in the export distribution is determined by the inverse of *buyer* heterogeneity exclusively. To see this, we calculate

$$\Pr\left[R_{ij}(z) < R_0\right] = 1 - \kappa_{3ij} R_0^{-1/\gamma_b},$$

where κ_{3ij} is a constant.[24] We summarize this in the following proposition.

Proposition 2. *The distribution of firm-level exports from country i to country j is Pareto with shape parameter $1/\gamma_b$. Hence, more heterogeneity among buyers in j leads to less heterogeneity in the export distribution among sellers in i.*

The intuition for this result is the following. If buyer expenditure is highly dispersed, then there are many large buyers in the market and most exporters will sell to them. This tends to dampen the dispersion in the number of buyers reached by different exporters. On the other hand, if buyer expenditure is less dispersed, then we have fewer large buyers in the market, and consequently higher dispersion in the number of buyers reached by different exporters.

The assumption of Pareto distributions on both the supply and demand side of the market helps us generate simple analytical results. With other distributional assumptions, dispersion in seller productivity would play a role in the export distribution. However, the main insight that buyer heterogeneity matters for the export distribution would most likely still survive under alternative distributional assumptions.

[23] The elasticity of exports with respect to f_{ij} is $1 - \gamma_b\gamma_s/(\sigma-1)$, which is negative given the restriction that $\gamma_b > (\sigma-1)/\gamma_s$.

[24] $\kappa_{3ij} = \frac{E_{Lj}\left(\kappa_1 N_{bj}\right)^{1/\gamma_b}}{\left(\tau_{ij} w_i \Omega_j\right)^{\gamma_s}} f_{ij}^{1/\gamma_b + \gamma_s/[\gamma_b(\sigma-1)]}$.

6 Empirical Implications

In this section, we test two main predictions of the model that emphasize the importance of buyer heterogeneity in explaining firm-level and aggregate trade patterns. The first prediction (Section 6.2) is that a demand shock facing firm m should increase firm-level exports, but the marginal export flow, i.e. the transaction to the smallest buyer, should remain unchanged as the marginal transaction is pinned down by the magnitude of buyer-seller fixed costs. The second prediction (Section 6.3) is that a similar-sized demand shock facing firm m in different destinations should translate into more sales in markets with less heterogeneity, as shown in Proposition 1. The empirical evidence is consistent with both predictions of the model.

6.1 A Measure of Demand

We start by calculating a measure of firm-destination specific demand. The objective is to create a variable that proxies for income among buyers in the destination country (w_j in the model, see e.g. equation (7)). In addition, we would like the variable to be firm-specific, so that we can control for market-wide factors that may also impact sales by fixed effects that vary at the destination over time. The general idea is to proxy demand facing firm m in country j by total imports in j, of the products m is exporting, from other sources than Norway. Given the small market share of Norwegian firms in most markets, this measure should be exogenous with respect to firm m's exports. We proceed by using product-level (HS6 digit) trade data from COMTRADE, and denote total imports of product p at time t from all sources except Norway as I_{pjt}.[25] The demand shock d_{mjt} is then defined as the unweighted average of imports for the products firm m is exporting,

$$d_{mjt} = \frac{1}{N_m} \sum_{p \in \Omega_m} \ln I_{pjt},$$

where Ω_m is the set of products firm m is exporting (to any country, in any year), and N_m is the number of products firm m is exporting.[26] We investigate the robustness of our results to other specifications of demand in Section 6.3.1.

6.2 Demand Shocks and the Marginal Buyer

In the model, a demand shock in market j has no impact on sales to the marginal buyer. This occurs because the gross profits associated with the marginal buyer exactly equals the buyer-seller fixed cost.[27] We estimate

$$\ln y_{mjt} = \alpha_{mt} + \beta_{jt} + \eta \ln d_{mjt} + \epsilon_{mjt}, \tag{10}$$

[25] We use CEPII's BACI database using the HS 1996 revision.

[26] Ω_m is the same in all destinations and in all years, so that firm behaviour across time and countries does not affect the average. A few importer-product pairs are missing in one or more years, these pairs are dropped.

[27] Inserting equation (5) into (15) yields $r_{ij}\left(z, \underline{E}_{ij}(z)\right) = \sigma f$.

where y_{mjt} is the log marginal export flow for firm m in market j at time t (i.e. $\min_b y_{mbjt}$, where b is buyer), and d_{mjt} is the demand shock facing firm m in market j. We include both firm-year (α_{mt}) and country-year (β_{jt}) fixed effects, allowing for changes in time-varying firm-specific factors such as productivity, and time-varying market-wide shocks, e.g. the real exchange rate. Identification then comes from comparing growth in exports within the same firm across markets, while controlling for country-specific trends. Our approach resembles a triple differences model as we compare growth in exports both across markets and across firms. Specifically, for two firms A and B and two markets 1 and 2, η is identified by the difference in firm A's exports growth to markets 1 and 2, relative to the difference in firm B's exports growth in markets 1 and 2.[28] In addition to using marginal exports as the dependent variable, we also estimate equation (10) using total firm-level exports ($\sum_b y_{mbjt}$), number of buyers, and maximum exports across buyers ($\max_b y_{mbjt}$) as dependent variables.

