Wholesalers and Economies of Scope in International Trade*

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Abstract

This paper offers an explanation for the existence of wholesalers and other intermediaries in international trade, and analyses their effect in an economy with heterogeneous manufacturing firms. Exporting firms have to pay a fixed cost of establishing a distribution network in a foreign market. However, wholesalers possess a technology different to normal manufacturing firms: they can buy manufacturing goods domestically and sell in foreign markets, and they can handle more than one good. A wholesaler therefore faces an additional fixed cost which is convex and monotonically increasing in the number of goods it handles. The entry of wholesale firms leads to productivity sorting. The most productive firms export on their own by paying a fixed cost, but a range of firms with intermediate productivity levels export through international wholesalers. A higher fixed cost of exporting leads to (i) a higher share of the total value of exports and (ii) a higher share of exported product scope that is distributed by wholesalers. A higher fixed cost of exporting gives wholesalers a larger role, since these can spread the fixed cost across more than one good. The wholesale technology therefore exhibits economies of scope. Finally, a gravity model is developed where the 'multilateral resistance variable' is found to include the number of wholesalers of trading partners. Their presence lowers a country's price index, as well as mitigates the positive effect that fixed trade costs have on price levels. An empirical analysis using Swedish firm-level data supports the main assumption and predictions of the model.

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1 Introduction

This paper develops a theoretical model that analyzes one of the important roles of wholesale firms in international trade, namely their comparative advantage in generating economies of scope. It is by now a well-known empirical regularity that wholesalers account for a non-negligible share of exports from most countries, and that they on average export a larger range of products than producing firms. I suggest a simple explanation for this: one key reason that wholesalers exist in international trade is that they are able to use their distribution networks to sell a large portfolio of products abroad, and that they do this at a lower cost than other firms would face. I use this assumption to develop a theoretical model which can easily be adapted to other, more complicated and multicountry, economic settings while at the same time allowing free entry and maintaining a general equilibrium framework. As I show in this paper, this specific characteristic of wholesale firms can explain some of the most important empirical facts about the role played by wholesale firms in international trade, as found in earlier studies as well as in the Swedish data on firms and trade which this paper studies.

One might ask why it is important to understand the role of intermediation in international trade. I argue that there are two main reasons. First, in most countries wholesalers account for reasonably large shares of aggregate exports. Second, firms are highly heterogeneous in terms of size, productivity and participation in international trade,[1] and the effects of intermediation on firms are thus likely to be highly asymmetric. Consumers in modern economies buy few, if any, products directly from the original producer. Instead, a vast majority of goods are, to some extent, intermediated by retailers, wholesalers, international trading companies and other intermediaries. This phenomenon is likely even more important for internationally traded goods as compared to domestically traded goods. Recent empirical research shows that intermediation is important also for how producers of goods enter foreign markets. For example, Ahn, Khandelwal, and Wei (2010) find that 22% of aggregate Chinese export sales can be attributed to intermediary firms and Blum, Claro, and Horstmann (2010) report that around 35% of imports into Chile are handled by wholesalers. Bernard, Grazzi, and Tomasi (2011) find that slightly more than 10% of Italian exports are handled by wholesalers. McCann (2010) and Abel (2011) use East European and Turkish datasets, respectively, and find that "indirect" exporting (exports through intermediaries) is indeed important and also seems to be correlated with important firm characteristics. Feenstra and Hanson (2004) examine the role of Hong Kong in re-exporting goods from China during the period 1988–1998 and find that 53% of Chinese exports were shipped

[1] See, for example, Bernard and Jensen (1995, 1997).

through Hong Kong as re-exports. The authors argue that intermediation was one of the more important reasons. These ratios are even larger for some goods typically associated with China's rapid export growth in the 1990s, such as 77% for footwear and 83% for toys. Bernard, Jensen, Redding, and Schott (2010) find that exporting firms in the US exhibit substantial heterogeneity as regards export mode, i.e. whether firms manage their own exporting activities or export through intermediaries. Basker and Van (2011) document the role of Wal-Mart as a catalyst for US imports from China and note that this large US retailer accounts for 15% of US imports from China. Consequently, the common assumption in the literature on international trade—that firms are always responsible for their own exporting activities—does not provide a full picture of how firms enter foreign markets and why.[2] However, a growing theoretical literature is currently exploring the issue of intermediation in international trade. So far, this has mainly focused on the role of intermediaries in reducing contracting or matching frictions between buyers and sellers, as in Antràs and Costinot (2010, 2011)), Biglaiser (1993) or Rubinstein and Wolinsky (1987); on their positions in networks in international trade, as in Rauch (1999, 2001), Rauch and Watson (2004) or Petropoulou (2008); or on how intermediation relates to firm heterogeneity and fixed costs in exporting, as in Ahn, Khandelwal, and Wei (2010), Blum, Claro, and Horstmann (2011) or Felbermayr and Jung (2011).[3]

This paper tells a rather different story about why intermediaries exist in international trade. The basic notion is that intermediaries assist producing firms in overcoming destination-specific barriers of entry. Here, intermediaries are wholesalers that are able to pool the fixed cost of exporting across more than one good.[4] I utilize a standard model of international trade with firm heterogeneity, as in Melitz (2003), and introduce a sector of wholesalers. These do not produce goods themselves. Instead, they buy goods in their local market and export these goods to foreign markets. They only have to incur the fixed cost of establishing a distribution network in a foreign market once (regardless of how many goods they export). However, they face a fixed cost of their distribution network, which is convex and increasing in product scope (the range of goods that a wholesaler exports). For a producer, exporting through a wholesaler is therefore an alternative to setting up its own distribution channel. The main focus of the paper is on how aggregate trade flows and het-

[2] For further empirical evidence, see also Basker and Van (2010), Bernard, Grazzi, and Tomasi (2011) and Rauch and Trindade (2002).

[3] Raff and Schmitt (2006, 2007, 2009) study issues relating to strategic interaction between wholesalers, retailers and producers.

For an interesting overview of earlier studies and important issues involved, see also Peng and Ilinitch (1998).

[4] The term wholesalers will be used in the paper since the empirical analysis uses data for wholesale firms, but the theoretical model could just as well be applied to intermediaries in general.

erogeneous producers of goods respond to the possibility of exporting through wholesalers, as an alternative to managing their own distribution networks, and therefore wholesalers are assumed to be homogeneous.

The paper defines the general equilibrium of a model with wholesalers, which is characterized by free entry in all sectors. This generates a number of predictions about how exporting is conducted in the presence of intermediation. First, producers sort according to productivity in determining their mode of exporting. The most productive firms continue to manage their own exporting activities and incur the fixed cost associated with this as in the standard model. However, some firms that were almost productive enough to export on their own in a standard model now choose to do so, but through wholesalers instead. The least productive firms do not export through any of the two modes.[5] Second, the size of the fixed cost of foreign market entry affects the choice of export mode. A higher fixed cost is associated with a larger importance of wholesalers: a larger share of aggregate exports is now intermediated rather than exported directly by the producing firms. Moreover, a larger number of firms choose to export through wholesalers rather than managing their own distribution systems when fixed costs of exporting are high. Finally, a larger fixed cost is associated with each wholesaler handling more goods (having a larger scope).

The core mechanism at work in the model is the following: Wholesalers manage to spread the fixed cost of exporting across more than one good. But, to cover the fixed cost, they need to charge a markup between the procurement price of the good and what it charges the final consumer in the foreign country. This markup that wholesalers charge causes productivity sorting in the choice of export mode: the most productive firms choose to incur their own fixed cost of exporting since their operating profit is large enough. However, some goods, which cannot be profitably exported by the producer itself, can be exported at a lower fixed cost (per good) by wholesalers, who export several goods but only have to make one investment in the fixed cost. This means that the wholesale technology exhibits *economies of scope*. When fixed costs increase, wholesalers become more important, since fewer firms can export on their own. Moreover, wholesalers have to expand and handle more goods to be able to cover the larger fixed cost. Wholesalers therefore help producers in overcoming destination-specific barriers to entry.

To reach the above conclusions, I have assumed free entry of manufacturing and wholesale firms in order to restrict the model as little as possible. In the final part of the theoretical section, however, I drop the free entry assumption and develop a multicountry gravity

[5] The mechanisms which cause sorting are analogous to those in Helpman, Melitz, and Yeaple (2004). They model horizontal FDI as a mode of foreign market entry which, compared to exporting, is associated with a higher fixed cost but a lower variable cost.

model under the assumptions in Chaney (2008) which does not allow for free entry in the manufacturing sector. The 'multilateral resistance variable' is found to include the number of wholesalers of trading partners, and their presence lowers a country's price index as well as mitigates the positive effect that fixed trade costs have on the price level. Since the price level is indirectly a measure of welfare, wholesalers therefore contribute positively to welfare.

Swedish data is used to test the main assumption and predictions of the model. In this context, Sweden represents a small and highly open economy for which merchandise trade amounted to 63% of GDP in 2005 according to the World Bank, which can be compared to 21% for the United States in the same year. Specifically, I use Swedish firm-level data from 2005, which matches data from the Swedish customs office with production data on the universe of Swedish firms. The data structure enables a sector classification of firms according to main business activity, and also contains their trade flows by an eight-digit Combined Nomanclature (CN8) product code and destination. It can therefore be observed what goods are exported by firms listed as either 'wholesalers' or 'manufacturers' where the latter are treated as the producers of goods. The analysis supports the main assumption and the predictions of the model. Crucially, for the basic assumption about economies of scope, Swedish wholesalers export a larger scope of products (or CN8 product categories) than producers. A wholesaler exports about 54% more products per firm when destination-specific effects and firm size are accounted for, an empirical fact which supports the notion that there is a technological difference between wholesalers and producers. Moreover, wholesalers export, on average, substantially less in value (between 35 and 57% less) per firm within a product category than producers. Finally, wholesalers play a more important role in aggregate exports (both in terms of total value and in the number of CN8 product categories exported) from Sweden to countries characterized by larger fixed costs. Admittedly, no perfect measure of fixed costs exists so these are proxied by institutional variables, such as the difficulty to import, or the inverse of the residual from a gravity equation.

Some other papers in the literature also focus on the interaction between fixed costs and export mode in a setting of heterogeneous manufacturing firms, as in Melitz (2003). The interesting paper by Ahn, Khandelwal, and Wei (2010) is the most closely linked to mine in the literature. They use Chinese export data where they identify intermediary firms by name. Among many important empirical results, they find that Chinese intermediaries are fairly large and more important for aggregate exports than in developed countries such as the US, Italy, Belgium or Sweden. They also construct a model with firm heterogeneity where the main mechanism is that firms either pay a fixed costs of entry for each market to which they export, or pay one fixed cost of intermediation whereby they can serve all markets in the world but faces a higher variable cost of exporting. The way in which my paper differs theoretically is that I focus on a different theoretical channel (the product scope advantage of wholesale firms) and model wholesale firms explicitly in a general equilibrium analysis. Empirically, our papers differ in the way that I examine a small and open developed economy, Sweden, and that I identify wholesalers by what they report as their "main business activity".

Additional interesting papers in the literature exploring firm heterogeneity and intermediation include, for example, Tang and Zhang (2011) which examines more closely the role of quality and the degree of competition for the role of wholesalers and also uses Chinese data. Felbermayr and Jung (2011) build a model which focuses on the potential hold-up problem between producers and intermediaries while Blum, Claro, and Horstmann (2011) focus on the role of wholesalers in alleviating matching frictions between producers and consumers of goods.[6]

Importantly, Bernard, Jensen, Redding, and Schott (2010) find evidence for 'mixed' firms (plants that engage in both manufacturing and wholesale activities). The authors have information on the main business activity of each plant and among these categories are 'wholesale' and 'retail'. Firms which consist of plants engaging in both production and wholesale (or retail) are labelled as 'mixed' (this means that they have at least one plant which engages in wholesale and one plant which does not). Firms in this category are found to be larger, both in terms of turnover and number of employees, but also in terms of export and import volumes. It is possible to see the model that I propose in this paper as one that analyses the extreme cases of only 'pure' wholesalers and 'pure' producers in order to highlight the effect of economies of scope in the wholesale technology, although the structure of firms in reality is more complex.

Section 2 develops the model by introducing a wholesale industry into the model in Melitz (2003) and derives the main results. These predictions are also incorporated into a general gravity model with firm heterogeneity, as in Chaney (2008), to find the effect of wholesalers on welfare. Section 3 describes the Swedish data and provides the empirical analysis. Section 4 concludes.

[6] Krautheim (2009) also develops a model with firm heterogeneity where fixed costs play a role. Here, "Export-Supporting FDI" enables firms to transfer tasks related to distribution to a foreign affiliate in the export destination.

2 The Model

2.1 Basics

The model builds on the structure in Melitz (2003) but with an additional 'agricultural' sector characterized by constant returns to scale. It depicts two economies ('Home' and 'Foreign', the latter denoted by superscript 'F') with a primary production factor labor, L, which is used in all sectors. Ignoring the wholesale sector for the moment, there are two main sectors in the economy. First, the agricultural sector is a Walrasian, homogeneous-good sector with costless trade. Second, the manufacturing sector is characterized by increasing returns, Dixit-Stiglitz monopolistic competition and iceberg trade costs. Manufacturers face constant marginal production costs and three types of fixed costs. The fixed cost, F_E, is the standard Dixit-Stiglitz cost of developing a new variety. The other two fixed costs involved reflect the one-time expense of introducing a new variety into a market: $\widetilde{F}_D(\theta, wL)$ if it is the domestic market and $\widetilde{F}_X\left(\theta^F, w^F L^F\right)$ for the foreign market, where θ denotes a vector of country-specific characteristics that determine the difficulty of entry (such as, for example, the quality of institutions) and w denotes the wage level in a country. Consequently, wL denotes the gross domestic product of a country. When analyzing the comparative statics of the model, I will use these relationships to see how country characteristics affect outcomes through the fixed cost of entry but for ease of exposition I denote $\widetilde{F^j} \equiv \widetilde{F^j}\left(\theta^j, w^j L^j\right)$ until then.[7]

There is heterogeneity with respect to firms' productivity levels, φ. Each Dixit-Stiglitz firm/variety is therefore associated with a particular labor output coefficient denoted by φ_i for firm i. After sinking F_E units of labor in the product innovation process, the firm is randomly assigned φ_i from the cumulative distribution function $G(\varphi)$.