The results confirm the predictions from the model. Table 6 shows that positive demand shocks have no impact on the marginal export flow (column 3), while both total exports, maximum exports, and the number of buyers per firm (columns 1, 2, and 4) are positively and significantly related to positive demand shocks in the destination country.[29] The model, however, would predict that the elasticity of exports to a demand shock is identical to the elasticity of the number of customers to a demand shock, see equations (7) and (8), while the results show that the exports elasticity is stronger than the customers elasticity. One possible reason for this discrepancy is that the empirical productivity and expenditure distributions may deviate from the assumed Pareto shape.[30]

6.3 Demand Shocks and Importer Heterogeneity

One of the main features of the theoretical framework is the role of buyer-side heterogeneity in determining the response of exports to demand shocks, i.e. that the demand shock elasticity is greater in markets with less buyer heterogeneity. We test this prediction by calculating various measures of buyer dispersion, and then checking whether the demand elasticities estimated in Section 6.2 are higher in markets with less heterogeneity. Specifically, we estimate

$$\ln y_{mjt} = \alpha_{mt} + \beta_{jt} + \eta_1 \ln d_{mjt} + \eta_2 \ln d_{mjt} \times \Xi_j + \epsilon_{mjt}, \tag{11}$$

where Ξ_j is a measure of buyer dispersion in destination market j.

Ideally, we would want a measure of dispersion in expenditure, E, in different markets. A close proxy for this is a measure of dispersion in firm size. We gather data on the firm size distribution from World Bank's Enterprise Surveys, and calculate a Pareto slope coefficient (Ξ^1), the 90/10

[28]The fixed effects α_{mt} and β_{jt} are differenced out for $\Delta \ln y_{mjt} - \Delta \ln y_{mj-1,t} - (\Delta \ln y_{jt} - \Delta \ln y_{j-1,t})$.

[29]In the min and max regressions, we only use firms with more than 5 customers. We also restrict the sample size to be identical to the sample size in the regressions in Section 6.3. Results based on the entire sample are not significantly different.

[30]Pareto implies that average exports per customer $R_{ij}(z)/B_{ij}(z) = \kappa f$, i.e. only a function of the buyer-seller fixed cost.

percentile ratio (Ξ^2), and the standard deviation of log employment for each country (Ξ^3).[31] The Enterprise Surveys are firm-level surveys of a representative sample of an economy's private sector (manufacturing and services). The survey aims to achieve cross-country comparisons, so that our dispersion measures should not be contaminated by differences in sampling design. Formal companies with 5 or more employees are included.[32]

The results are shown in Table 7. We find that the elasticity (for both export value and the number of buyers) is significantly dampened in markets with more heterogeneity, consistent with our model. Note that the coefficient is positive in columns 1 and 2 since the Pareto coefficient is the inverse of dispersion. The magnitudes are also economically significant: Moving from the 25th to the 75th percentile of the Pareto coefficient increases the demand elasticity by 11 percent, suggesting that demand-side factors are quantitatively important for our understanding of trade elasticities.[33]

6.3.1 Robustness

In this section, we perform a number of robustness checks. First, a concern is that Norwegian exports to countries included in the Enterprise Surveys only amounts to roughly 1/3 of total exports. We therefore check the robustness of our results by using an alternative data source. We gather data on dispersion in exports for 39 countries from the World Bank's Exporter Dynamics database.[34] Unfortunately, the data does not include firm-level information, but it it provides the mean and standard deviation of exports, which allows us to calculate the coefficient of variation for all 39 countries.[35] A potential concern is that buyer dispersion is inferred from exports dispersion. However, as our buyers are importers, and as importers themselves tend to be exporters (Bernard, Jensen, Redding, and Schott, 2007), we believe that this is a reasonable approximation. We estimate equation (11) using the coefficient of variation (Ξ^4). Columns (1) and (2) in Table 8 show that the same significant pattern holds in this case, although the magnitudes are not directly comparable due to the different measures of dispersion.

A second concern is that buyer dispersion may be correlated with other factors that also affect the demand elasticity; for example both buyer dispersion and demand elasticities may be different in low-income countries. We address this issue by purging GDP per capita from our Pareto shape coefficient Ξ^1. Specifically we regress Ξ^1 on GDP per capita and use the fitted residual instead

[31] We calculate the Pareto slope coefficient by regressing the empirical inverse CDF on firm employment, both in logs, for each destination market; the resulting slope coefficient is (the negative of) the Pareto slope coefficient.

[32] The survey covers 87 countries, mostly developing countries. In 2006 these countries received 29 percent of Norwegian exports. We drop countries where the survey has fewer than 100 observations per country. These countries are: BR, ER, GY, JM, LB, LS, ME, OM, TR.

[33] The 25th and 75th percentiles are 0.58 and 0.80, so that the demand elasticities are 0.41 and 0.46 respectively.

[34] The countries are AL, BD, BE, BF, BG, BR, BW, CL, CM, CR, DO, EC, EE, EG, ES, GT, IR, JO, KE, KH, LA, MA, MK, ML, MU, MW, MX, NI, NZ, PE, PK, SE, SN, SV, TR, TZ, YE and ZA.

[35] In 2006, the countries for which the database provide information received 20 percent of Norwegian exports.

of Ξ^1. This is what is shown in columns (3) and (4); overall the results are very similar to the baseline case in Table 7. A third concern is that the demand shock variable d_{mjt} may suffer from measurement error, as imports may not fully capture demand facing Norwegian firms. As a simple test, we instead replace d_{mjt} with GDP_{jt} as our proxy for demand. In this case, we cannot include country-year fixed effects (only country fixed effects and a real exchange rate control variable). The results in columns (5) and (6) show the same pattern as in the baseline case, although the standard errors are somewhat higher.