The analysis exclusively focuses on steady-state equilibria and intertemporal considerations are ignored; the present value of firms is kept finite by assuming that firms face a constant Poisson hazard rate δ of forced exit.

Consumers in each country have two-tier utility functions with the upper tier (Cobb-Douglas) determining the consumer's division of expenditure among the sectors and the second tier (CES) dictating the consumer's preferences over the various differentiated varieties within the manufacturing sector.

[7] I will not make any assumption on exactly how the fixed cost is affected by country size since this is difficult to know. For example, Arkolakis (2010) points out that due to returns to scale in the technology of entry (i.e. advertising technology) firms tend to pay a smaller fixed cost per customer in large economies but a larger total fixed cost. Moreover, larger destinations tend to attract more exporters, see for example Mayer and Ottaviano (2008), which (controlling for the degree of competitive pressure) possibly makes it easier for a potential new exporter to do so as well since it can observe the methods of entry of other exporters.

All individuals in Home have the utility function

$$U = C_M^{\mu} C_A^{1-\mu} \tag{1}$$

where $\mu \in (0, 1)$, and C_A is the consumption of the homogeneous good. Manufactures enter the utility function through the index C_M, defined by

$$C_M = \left[\int_0^N c_i^{(\sigma-1)/\sigma} di \right]^{\sigma/(\sigma-1)} \tag{2}$$

where N is the mass of varieties consumed, c_i the amount of variety i consumed and $\sigma > 1$ the elasticity of substitution between varieties.

Each consumer spends a share μ of his income on manufactures, and demand for a variety i is therefore

$$x_i = A p_i^{-\sigma}, \tag{3}$$

where

$$A \equiv \frac{\mu L}{P^{1-\sigma}}, \tag{4}$$

p_i is the consumer price of variety i, L is the population size and $P \equiv \left(\int_{i \in \Omega} p_i^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}$ the price index of manufacturing goods available in the Home country. The set of available varieties is denoted by Ω.

The unit factor requirement of the homogeneous good is one unit of labor. This good is freely traded and since it is chosen as the numeraire

$$p_A = w = 1 \tag{5}$$

where w is the nominal wage of workers.

In an economy without wholesalers, shipping the manufactured good involves a frictional trade cost of the 'iceberg' form: for one unit of a good from Home to arrive in the Foreign country, $\tau > 1$ units must be shipped. It is assumed that trade costs are equal in both directions. Profit maximization by a manufacturing firm i located in Home exporting to the Foreign country leads to the following consumer price in Foreign of firm i's good:

$$p_i^F = \frac{\sigma}{\sigma - 1} \tau \varphi_i^{-1}. \tag{6}$$

Entrepreneurs entering the manufacturing sector draw their marginal productivity, φ, from the probability distribution $G(\varphi)$ after having sunk F_E units of labor to develop a new variety. Having learned their productivity, firms decide on entry in the domestic and foreign market, respectively. Doing so is associated with fixed market entry costs; firms pay $\widetilde{F}_D$ to enter the domestic market and $\widetilde{F}_X$ to enter the foreign market. Firms will therefore enter a market as long as the operating profit in this market is sufficiently large to cover market entry cost associated with the market. Because of the constant mark-up pricing, it is easily shown that operating profits equal revenues divided by σ. The critical cut-off levels of productivity needed in order to enter the domestic and foreign markets (for the operating profit to be as large as the discounted fixed cost of entry) are given by:

$$\varphi_D^{\sigma-1} A = F_D \tag{7}$$

$$\varphi_X'^{\sigma-1} \tau^{1-\sigma} A^F = F_X \tag{8}$$

where $F_D \equiv \delta\left(\sigma-1\right)^{1-\sigma} \sigma^{\sigma} \widetilde{F}_D$and $F_X \equiv \delta\left(\sigma-1\right)^{1-\sigma} \sigma^{\sigma} \widetilde{F}_X$. A and A^F indicate "per-firm demand" of the Home market and the Foreign market, respectively. Accounting also for free entry, which means that $E\left(\pi\right) = F_E$, yields that $A = A^F$. The reason for using the notation φ_X' is that the export cut-off will be different when wholesalers are introduced. Equations (7) and (8) yield the standard result from Melitz (2003) which can be summarized as follows (provided that $\frac{1}{\tau^{1-\sigma}} \frac{F_X}{F_D} > 1$):

Proposition 1 *In a world without wholesalers, only firms with a marginal productivity above φ_X' choose to export, firms with a productivity between φ_D and φ_X' serve the domestic market and firms with a marginal productivity below φ_D exit immediately.*

2.2 Introducing wholesalers

The third sector, which is the novel feature of the model, is the wholesale sector (variables relating to this sector are denoted by the superscript "W"). Wholesale firms are indexed by j and are homogeneous. The wholesale technology gives a wholesaler firm j the ability to source a range of goods and ship these to the Foreign country. The mass of goods that wholesaler j ships (equal to the mass of manufacturing firms the wholesaler is buying goods from) is denoted by m_j^W. The sector is characterized by free entry. A wholesaler faces the same cost as manufacturing firms to establish a retail channel in the foreign country, F_X, but has the technology to export several goods. Operations are assumed to become more costly the more goods a firm handles, so it also faces a per-period fixed cost that is monotonically and convexly increasing in the range of goods it handles. Its total fixed cost of foreign market entry is therefore:

$$F_{Xj}^{W} = F_X + \frac{\left(m_j^W\right)^{\gamma}}{\gamma} \tag{9}$$

where $\gamma > 1$ and m_j^W is the mass of domestic manufacturing goods the wholesale firm j is handling. Since manufacturing firms are atomistic and therefore has a mass equal to zero, if a wholesale firm were to only export one single good, its scope measure m_j^W would be zero and $\lim_{m_j^W \to 0} F_{Xj}^W = F_X$. Therefore, a wholesale firm which only exports one good has the same fixed cost of exporting as a manufacturer. Moreover, the functional form in (9) is chosen both for technical and intuitive reasons. The technical reason is that some convexity needs to be included in this function to put an upper bound on the scope of wholesalers. If it was not present (i.e. if $\gamma = 0$), the economies of scope would be infinite and only one wholesaler would exist and would export all goods. The intuitive reason is that it is more costly to maintain an international distribution system the more different goods are in nature. If m_j^W is low, the wholesaler is more specialized in a more narrow range of products, for example sport cars of different kinds. However, as m_j^W increases, the products necessarily become more different; in the specific example the whole firm also starts to export other types of cars and other types of motor vehicles etc., and the level of specialization decreases and the cost per product increases. The wider the scope, the more costly each product is to export.