In sum, we find confirmation of the main prediction of the model. Markets with more homogenous firm/buyer distributions have greater elasticities for both the log level of exports and the number of buyers than do markets with more heterogeneous firm distributions.

7 Conclusion

We use highly disaggregated trade transaction data from Norway to explore the role of buyers (importers) in aggregate and firm-level exports. We find that the extensive margin of the number of buyers plays an important role in cross-country exports at the aggregate level and within firms. This new extensive margin is comparable in magnitude to previously documented extensive trade margins, e.g. firms, destinations and products.

We introduce a series of stylized facts about buyers in international trade including extreme concentration of exports across both sellers and buyers, heterogeneity of the dispersion in cross-buyer expenditures across destinations, and the Pareto nature of the distributions of buyers per exporter and sellers per importer. We find that large exporters reach more customers and have more dispersion in exports across buyers within a destination and there is negative assortativity in the exporter-import matches, large exporters on average reach importers who buy from a smaller number of foreign firms.

We extend a basic model of heterogeneous exporters to include heterogeneity in expenditures across buyers within a destination. Exporter must pay a fixed cost to match with any given buyer. In our stylized model with the strong assumption of both Pareto-distributed productivity across exporters and Pareto-distributed expenditures across buyers, variation in buyer dispersion determines the dispersion of firm-level exports. This framework matches the stylized facts and yields interesting new testable implications that are confirmed in the Norwegian data. An increase in foreign demand increases firm-level exports but the marginal export flow does not change as it is pinned down by the magnitude of the buyer-seller fixed costs. In addition, the heterogeneity of buyer expenditures matters for the response to demand and trade cost shocks. We find that the response of firm-level exports to comparable demand shocks across destinations varies systematically with the dispersion of expenditures. Exports respond more to destinations with low dispersion across buyer firms.

These results suggest that demand-side characteristics may play an important role in determining the aggregate export response to shocks. Future research might fruitfully focus on the growth and stability of these exporter-importer networks as well as the sources of heterogeneity in buyer expenditure itself.

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Appendix

A Equilibrium Sorting

Proof. Equation (3) implicitly defines the $\underline{z}_{ij}(E)$ function. We start with the guess $\underline{z}_{ij}(E) = S_{ij}E^s$ and the inverse $\underline{E}_{ij}(z) = (z/S_{ij})^{1/s}$, where S_{ij} and s are unknowns. Insert this, as well as the price index (equation (2)), into equation (3) ,

$$
\begin{aligned}
\frac{\gamma_2/\gamma_s}{\sum_k N_{sk}\left(\bar{m}\tau_{kj}w_k\right)^{1-\sigma}\left(S_{kj}\underline{E}^s\right)^{-\gamma_2}} &= \frac{\sigma f_{ij}}{\underline{E}} z^{1-\sigma}\left(\bar{m}\tau_{ij}w_i\right)^{\sigma-1} \\
\frac{\underline{E}^{s\gamma_2+1}}{\sum_k N_{sk}\left(\bar{m}\tau_{kj}w_k\right)^{1-\sigma} S_{kj}^{-\gamma_2}} &= \sigma f_{ij}\frac{\gamma_s}{\gamma_2}\left(\bar{m}\tau_{ij}w_i\right)^{\sigma-1} z^{1-\sigma}.
\end{aligned}
$$

Hence,

$$
\frac{1}{s} = \frac{1}{s}\frac{1-\sigma}{s\left(\gamma_2+1/s\right)} \quad \iff \quad \frac{1}{s} = -\gamma_s,
$$

and

$$
\begin{aligned}
\left(\frac{1}{S_{ij}}\right)^{1/s} &= \left[\sigma f_{ij}\frac{\gamma_s}{\gamma_2}\left(\bar{m}\tau_{ij}w_i\right)^{\sigma-1}\sum_k N_{sk}\left(\bar{m}\tau_{kj}w_k\right)^{1-\sigma} S_{kj}^{-\gamma_2}\right]^{1/(s\gamma_2+1)} \\
\left(\frac{1}{S_{ij}}\right)^{-\gamma_s} &= \left[\sigma f_{ij}\frac{\gamma_s}{\gamma_2}\left(\bar{m}\tau_{ij}w_i\right)^{\sigma-1}\sum_k N_{sk}\left(\bar{m}\tau_{kj}w_k\right)^{1-\sigma} S_{kj}^{-\gamma_2}\right]^{1/(-\gamma_2/\gamma_s+1)} \\
S_{ij} &= \left[\sigma f_{ij}\frac{\gamma_s}{\gamma_2}\left(\tau_{ij}w_i\right)^{\sigma-1}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{1-\sigma} S_{kj}^{-\gamma_2}\right]^{1/(\sigma-1)}. \qquad (12)
\end{aligned}
$$

In sum, the cutoffs are

$$
\begin{aligned}
\underline{z}_{ij}(E) &= S_{ij}E^{-1/\gamma_s} \qquad (13) \\
\underline{E}_{ij}(z) &= S_{ij}^{\gamma_s} z^{-\gamma_s}
\end{aligned}
$$

□

B Solving S_{ij} and P_j

Proof. Given $E < \bar{E}_{ij}$, inserting the expression for the cutoff (equation (13)) into the price index in equation (2) yields

$$
P_j(E)^{1-\sigma} = E^{\gamma_2/\gamma_s}\bar{m}^{1-\sigma}\frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{1-\sigma} S_{kj}^{-\gamma_2}.
$$

Inserting the expression for S_{kj} from equation (12) then yields

$$
P_j(E)^{1-\sigma} = E^{\gamma_2/\gamma_s}\frac{\bar{m}^{1-\sigma}}{\sigma f_{ij}}\left(\frac{S_{ij}}{\tau_{ij}w_i}\right)^{\sigma-1}.
$$

This must hold for all i, so

$$f_{ij}^{-1/(\sigma-1)}\frac{S_{ij}}{\tau_{ij}w_i} = f_{kj}^{-1/(\sigma-1)}\frac{S_{kj}}{\tau_{kj}w_k}.$$

By exploiting this fact, we can transform the expression for S_{ij},

$$S_{ij}^{\sigma-1} = \sigma f_{ij}\frac{\gamma_s}{\gamma_2}\left(\tau_{ij}w_i\right)^{\sigma-1}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{1-\sigma}S_{kj}^{-\gamma_2}.$$

$$\begin{aligned}
S_{ij}^{\sigma-1} &= \left(\tau_{ij}w_i\right)^{\sigma-1}\sigma f_{ij}\frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{1-\sigma}\left(\tau_{kj}w_k\right)^{-\gamma_2}f_{kj}^{-\gamma_2/(\sigma-1)}\left(f_{kj}^{-1/(\sigma-1)}\frac{S_{kj}}{\tau_{kj}w_k}\right)^{-\gamma_2}\\
&= \left(\tau_{ij}w_i\right)^{\sigma-1}\sigma f_{ij}\frac{\gamma_s}{\gamma_2}\left(f_{ij}^{-1/(\sigma-1)}\frac{S_{ij}}{\tau_{ij}w_i}\right)^{-\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{-\gamma_s}f_{kj}^{-\gamma_2/(\sigma-1)} \quad\iff\\
S_{ij}^{\gamma_s} &= \left(\tau_{ij}w_i\right)^{\gamma_s}\sigma f_{ij}^{\gamma_s/(\sigma-1)}\frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{-\gamma_s}f_{kj}^{-\gamma_2/(\sigma-1)} \quad\iff\\
S_{ij} &= \tau_{ij}w_i f_{ij}^{1/(\sigma-1)}\left(\sigma\frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{-\gamma_s}f_{kj}^{-\gamma_2/(\sigma-1)}\right)^{1/\gamma_s}.
\end{aligned}$$

We define

$$\Omega_j \equiv \left(\sigma\frac{\gamma_s}{\gamma_2}\sum_k N_{sk}\left(\tau_{kj}w_k\right)^{-\gamma_s}f_{kj}^{-\gamma_2/(\sigma-1)}\right)^{1/\gamma_s},$$

which yields the closed form solutions for the sorting functions, $\underline{z}_{ij}(E) = f_{ij}^{1/(\sigma-1)}\tau_{ij}w_i\Omega_j E^{-1/\gamma_s}$ and $\underline{E}_{ij}(z) = f_{ij}^{\gamma_s/(\sigma-1)}\left(\tau_{ij}w_i\Omega_j\right)^{\gamma_s}z^{-\gamma_s}$. □

Note that we can now write the price index as

$$P_j(E)^{1-\sigma} = E^{\gamma_2/\gamma_s}\frac{\bar{m}^{1-\sigma}}{\sigma}\Omega_j^{\sigma-1}.$$

C Distributor Expenditure and Productivity

We have so far derived expressions for sorting as a function of distributor total expenditure E. In this section, we first derive the equilibrium relationship between distributor expenditure and productivity, and next characterize the expenditure distribution $G_j(E)$ as a function of the distributor productivity distribution $\tilde{G}_j(z)$.

Revenue for a final goods producer is

$$\tilde{r}_i = \left(\frac{\tilde{p}_i}{\tilde{P}_i}\right)^{1-\sigma}\mu Y_i = \left(\frac{\bar{m}P_i(\tilde{z})}{\tilde{z}\tilde{P}_i}\right)^{1-\sigma}\mu Y_i,$$

where $\tilde{p}_i = \bar{m}P_i(\tilde{z})/\tilde{z}$ is the price charged and $\tilde{P}_i$ is the CES price index for final goods, $\tilde{P}_i^{1-\sigma} = \int_{\tilde{\Omega}_i}\tilde{p}_i(\upsilon)^{1-\sigma}d\upsilon$. Rewriting revenue as a function of E, and inserting the equilibrium expression for