I assume that a wholesaler gets the exclusive right to sell the manufacturing good in the foreign market (thereby excluding the possibility that more than one wholesaler sell the same manufacturing good). Since the wholesaler faces a CES demand abroad, its demand function towards manufacturing firms when procuring their products is also characterized by a CES structure. This causes manufacturing firms to charge the same price to wholesalers as they do to consumers. And since the manufacturer imposes a CES markup over its marginal cost and the wholesaler does the same, the final consumer price in the foreign economy for a good sold by a wholesaler is characterized by a “double marginalization”; the CES markup of $\frac{\sigma}{\sigma-1}$ is imposed twice.

$$p_{ij}^{W} = \left(\frac{\sigma}{\sigma - 1}\right)^2 \tau \varphi_i^{-1} \tag{10}$$

where p_{ij}^W is the price charged by wholesaler j selling manufacturing firm i’s good in the foreign market.[8]

Proposition 2 *A wholesaler imposes a double marginalization over the initial marginal cost of the producer.*

Proof. The marginal cost of wholesaler j consists of two parts. First, it pays an iceberg trade cost, τ, and, second, it pays the procurement price of the domestic manufacturing good (from manufacturer i). Since a monopolistically competitive manufacturer does not necessarily charge the same price to final consumers and wholesaler firms, the price manufacturer i charges wholesaler j is for now denoted by $p_{ij,P}$. The wholesaler's marginal cost, MC_{ij}^W of procuring ans shipping manufacturer i's good is then equal to

$$MC_{ij}^W = \tau p_{ij,P}.$$

The wholesaler faces the demand $A^F \left(p_{ij}^W\right)^{-\sigma}$ in the foreign economy where p_{ij}^W is the price that wholesale firm j charges for manufacturing firm i's good in Foreign. Faced with a CES type of demand, it will charge a constant markup over its marginal cost:

$$\begin{aligned} p_{ij}^W &= \frac{\sigma}{\sigma - 1} MC_{ij}^W \\ &= \frac{\sigma}{\sigma - 1} \tau p_{ij,P}. \end{aligned}$$

The demand for good i sold by wholesaler j in Foreign will be equal to $x_{ij} = A^F \left(\frac{\sigma}{\sigma-1} \tau p_{ij,P}\right)^{-\sigma}$ and wholesaler j's cost function is therefore:

$$C_{ij}^W \left(p_{ij,P}, x_i\right) = \tau p_{ij,P} x_{ij}$$

[8] It could be argued that imposing a double marginalization is a strong assumption. There are two aspects to this that makes me believe that this is not the case. First, it is an endogenous outcome of a CES setting which is standard in the literature: wholesalers are free to set their price and choose a CES markup when doing so since this is profit maximizing. Since the demand of their consumers is characterized by CES preferences, this causes their input demand (as derived by Shepard's lemma from the cost function of wholesalers) to be characterized by CES preferences as well, which motivates the markup choice by manufacturing firms. Second, even if wholesalers and manufacturers are allowed to negotiate, there are many reasons to believe that this contract in reality would not be completely non-distortionary and that there would indeed be some extra margin component which is paid to the wholesaler. But even so, in order for wholesalers to generate non-negative profits, they must charge the manufacturer (whose product it is buying) some strictly positive price for their services in order to cover their fixed costs. This additional price will make it more profitable for the manufacturer to export on its own if it can. Finally, the empirical facts that wholesalers and manufacturers co-exist in most export markets and that the most productive manufacturers choose to export on their own, as in McCann (2010) and Abel (2011), suggest that there is some reason for manufacturers to avoid using intermediation services if they can.

Applying Shephard's lemma to find wholesaler j's demand function for good i (i.e. the demand function that manufacturer i faces from wholesaler j), yields:

$$D_{ij}^{W}\left(p_{ij,P}\right)=\frac{\partial C_{ij}^{W}\left(p_{ij,P}\right)}{\partial p_{ij,P}}=\tau x_{ij}=\tau^{1-\sigma}A^{F}\left(\frac{\sigma}{\sigma-1}p_{ij,P}\right)^{-\sigma}.$$

This result has two important implications. First, the producer firm faces the exact same demand elasticity from wholesale firms as that from domestic consumers, and will therefore charge the same price to wholesalers as it does to domestic consumers (a constant markup over its marginal cost), $p_{ij,P}=p_i$. Second, it can be seen that the wholesaler will charge the following price in the foreign economy (foreign consumers have CES demand and the wholesaler will charge a standard CES markup over its marginal cost):

$$p_{ij}^{W}=\left(\frac{\sigma}{\sigma-1}\right)^{2}\tau\varphi_i^{-1}. \tag{11}$$

The term $\left(\frac{\sigma}{\sigma-1}\right)^{2}$ decreases in the elasticity of substitution which means that the degree of double marginalization is smaller in sectors where varieties are more substitutable. ■

Proposition 3 *The double marginalization is higher in less competitive sectors, i.e. in sectors characterized by low elasticities of substitution.*

Proof. See proof to Proposition 2.

Since manufacturers can choose their export mode (i.e. by establishing their own distribution system or exporting through a wholesaler), their choices are determined by what mode yields the highest profits from exporting. The expected profits (discounted by the forced exit rate δ) of a manufacturing firm i that exports through wholesaler j will be

$$\frac{1}{\delta}\left(p_{ij,P}\tau x_{ij}\left(p_{ij}^{W}\right)-\varphi_i^{-1}\tau x_{ij}\left(p_{ij}^{W}\right)\right)=\frac{1}{\delta}\tau^{1-\sigma}\varphi_i^{\sigma-1}A^{F}\left(\frac{\sigma-1}{\sigma}\right)^{2\sigma}\frac{1}{\sigma-1} \tag{12}$$

where $x_{ij}\left(p_{ij}^{W}\right)$ indicates foreign sales of good i at price p_{ij}^{W}, i.e. the price set by the wholesaler. The expected discounted profits of a manufacturing firm exporting on its own would be

$$\frac{1}{\delta}\left(\tau p_i x_i\left(\tau p_i\right)-\varphi_i^{-1}\tau x_i\left(\tau p_i\right)\right)-\widetilde{F}_X=\frac{1}{\delta}\tau^{1-\sigma}\varphi_i^{\sigma-1}A^{F}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\frac{1}{\sigma-1}-\widetilde{F}_X. \tag{13}$$

Comparing the profits for a manufacturing firm choosing between the two export modes yields the following condition, using (12) and (13), for the firm to choose to export on its own:

$$\varphi_i^{\sigma-1} > \frac{F_X}{\tau^{1-\sigma}A^F}\frac{1}{\left(1-\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\right)}. \tag{14}$$

This means that more productive firms will want to export on their own rather than through a wholesaler. This is due to the fact that they are productive enough to take the fixed cost of exporting themselves and avoid the markup incurred on them by the wholesaler. Note also that (14) defines the new export cut-off

$$\varphi_X^{\sigma-1} = \frac{1}{\left(1-\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\right)}\frac{F_X}{\tau^{1-\sigma}A^F} > \frac{F_X}{\tau^{1-\sigma}A^F} = \left(\varphi_X'\right)^{\sigma-1}.$$

The inequality sign demonstrates that, with wholesalers present, some producers that previously exported on their own now decide to use wholesalers instead. Therefore the export cut-off is higher with wholesalers in the model than without. This phenomenon is illustrated in figure 1. The lines π_X and π_W show the operating profits of manufacturing firm exporting on its own and exporting through a wholesaler, respectively, as functions of their productivity levels. The line π_W starts from zero since a manufacturing firm does not have to pay any fixed costs when exporting through a wholesaler. However, exporting directly requires paying a fixed cost F_X. The slope of π_W is lower than that of π_X due to the additional markup charged by the wholesaler. A manufacturer with productivity higher than φ_X will always have higher profits from exporting on its own ($\pi_X > \pi_W \ \forall \ \varphi > \varphi_X$).