$P_i(E)$, given $E < \bar{E}_{ij}$, yields

$$\begin{aligned} \bar{m}E &= \left(\frac{\bar{m}P_i(E)}{\tilde{z}\tilde{P}_i}\right)^{1-\sigma}\mu Y_i \\ &= \left(\frac{\bar{m}}{\tilde{z}\tilde{P}_i}\right)^{1-\sigma} E^{\gamma_2/\gamma_s}\bar{m}^{1-\sigma}\frac{\mu}{\sigma}\Omega_i^{\sigma-1}Y_i \quad \Longleftrightarrow \\ E^{1-\gamma_2/\gamma_s} &= \bar{m}^{1-2\sigma}\frac{\mu}{\sigma}\left(\Omega_i\tilde{P}_i\right)^{\sigma-1}\tilde{z}^{\sigma-1}Y_i \quad \Longleftrightarrow \\ E &= \kappa_4\left(\Omega_i\tilde{P}_i\right)^{\gamma_s} Y_i^{\gamma_s/(\sigma-1)}\tilde{z}^{\gamma_s}, \end{aligned} \tag{14}$$

where $\kappa_4 = \bar{m}^{-\frac{2\sigma-1}{\sigma-1}\gamma_s}\left(\frac{\mu}{\sigma}\right)^{\gamma_s/(\sigma-1)}$. Hence, total spending on intermediates is increasing in productivity with an elasticity γ_s and increasing in total worker income with an elasticity $\gamma_s/(\sigma-1)$.

Next we would like to characterize the expenditure distribution $G_j(E)$. A complication is that the expression for E in equation (14) only holds for $E < \bar{E}_{ij}$. As argued in Section E, $\bar{E}_{ij}$ is in the far right tail of the distribution, so that $\bar{E}_{ij} \to \infty$ is a reasonable approximation. Assuming that final goods productivity is distributed Pareto, $\tilde{G}(\tilde{z}) = 1 - \tilde{z}^{-\tilde{\gamma}_b}$, and given the expression for E in equation (14), the expenditure distribution in country i is then

$$\begin{aligned} G_i(E_0) &= \Pr[E < E_0] \\ &= \Pr\left[\tilde{z} < \kappa_4^{-1/\gamma_s}\Omega_i^{-1}\tilde{P}_i^{-1}Y_i^{-1/(\sigma-1)}E_0^{1/\gamma_s}\right] \\ &= 1 - (E_{Li}/E_0)^{\tilde{\gamma}_b/\gamma_s}, \end{aligned}$$

where $E_{Li} \equiv \kappa_4\left(\Omega_i\tilde{P}_i\right)^{\gamma_s}Y_i^{\gamma_s/(\sigma-1)}$. Hence, expenditure is distributed Pareto with shape parameter $\tilde{\gamma}_b/\gamma_s$. Higher worker income, final goods price index $\tilde{P}_i$ and multilateral resistance Ω_i shifts the location of the distribution to the right. The structural interpretation of the coefficient γ_b in the main text is therefore $\gamma_b = \tilde{\gamma}_b/\gamma_s$.

D Firm-level Trade

Using equations (1) and (2), as well as the sorting function $\underline{E}_{ij}(z)$, and given $z < \bar{z}_{ij}$ and $E < \bar{E}_{ij}$, firm-level exports are

$$\begin{aligned} R_{ij}(z) &= N_{bj}\int_{\underline{E}_{ij}(z)}^{\bar{E}_{ij}} r_{ij}(z,E)\,dG_j(E) \\ &= N_{bj}\int_{\underline{E}_{ij}(z)}^{\bar{E}_{ij}}\left(\frac{p_{ij}(z)}{P_j(E)}\right)^{1-\sigma} E E_{Lj}^{\gamma_b}\gamma_b E^{-\gamma_b-1}dE \\ &= N_{bj}(\tau_{ij}w_i)^{1-\sigma} z^{\sigma-1}\sigma\Omega_j^{1-\sigma}E_{Lj}^{\gamma_b}\gamma_b\int_{\underline{E}_{ij}(z)}^{\bar{E}_{ij}} E^{-\gamma_2/\gamma_s-\gamma_b}dE \\ &= N_{bj}(\tau_{ij}w_i\Omega_j)^{1-\sigma} z^{\sigma-1}\sigma E_{Lj}^{\gamma_b}\frac{\gamma_b\left(\underline{E}_{ij}^{-\gamma_2/\gamma_s-\gamma_b+1} - \bar{E}_{ij}^{-\gamma_2/\gamma_s-\gamma_b+1}\right)}{\gamma_2/\gamma_s+\gamma_b-1}. \end{aligned}$$

As argued in appendix Section E, $\bar{E}_{ij}$ will take a high value, so that $\bar{E}_{ij}^{-\gamma_2/\gamma_s-\gamma_b+1} \approx 0$. Exports are then

$$
\begin{aligned}
R_{ij}(z) &\approx N_{bj}\left(\tau_{ij}w_i\Omega_j/z\right)^{1-\sigma}\sigma E_{Lj}^{\gamma_b}\frac{\gamma_b\left(f_{ij}^{\gamma_s/(\sigma-1)}\left(\tau_{ij}w_i\Omega_j/z\right)^{\gamma_s}\right)^{-\gamma_2/\gamma_s-\gamma_b+1}}{\gamma_2/\gamma_s+\gamma_b-1} \\
&= \kappa_1 N_{bj} f_{ij}^{1-\gamma_b\gamma_s/(\sigma-1)} E_{Lj}^{\gamma_b}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b},
\end{aligned}
$$

where $\kappa_1 = \gamma_b\sigma/\left(\gamma_2/\gamma_s+\gamma_b-1\right)$. Note that, given that $\gamma_b > (\sigma-1)/\gamma_s$, $\partial \ln R_{ij}/\partial \ln f_{ij} < 0$, so higher buyer-seller fixed costs lower firm sales.

We can alternatively express revenue as a function of the hurdle $\underline{E}_{ij}(z)$, which yields

$$
R_{ij}(z) = \kappa_1 N_{bj} f_{ij} E_{Lj}^{\gamma_b}\underline{E}_{ij}(z)^{-\gamma_b}.
$$

We can also express revenue for a given buyer seller match as

$$
r_{ij}(z,E) = \sigma\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\sigma-1}E^{1-\gamma_2/\gamma_s}. \tag{15}
$$

The distribution of within-firm sales is, using equation (15), is

$$
\begin{aligned}
H(r_0) &= \Pr\left[r_{ij}(z,E) < r_0 \mid E > \underline{E}_{ij}(z),\ z\right] \\
&= \Pr\left[\sigma\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\sigma-1}E^{1-\gamma_2/\gamma_s} < r_0 \mid E > \underline{E}_{ij}(z),\ z\right] \\
&= \Pr\left[E < \left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{-\gamma_s}\left(\frac{r_0}{\sigma}\right)^{\gamma_s/(\sigma-1)} \mid E > \underline{E}_{ij}(z),\ z\right] \\
&= 1-\underline{E}_{ij}(z)^{\gamma_b}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_b\gamma_s}\left(\frac{r_0}{\sigma}\right)^{-\gamma_b\gamma_s/(\sigma-1)} \\
&= 1-\left(\sigma f_{ij}\right)^{\gamma_b\gamma_s/(\sigma-1)} r_0^{-\gamma_b\gamma_s/(\sigma-1)}.
\end{aligned}
$$

The firm-level measure of buyers for a firm with productivity z is

$$
\begin{aligned}
B_{ij}(z) &= N_{bj}\int_{\underline{E}_{ij}(z)} dG_j(E) \\
&= N_{bj}E_{Lj}^{\gamma_b}\underline{E}_{ij}(z)^{-\gamma_b} \\
&= N_{bj}E_{Lj}^{\gamma_b} f_{ij}^{-\gamma_s\gamma_b/(\sigma-1)}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b}.
\end{aligned} \tag{16}
$$

The firm-level measure of sellers for a buyer with expenditure E is

$$
L_{ij}(E) = N_{si}\int_{\underline{z}_{ij}(E)} dF(z) = N_{si} f_{ij}^{-\gamma_s/(\sigma-1)}\left(\tau_{ij}w_i\Omega_j\right)^{-\gamma_s}E, \tag{17}
$$

so buyer expenditure and the number of sellers are proportional.

Finally, equilibrium firm-level profits are

$$\begin{aligned}\Pi_{ij}(z) &= \frac{R_{ij}(z)}{\sigma} - f_{ij}B_{ij}(z) \\ &= \frac{\kappa_1}{\sigma} N_{bj} f_{ij}^{1-\gamma_b\gamma_s/(\sigma-1)} E_{Lj}^{\gamma_b}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b} - f_{ij}N_{bj}E_{Lj}^{\gamma_b} f_{ij}^{-\gamma_s\gamma_b/(\sigma-1)}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b} \\ &= \left(\frac{\kappa_1}{\sigma}-1\right) N_{bj} f_{ij}^{1-\gamma_b\gamma_s/(\sigma-1)} E_{Lj}^{\gamma_b}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\gamma_s\gamma_b}.\end{aligned}$$

For $z \geq \bar{z}_{ij}$ firms, the buyer threshold is E_{Lj}, $\underline{E}_{ij} = E_{Lj}$, so that firm-level exports are

$$R_{ij}(z) = \kappa_1 N_{bj} E_{Lj}^{-\gamma_2/\gamma_s+1}\left(\frac{z}{\tau_{ij}w_i\Omega_j}\right)^{\sigma-1},$$

and the number of buyers is simply $B_{ij}(z) = N_{bj}$.

E Approximations

In this section, we show that for plausible parameter values, we can safely ignore the impact of type (ii) buyers and sellers. In a closed economy, the expression for $\bar{E}$ is

$$\frac{\bar{E}}{E_L} = \sigma\frac{\gamma_s}{\gamma_2}\frac{f}{E_L}N_s,$$

and $\bar{z}$ can be written as $\bar{z} = \left(\bar{E}/E_L\right)^{1/\gamma_s}$. We approximate $\bar{E} \to \infty$ and $\bar{z} \to \infty$, which could arise due to a combination of high match-specific fixed costs f, a large measure of firms N_s and low minimum expenditure E_L.

We illustrate the magnitude of the approximation error as follows. We pick standard values from the literature for σ and γ_s, $\sigma = 4$ and $\gamma_s = 4.12$.[36] We do not observe the measure of firms, N_s, directly, but we can get a lower bound by looking at the number of exporters in the most popular destination, Sweden, which gives us $N_s = 8379$.[37]Assuming that match specific costs f are ten times the smallest expenditure in the market, $f/E_L = 10$, we get $\bar{E}/E_L = 1.2\times10^6$ and $\bar{z} = 0.3\times10^2$, both in the far right tail of the expenditure and productivity distributions. Introducing more countries and positive trade costs, $\tau_{ij} > 1$, would increase the thresholds further. With these parameter values, we can evaluate the error in the expression for firm-level exports $R_{ij}(z)$ in Section D. Given a value of $\gamma_b = \gamma_s = 4.12$, we get $\bar{E}_{ij}^{-\gamma_2/\gamma_s-\gamma_b+1} = 2.2 \times 10^{-21}$.