Supposing that wholesalers only find it profitable to buy goods with a productivity higher than φ_W means that firms with productivity levels between φ_W and φ_X will prefer to export through a wholesaler rather than on their own. Also, the export cut-off in an economy without wholesalers, φ_X', will always lie to the left of φ_X, which can be seen in the graph. Note also that since wholesaler prices are higher, they also export smaller volumes per good. The reason that their prices are higher is due to (i) their additional markup and (ii) the fact that they export goods produced by less productive firms.

Finally, equation (14) shows that the degree of competition (the elasticity of substitution across varieties) in a sector affects the productivity cutoff for direct exporting since it determines the impact of the double marginalization imposed by wholesalers. Less competition (i.e. a smaller σ) means that the cutoff for direct exporting is lower since the wholesaler's additional margin is higher which makes it relatively more expensive to use.

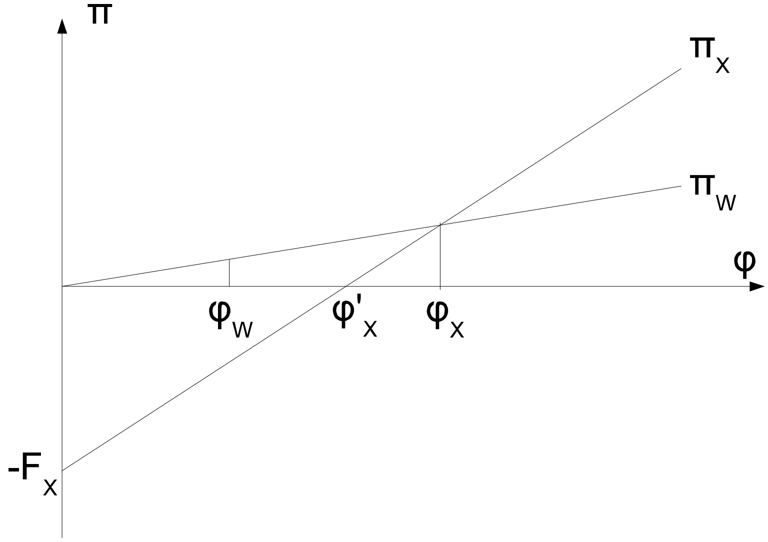

Figure 1: Relative profits for different export modes. π_X indicates the operating profit of a producer which exports on its own and π_W indicates the operating profit of a producer exporting through a wholesaler.

Proposition 4 *The model generates productivity sorting as regards choice of export mode. The most productive firms, $\varphi > \varphi_X$, export their products on their own, firms with intermediate productivity levels, $\varphi \in [\varphi_W, \varphi_X)$, export through wholesalers and the least productive firms, $\varphi \in [\varphi_D, \varphi_W)$, do not export. That $\varphi_D < \varphi_W$ has, however, to be assumed.*

Proposition 5 *Export sales per good are lower for wholesalers than for producers exporting on their own.*

Proposition 6 *Sectors characterized by less competition (low elasticity of substitution) have a lower export cutoff due to the stronger effect of the double marginalization imposed by wholesalers.*

Proof. See appendix A.1.

Wholesale firms are homogeneous and I assume that the atomistic manufacturing firms that use wholesalers for the distribution of their goods are randomly matched with wholesaler firms (see figure 2). This ensures that wholesaler firms in equilibrium will, on average, have identical baskets of goods that they export. They will therefore have the same number of products and also the same distribution of productivity among the goods in their baskets.[9] The scope of goods that wholesaler firms then handle will be equal to the mass of manufacturing firms that use wholesalers for exporting (i.e. those with a level of productivity between φ_W and φ_X). The mass of manufacturers in this range is $M^M \frac{G(\varphi_X)-G(\varphi_W)}{1-G(\varphi_D)}$ where M^M is the mass of manufacturing firms in total. The scope per wholesaler is then equal to this expression divided by the number of wholesale firms, n^W:

$$m_j^W = \frac{M^M}{n^W} \frac{G(\varphi_X) - G(\varphi_W)}{1 - G(\varphi_D)}. \tag{15}$$

The assumption of random matching between manufacturing firms and wholesalers may appear to be strong, especially given the convexity in the fixed cost function of wholesalers which indicates that wholesalers prefer to export products which are closer to each other

[9] Wholesalers control more than one good and are therefore no longer atomistic like the manufacturing firms. This could potentially have implications for how they affect prices, but it is assumed here that parameters are such that these baskets of atomistic products are still small enough not to have an effect on the aggregate price level. In a sense, a wholesaler could be labelled 'moleculistic', i.e. larger than an 'atomistic' firm but still small enough not to have an effect on the aggregate price level. In this context, it can also be noted that in the seminal contributions by, for example, Dixit and Stiglitz (1977) and Krugman (1979, 1980), the distribution of differentiated varities are discrete and not continuous such as in the more recent trade literature. With a discrete and finite set of varieties, all manufacturing firms are theoretically able to affect the aggregate price index so it has to be assumed that they do not.

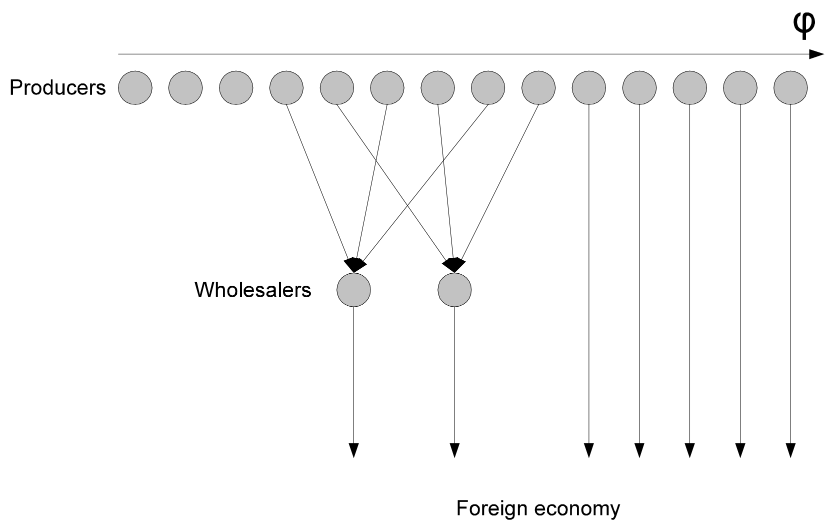

Figure 2: Productivity sorting and export mode.

in nature. However, the results would hold even if manufacturing firms were matched only within, for example, broader sector categories as long as wholesalers are homogenous in terms of costs. The key mechanism in the model, that wholesalers face a lower fixed cost per product, would hold even if manufacturers were matched less randomly. One example would be that some wholesalers are matched with more productive manufacturers than others. These wholesalers with a portfolio of more productively produced products would, however, still demand a markup from the producers, $(\sigma/(\sigma-1))$ with CES preferences, and therefore deter the most productive exporters but encourage manufacturers from the intermediate productivity range. Finally, even if wholesalers were assumed to be heterogeneous in terms of their cost function, and even if this would be correlated with markup they choose to set, this key difference between the two export modes would prevail due to the fact that all wholesalers, regardless of costs, must charge some markup for each good in order for them to finance the extra cost it means for them to add an additional product to their existing scope.