[36] The elasticity of substitution from Broda and Weinstein (2006), using the 1990-2001 mean at the SITC-3 level. γ_s from Simonovska and Waugh (2012). They estimate the aggregate trade elasticity to 4.12, which is equivalent to γ_s in a broad range of models. This gives us $\gamma_2 = \gamma_s - (\sigma-1) = 1.12$.

[37] Total sales in a market is $N_s\int_{\underline{z}} R(z)\,dF(z)$, where $R(z)$ is sales for a firm with productivity z and $\underline{z}$ is the entry hurdle. Assuming that the entry hurdle in Sweden is close to the lower support of the distribution, N_s is simply total sales divided by average sales.

F Sorting in Model and Data

Figure 6 shows the empirical relationship between a firm's number of customers and average number of connections among its customers, i.e. the correlation between the degree of a node and the average degree of its' neighbors. In this section, we derive the corresponding relationship in the model.

Using equations (17) and (5), the number of connections for the marginal customer of a firm with productivity z is $L_{ij}\left(\underline{E}_{ij}(z)\right) = N_{si} z^{-\gamma_s}$. Using equation (16), we can rewrite this as

$$\underline{L}_{ij} = N_{si} \frac{E_{Lj} N_{bj}^{1/\gamma_b} f_{ij}^{\gamma_s/(\sigma-1)}}{\left(\tau_{ij} w_i \Omega_j\right)^{\gamma_s}} B_{ij}{}^{-1/\gamma_b},$$

which relates a firm's number of of customers B_{ij} to the number of connections for the firm's marginal customer $\underline{L}_{ij}$.

In the data, we explore the average number of connections among all the firm's customers, not just the marginal one. The average number of connections among the customers of a firm with productivity z is

$$\begin{aligned}
\hat{L}_{ij}(z) &= \frac{1}{1 - G_j\left(\underline{E}_{ij}(z)\right)} \int_{\underline{E}_{ij}(z)} L_{ij}(E)\, dG_j(E) \\
&= \frac{1}{E_{Lj}^{\gamma_b} \underline{E}_{ij}(z)^{-\gamma_b}} N_{si} f_{ij}^{-\gamma_s/(\sigma-1)} \left(\tau_{ij} w_i \Omega_j\right)^{-\gamma_s} E_{Lj}^{\gamma_b} \gamma_b \int_{\underline{E}_{ij}(z)} E^{-\gamma_b} dE \\
&= N_{si} f_{ij}^{-\gamma_s/(\sigma-1)} \left(\tau_{ij} w_i \Omega_j\right)^{-\gamma_s} \frac{\gamma_b}{\gamma_b - 1} \underline{E}_{ij}(z) \\
&= \frac{\gamma_b}{\gamma_b - 1} N_{si} z^{-\gamma_s}.
\end{aligned}$$

The average number of connections among the customers of a firm with B_{ij} customers is then

$$\hat{L}_{ij}(B_{ij}) = \frac{\gamma_b}{\gamma_b - 1} \frac{N_{si} N_{bj}^{1/\gamma_b} f_{ij}^{\gamma_s/(\sigma-1)} E_{Lj}^{\gamma_b}}{\left(\tau_{ij} w_i \Omega_j\right)^{\gamma_s}} B_{ij}{}^{-1/\gamma_b}.$$

Hence, the elasticity of $\hat{L}_{ij}$ with respect to B_{ij} is simply $-1/\gamma_b$.

Table 1: Descriptive statistics.

	SE	DE	US	CN	OECD	non-OECD
Number of exporters	8,614	4,067	2,088	725	1,588.2	98.2
Number of buyers	16,822	9,627	5,992	1,489	3,055.6	144.5
Buyers/exporter, mean	3.6	3.6	4.5	3.6	2.7	1.6
Buyers/exporter, median	1	1	1	1	1	1
Exporters/buyer, mean	1.9	1.5	1.6	1.7	1.5	1.2
Exporters/buyer, median	1	1	1	1	1	1
Share trade, top 10% sellers	.94	.97	.96	.86	.90	.75
Share trade, top 10% buyers	.95	.95	.97	.89	.89	.73
Log max/median exports	10.7	11.4	11.2	7.9	8.7	4.6
Log max/median imports	10.8	10.8	11.7	8.4	8.4	4.6
Share in Norwegian total exports (in %)	11.3	9.6	8.8	2.1	81.6	18.4

Note: 2006 data. Country codes are CN: China, DE: Germany, JP: Japan, SE: Sweden, US: U.S.A. OECD and non-OECD are the unweighted means of outcomes for all countries in the two groups. Log max/median exports (imports) is the log ratio of the largest exporter (importer), in terms of trade value, relative to the median exporter (importer).

Table 2: The margins of aggregate trade.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Sellers	Products	Buyers	Density	Intensive
Exports (log)	0.57^a	0.53^a	0.61^a	-1.05^a	0.32^a
	(0.02)	(0.02)	(0.02)	(0.04)	(0.02)
N	205	205	205	205	205
R^2	0.86	0.85	0.81	0.81	0.50

Note: 2006 data. Robust standard errors in parentheses. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1.

Table 3: Gravity equation coefficients, aggregated level.