The total fixed cost of a wholesaler, as specified in equation (9) can be written:

$$\begin{aligned} F_{Xj}^{W} &= F_X + \frac{\left(m_j^W\right)^{\gamma}}{\gamma} \\ &= F_X + \frac{1}{\gamma}\left(\frac{M^M}{n^W}\frac{G\left(\varphi_X\right) - G\left(\varphi_W\right)}{1 - G\left(\varphi_D\right)}\right)^{\gamma} \end{aligned} \tag{16}$$

where φ_W is the marginal productivity of the least productive manufacturing firm that exports through wholesalers.

A wholesaler takes as given the number of other wholesale firms and the mass of domestic manufacturing firms and its pricing mechanism is, as described in equation (10), a constant markup over the marginal cost. Therefore the number of wholesale firms and the range of goods they consume can be determined by two conditions. First, the free entry condition for wholesalers states that the profits of wholesale firms should be zero. Second, an optimal scope condition by wholesalers, i.e. that the marginal increase in operating profits for a wholesaler firm to expand its set of goods distributed (its scope) must equal the resulting marginal increase in fixed costs, specifies the scope of each wholesale firm.

$$F_X + \frac{\left(m_j^W\right)^{\gamma}}{\gamma} = m_j^W \tilde{\pi}_j^W \quad \text{(Zero profit condition)} \tag{17}$$

$$\frac{\partial}{\partial m_j^W}\left(F_X + \left(\frac{m_j^W}{\gamma}\right)^{\gamma}\right) = \frac{\partial}{\partial m_j^W}\left(m_j^W \tilde{\pi}_j^W\right) \quad \text{(Optimal scope).} \tag{18}$$

These two conditions jointly determine the mass of manufacturing firms exporting through each wholesaler, m_j^W, and the weighted average of profit per good handled

$$m_j^W = F_X^{\frac{1}{\gamma}}\left(\frac{\gamma}{\gamma - 1}\right)^{\frac{1}{\gamma}} \tag{19}$$

$$\tilde{\pi}_j^W = F_X^{\frac{\gamma-1}{\gamma}}\left(\frac{\gamma}{\gamma - 1}\right)^{\frac{\gamma-1}{\gamma}}. \tag{20}$$

The fixed cost of exporting, F_X, is the key variable in understanding how the size of wholesaler firms is determined. A larger fixed cost of exporting forces wholesale firms to expand their scope so that the fixed cost is spread across more goods. It also makes the operating profit per good handled to be larger in equilibrium. The parameter determining how difficult it is for wholesalers to handle more goods, γ, also plays an important role. The elasticity of the optimal scope with respect to the fixed cost in equation (19) is $\frac{1}{\gamma}$ which decreases in γ; the more difficult it is to handle many goods, the less responsive is the scope of wholesalers to fixed costs.

Proposition 7 *The optimal scope of wholesalers increases in the size of the fixed cost of exporting.*

Proposition 8 *The elasticity of the optimal scope of wholesalers with respect to the fixed cost of exporting is lower when it is more difficult for wholesalers to expand their scope (when γ is high).*

To close the equilibrium, I note that the operating profit of wholesaler j selling good i is:

$$\pi_{ij}^{W} = p_{ij}^{W} x_{ij} - p_{ij,P}\tau x_{ij} = A^{F}\tau^{1-\sigma}\varphi_{i}^{\sigma-1}\left(\frac{\sigma}{\sigma-1}\right)^{1-2\sigma}\frac{1}{\sigma-1}.$$

Therefore, the total operating profit of wholesale firm j is

$$m_{j}^{W}\widetilde{\pi}_{j}^{W}(\varphi_{W},\varphi_{X}) = m_{j}^{W}\frac{1}{G(\varphi_{X})-G(\varphi_{W})}\tau^{1-\sigma}A^{F}\left(\frac{\sigma}{\sigma-1}\right)^{1-2\sigma}\frac{1}{\sigma-1}\int_{\varphi_{W}}^{\varphi_{X}}\varphi^{\sigma-1}dG(\varphi) \tag{21}$$

where $\widetilde{\pi}_{j}^{W}(\varphi_{W},\varphi_{X})$ is the average operating profit per good handled given the range of productivity in the basket.

Combining (20), and (21) gives:

$$\frac{1}{G(\varphi_{X})-G(\varphi_{W})}\tau^{1-\sigma}A^{F}\left(\frac{\sigma}{\sigma-1}\right)^{1-2\sigma}\frac{1}{\sigma-1}\int_{\varphi_{W}}^{\varphi_{X}}\varphi^{\sigma-1}dG(\varphi) = F_{X}^{\frac{\gamma-1}{\gamma}}\left(\frac{\gamma}{\gamma-1}\right)^{\frac{\gamma-1}{\gamma}} \tag{22}$$

where φ_{W} is the equilibrium level of the lowest productivity needed for a manufacturing firm to use a wholesaler firm to export.[10] The export cut-off, φ_{X}, is determined according to (8) by τ, F_{X} and A^{F}. The variable and fixed trade costs are exogenous but A^{F} is endogenous. Since the left side of (22) is monotonically increasing in φ_{W}, equation (22) yields an implicit solution for φ_{W} as a function of A^{F}.

[10] There is nothing in the model that ensures that $\varphi_{W} > \varphi_{D}$ (that manufacturers exporting through wholesalers need to be more productive than manufacturers producing for the domestic market). This has to be assumed but this restriction is similar to the assumption in the literature that $\varphi_{X} > \varphi_{D}$ (that exporters are more productive than nonexporters). In any case, this does not matter for the final results.

Using the equilibrium value for φ_W, it is also possible to find a solution for the number of wholesale firms by combining (15) and (19):

$$\frac{M^M}{n^W}\left(\frac{G(\varphi_X)-G(\varphi_W)}{1-G(\varphi_D)}\right)=F_X^{\frac{1}{\gamma}}\left(\frac{\gamma}{\gamma-1}\right)^{\frac{1}{\gamma}}. \tag{23}$$

Finally, the free entry condition for manufacturing firms says that, in expectation, the expected total profit of entrepreneur must equal the fixed entry cost:

$$\int_{\varphi_D}^{\infty}\left(\varphi^{\sigma-1}A-F_D\right)dG(\varphi)+\int_{\varphi_W}^{\varphi_X}\left(\varphi^{\sigma-1}\tau^{1-\sigma}A^F\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\right)dG(\varphi)$$
$$+\int_{\varphi_X}^{\infty}\left(\varphi^{\sigma-1}\tau^{1-\sigma}A^F-F_X\right)dG(\varphi)=F_E. \tag{24}$$

The set of equations (4), (7), (14), (22), (23) and (24) yield implicit solutions for the productivity cutoffs φ_D, φ_W, φ_X and the mass of wholesale and manufacturing firms, n^W, M^M. The 'per-firm demand' A in Home and A^F in Foreign are determined by the mass of firms, number of wholesalers together with the productivity cutoff levels through the expression for the price levels. This set of equations therefore defines a general equilibrium in the sense that there is free entry in all sectors, and that price levels and market demand are endogenous.

2.3 Imposing the Pareto distribution

To find exact expressions for the importance of wholesalers in the economy, the exact distribution of productivity, $G(\varphi)$ has to be specified. I therefore impose the scale-free Pareto distribution. which has been found to correspond reasonably well with observed distributions of firm productivity, see Axtell (2001) or Luttmer (2007). Now

$$G(\varphi)=1-\varphi^{-k},$$

where $\varphi\in[1,\infty)$. For solutions to exist it is also required that $\beta\equiv\frac{k}{\sigma-1}>1$.

To calculate the relative export volumes that occur by firms exporting on their own versus through wholesalers, it can be noted that the export volume of a good through the two export modes is:

$$V_{i,X}(\varphi_i) = p_i x_i = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \tau^{1-\sigma} \varphi_i^{\sigma-1} A^F \qquad \text{(direct exporting)} \tag{25}$$

$$V_{j,W}(\varphi_i) = p_{ij}^W x_{ij}^W = \left(\frac{\sigma}{\sigma-1}\right)^{2(1-\sigma)} \tau^{1-\sigma} \varphi_i^{\sigma-1} A^F \qquad \text{(wholesale).} \tag{26}$$

The ratio of total export volumes will therefore be

$$\frac{V_W}{V_X} = \frac{\int_{\varphi_W}^{\varphi_X} V_W(\varphi)\, dG(\varphi)}{\int_{\varphi_X}^{\infty} V_X(\varphi)\, dG(\varphi)} = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} \left(\left(\frac{\varphi_X}{\varphi_W}\right)^{k-(\sigma-1)} - 1\right), \tag{27}$$

which is an explicit function of the relative productivity cut-off levels φ_X and φ_W.

The relative mass of firms exporting on their own versus through wholesalers versus can be written

$$\frac{\int_{\varphi_W}^{\varphi_X} dG(\varphi)}{\int_{\varphi_X}^{\infty} dG(\varphi)} = \left(\frac{\varphi_X}{\varphi_W}\right)^k - 1 \tag{28}$$

which is also an explicit function of the relative productivity cutoffs.

To see what affects the relative importance of wholesalers in both total value, equation (27), and scope, equation (28), it is necessary to understand what affects the relative productivity cut-off, $\frac{\varphi_X}{\varphi_W}$. An explicit solution for φ_W cannot be found but by evaluating equation (22), the following nonlinear relationship can be found:

$$\frac{\left(\frac{\varphi_X}{\varphi_W}\right)^k - 1}{\left(\frac{\varphi_X}{\varphi_W}\right)^{k-(\sigma-1)} - 1} = \lambda_1 \left(F_X\left(\theta, w^F L^F\right)\right)^{\frac{1}{\gamma}} \tag{29}$$

where λ_1 is a constant of parameters.[11] The expression shows that the relative productivity cut-off increases in the fixed cost of exporting where I now, again, include country-specific characteristics as mentioned in the beginning of this section.

First, a higher fixed cost causes the relative productivity cut-off to *increase*. This, therefore, causes: (i) more firms to export through wholesalers (which is equivalent to more varieties or products being exported through wholesalers) and (ii) the relative export volume that is managed by wholesalers to increase. This result originates in the central dynamic provided by the model: the wholesale industry pools the export fixed costs across goods and therefore reduces the fixed cost per good, a feature which is more important when fixed

[11] $\lambda_1 \equiv \frac{k}{k-(\sigma-1)} \left(\frac{\gamma-1}{\gamma}\right)^{\frac{\gamma-1}{\gamma}} \frac{1}{\left(1-\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\right)} \frac{1}{\sigma} \left(\frac{\sigma-1}{\sigma}\right)^{2(\sigma-1)}$.

costs are large. We saw previously that a higher fixed cost causes wholesale firms to expand the set of goods that they handle. By doing so, the fixed cost per good decreases. Second, neither the variable trade cost, τ, or per firm demand, A^F, play any direct role for the choice of export mode. This is due to the fact that for the operating profit, these variables affect wholesalers and direct exporters in identical ways (the only way in which they can possibly affect the relative productivity cut-off is through their effect on the fixed cost).[12] The wholesale technology therefore exhibits an increasing returns to scale property with regard to product scope. An increase in the product scope lowers the fixed cost *per good*, making wholesalers more important as fixed costs increase.

The net effect of the elasticity of substitution, however, is unclear. As we saw in Proposition 6, more competition (higher σ) causes firms at the margin between choosing direct or wholesale exporting to opt for exporting through wholesalers. This should make σ increase the role played by wholesalers. However, a higher σ also makes price differences more important for revenues and profitability. When the elasticity of substitution is high, the additional markup imposed by wholesalers becomes more important for how much is actually sold and this has a negative effect on the aggregate role played by wholesalers in exporting.

The conclusions above can be summarized in the following two propositions.

Proposition 9 *A higher fixed cost is associated with (i) a higher share of total exports being shipped by wholesalers and (ii) a larger number of firms exporting through wholesalers relative to exporting on their own. This is due to the fact that wholesalers spread the fixed cost of exporting across more goods.*

Proof. The following is a proof that

$$\frac{\partial}{\partial x}\left(\frac{\left(\frac{\varphi_X}{\varphi_W}\right)^k-1}{\left(\frac{\varphi_X}{\varphi_W}\right)^{k-(\sigma-1)}-1}\right)>0 \quad \text{if } \frac{\varphi_X}{\varphi_W}>1 \text{ and } k>\sigma-1>0.$$

[12] Distance appears to significantly affect the importance of intermediaries in activities relating to foreign trade in many empirical studies. Indeed, the empirical analysis in this paper shows that wholesalers are more important in distant markets. While contrary to the results of this paper, a range of explanations can be argued to give this pattern. An obvious one is that the fixed cost of entering a foreign market increases with distance, since cultural barriers, supervision costs etc. are larger in markets far away than in those close to the home country of a firm. This would be in line with the theoretical predictions presented here.

Market size per firm, A^F, should not be confused with country size, L. In all theoretical models with a homogenous sector and free entry in the differentiated sector, e.g. Helpman, Melitz, and Yeaple (2004), the market size per firm, $A=\frac{\mu L}{P^{1-\sigma}}$, is in fact the same across countries regardless of population size (since the price level is lower in larger economies). Regardless of assumptions, the entry of firms (which lowers prices) always counterbalances an increase in country size and the net effect depends on assumptions.

First, the condition for the derivative to be positive can be simplified to

$$\left(\frac{\varphi_X}{\varphi_W}\right)^k \left(\sigma - 1 - kx^{\sigma-1-k}\right) + k - (\sigma - 1) > 0.$$

Now, consider the factors of the first term. $\left(\frac{\varphi_X}{\varphi_W}\right)^k$ is minimized when $\frac{\varphi_X}{\varphi_W} = 1$ and $\sigma - 1 - k\left(\frac{\varphi_X}{\varphi_W}\right)^{\sigma-1-k}$ is minimized when $\frac{\varphi_X}{\varphi_W} = 1$ (recall that $\frac{\varphi_X}{\varphi_W} > 1$ and $k > \sigma - 1$). When $\frac{\varphi_X}{\varphi_W} = 1$, the expression on the left hand side is equal to 0. However, as $\frac{\varphi_X}{\varphi_W}$ increases, both $\left(\frac{\varphi_X}{\varphi_W}\right)^k$ and $\sigma - 1 - k\left(\frac{\varphi_X}{\varphi_W}\right)^{\sigma-1-k}$ increase, meaning that the whole expression on the left hand side will increase. Therefore, the condition holds since $\frac{\varphi_X}{\varphi_W}$ has to be *strictly* greater than 1. ■

Proposition 10 *The net effect of the elasticity of substitution on the aggregate importance of wholesalers in exporting is uncertain.*

Proof. See appendix A.2.