	(1)	(2)	(3)	(4)	(3)
VARIABLES	Exports	# sellers	# buyers	Avg. buyers/seller	Avg. exports/buyer
Distance	-1.15^a	-0.83^a	-0.81^a	-0.05^b	-0.13^a
GDP	1.06^a	0.64^a	0.71^a	0.11^a	0.28^a
N	167	167	167	167	167
R^2	0.75	0.75	0.75	0.44	0.26

Note: 2006 data. Robust standard errors in parentheses. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1. All variables in logs. The dependent variable in column (4) is the number of buyers per firm, averaged across all exporters. The dep. variable in column (5) is firm-level average exports per buyer (x_{mj}/b_{mj}), averaged across all exporters.

Table 4: The margins of firm level trade.

VARIABLES	(1) Products	(2) Buyers	(3) Density	(4) Intensive
Exports (log)	0.22^a	0.22^a	-0.12^a	0.69^a
	(0.003)	(0.003)	(0.002)	(0.003)
Firm & country FE	Yes	Yes	Yes	Yes
N	61,853	61,853	61,853	61,853
R^2	0.48	0.49	0.40	0.81

Note: 2006 data. Robust standard errors in parentheses, clustered by firm. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1.

Table 5: Gravity equation coefficients, firm level.

VARIABLES	(1) Exports	(2) # buyers	(3) Exports/buyer
Distance	-0.48^a	-0.31^a	-0.17^a
GDP	0.23^a	0.13^a	0.10^a
Firm FE	Yes	Yes	Yes
N	53,269	53,269	53,269
R^2	0.06	0.15	0.01

Note: 2006 data. Robust standard errors in parentheses, clustered by firm. ^{a} p$<$ 0.01, ^{b} p$<$ 0.05, ^{c} p$<$ 0.1. All variables in logs.

Table 6: Firm responses to demand shocks.

	(1) Revenue	(2) # buyers	(3) min	(4) max
d_{mjt}	.43^{a}	.14^{a}	.00	.96^{a}
	(.02)	(.01)	(.07)	(.08)
Country-year FE	Y	Y	Y	Y
Firm-year FE	Y	Y	Y	Y
N	105,756	105,756	8,106	8,106
Firms-years	44,068	44,068	4,055	4,055
Destinations	75	75	57	57

Note: Robust standard errors in parentheses, clustered by firm-year. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1. All variables in logs. The dep. variables in columns (3) and (4) are the minimum (maximum) export value for a firm, across its buyers; $\min_j y_{ijnt}$ and $\max_j y_{ijnt}$. Only exporters with $>$ 5 buyers in columns (3) and (4).

Table 7: Demand shocks and heterogeneity.

	Revenue	# buyers	Revenue	# buyers	Revenue	# buyers
d_{mjt}	$.30^a$	$.04^b$	$.60^a$	$.27^a$	$.70^a$	$.30^a$
	(.05)	(.02)	(.07)	(.03)	(.08)	(.03)
$d_{int} \times \Xi^1$ (Pareto)	$.20^a$	$.15^a$				
	(.08)	(.03)				
$d_{int} \times \Xi^2$ (P90/10)			$-.04^b$	$-.03^a$		
			(.02)	(.01)		
$d_{int} \times \Xi^3$ (Stddev)					$-.18^a$	$-.11^a$
					(.05)	(.02)
Country-year FE	Y	Y	Y	Y	Y	Y
Firm-year FE	Y	Y	Y	Y	Y	Y
N	105,756	105,756	105,756	105,756	105,756	105,756
Firms-years	44,068	44,068	44,068	44,068	44,068	44,068
Destinations	75	75	75	75	75	75

Note: Robust standard errors in parentheses, clustered by firm-year. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1. All variables in logs. Ξ^1, Ξ^2 and Ξ^3 denote the interaction between the demand shock d_{int} and the Pareto shape parameter, the log firm size 90/10 percentile ratio, and the standard deviation of log employment, respectively.

Table 8: Robustness: Demand shocks and heterogeneity.

	(1) Revenue	(2) # buyers	(3) Revenue	(4) # buyers	(5) Revenue	(6) # buyers
d_{mjt}	$.61^a$	$.27^a$	$.39^a$	$.17^a$	.06	-.07
	(.11)	(.05)	(.01)	(.01)	(.26)	(.08)
$d_{mjt} \times \Xi^1$ (Pareto)					$.50^c$	$.17^c$
					(.29)	(.09)
$d_{mjt} \times \Xi^4$ (CV)	$-.11^a$	$-.06^a$				
	(.04)	(.02)				
$d_{mjt} \times \Xi^5$ (Alt pareto)			$.27^a$	$.21^a$		
			(.08)	(.03)		
Country FE	N	N	N	N	Y	Y
Country-year FE	Y	Y	Y	Y	N	N
Firm-year FE	Y	Y	Y	Y	Y	Y
N	90,951	90,951	103,716	103,716	102,856	102,856
Firms-years	58,939	58,939	43,757	43,757	43,732	43,732
Destinations	37	37	74	74	75	75

Note: Robust standard errors in parentheses, clustered by firm-year. ^{a} p< 0.01, ^{b} p< 0.05, ^{c} p< 0.1. All variables in logs. Ξ^4 denotes the log coefficient of variation obtained from the World Bank's Exporter Dynamics Database, see main text, while Ξ^5 is the Pareto shape coefficient purged of correlation with GDP/capita. Columns (1) and (2) use Ξ^4; columns (3) and (4) use Ξ^5; columns (5) and (6) use GDP as a proxy for d_{int}.