Finally, if this model was expanded to a multicountry setting, the ratio of the productivity cutoffs, $\frac{\varphi_X^J}{\varphi_W^J}$, to each export destination J would depend on country J's fixed cost of entry. Since such costs differ across countries, many manufacturing firms would export directly to some countries but through a wholesaler to other countries. In this case, the equilibrium would contain firms that use both export modes at the same time but not, however, both export modes to the same country. This is the focus of the following section.

2.4 Gravity and Welfare

The model outlined above gives predictions for when wholesale firms are important for aggregate trade flows (both in terms of value of export flows and in terms of product scope). It also gives predictions for what firms select into which of the two export modes available. The advantage with the setup used so far is that it assumes free entry in both the manufacturing and wholesale industries and therefore generates a general equilibrium model. However, in this section, I make an important modification of the assumptions for two reasons. First, I wish to attain analytically solvable expressions for welfare, which in this model is measured by the price index. Second, I want to compare my model to a version of the model by Melitz (2003) that has become relatively standard in the literature, namely that of Chaney (2008). He estimates the effect of firm heterogeneity on the gravity model and modifies the 'multilateral resistance' variable proposed by Anderson and van Wincoop (2003).

This section therefore imposes the same assumptions for the manufacturing sector as Chaney (2008). Most importantly, free entry in the manufacturing sector, as in (24), is restricted.[13] Instead, there is a constant number of 'potential entrants' in country i, M_i^M, which is proportional to the size of that economy:

$$M_i^M = w_i L_i. \tag{30}$$

This means that the expected profit of firms is no longer zero. Instead, profits are collected into a global fund in which workers own shares according to their income. For comparability, I also assume that the productivity in the homogenous (agricultural) sector differs across countries which generates wage differences across countries. I denote the wage level in country i by w_i. The dividend per share in the global fund is equal to π and is the same across countries. Therefore, the output level in country i is equal to

$$Y_i = (1+\pi)\, w_i L_i. \tag{31}$$

The dividend, π, can therefore be written

$$\pi = \frac{\sum_i w_i L_i \left(\int_{\varphi_D^i}^{\infty} \pi_D^i(\varphi)\, dG(\varphi) + \sum_{j \neq i} \left(\int_{\varphi_X^{ij}}^{\infty} \pi_X^{ij}(\varphi)\, dG(\varphi) + \int_{\varphi_W^{ij}}^{\varphi_X^{ij}} \pi_W^{ij}(\varphi)\, dG(\varphi) \right) \right)}{\sum_j w_j L_j} \tag{32}$$

where $\pi_W^{ij}(\varphi)$ indicates the profits of a manufacturing firm with productivity φ from exporting through a wholesaler from country i to country j and $\pi_X^{ij}(\varphi)$ indicates the same but for direct exporting instead. The remaining assumptions are as before and wholesalers are assumed to be present in all countries. This provides the equilibrium conditions for all endogenous variables: $\varphi_D^i, \varphi_X^{ij}, \varphi_W^{ij}, Y^i, n_i^W, P_i\ \forall i, j$ and π. The variable n_i^W denotes the number of wholesale firms in country i.

Since nominal wages (measured in terms of the numeraire) are determined exogenously by each country's level of productivity in the homogenous sector, the relevant measure of welfare is the price index in the manufacturing sector weighted by the consumption share of manufacturing goods in the utility function: $P_i^{-\mu}$. It turns out that the model generates

[13] The reason for not choosing this restriction of entry already from the start is that the model generates all the results until this point while allowing for free entry which is the most preferable setup for a general equilibrium model.

an expression for the price level of manufacturing goods which is very similar to that found by Chaney (2008):

$$P_i = \lambda_2 Y_i^{\frac{1}{k}-\frac{1}{\sigma-1}} \theta_i$$

where

$$\theta_i^{-k} \equiv \frac{\sum_j \frac{Y_j}{Y_W} w_j^{-k} \tau_{ji}^{-k} \left(\rho^{\iota_{ij}} F_{ji}\right)^{1-\beta}}{1-\frac{\sigma\gamma}{\mu(\gamma-1)} \sum_{j\neq 1} \frac{n_j^W}{Y_i} F_{ji}} \tag{33}$$

and where ι_{ij} takes the value 1 if $i \neq j$ and 0 otherwise.[14]

Two components of this result are especially important. First, the presence of wholesalers in other countries, $n_j^W > 0$, lowers the price level in the Home country (country i above) which increases competition there and also raises welfare. Second, an increase in the fixed cost in a model without wholesalers increases the price level. However, when wholesalers are present, the positive effect of an increase in the fixed cost of entry from country j into country i is lower due to the presence of $n_j^W F_{ji}$ in the denominator. Wholesalers therefore mitigate the effect of fixed costs on price levels.

Finally, the variable described in equation (33) is this model's version of the so-called 'multilateral resistance' term highlighted by Anderson and van Wincoop (2003), an aggregate index of the remoteness of country i. Chaney (2008) calculates the multilateral resistance variable with his assumptions and finds:

$$\theta_i^{-k} \equiv \sum_j \frac{Y_j}{Y^W} w_j^{-k} \tau_{ji}^{-k} F_{ji}^{1-\beta}. \tag{34}$$

A comparison of equations (33) and (34) shows that the expressions are virtually identical except for the entry of ρ in the numerator and the effect of wholesale firms in the denominator. Since $n_j^W > 0$, it is therefore the case that the presence of wholesale firms lowers the price index in all countries and increases both welfare and competition as compared to the standard model in Chaney (2008). This effect is especially strong in bilateral relationships characterized by high fixed costs of entry. Moreover, it can be seen that the presence of wholesale firms (higher n_j^W) mitigates the effect of a higher fixed cost on the price level.

Proposition 11 *The presence of wholesalers in the economies of trading partners lowers*

[14] $\rho \equiv \frac{1}{1-\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}}$ and $\lambda_2 \equiv \left(\frac{\sigma}{\sigma-1}\right)^{\frac{1}{\beta}} \mu^{\frac{1}{k}-\frac{k}{\sigma-1}} \left(\frac{\beta-1}{\beta}\right)^{\frac{1}{k}} Y_W^{-\frac{1}{k}} (1+\pi)^{\frac{1}{k}}$.

a country's price index and increases welfare and competition in this country. Moreover, the presence of wholesalers mitigates the effect of an increase in the fixed cost on the price index.

3 Empirical evidence

3.1 Data

I use a dataset from Statistics Sweden which contains information on the economic activities of the universe of Swedish firms in 2005 (a firm is defined as the legal unit). The data is collected by the Swedish tax authority (Skatteverket) and contains information on, for example, total annual revenues, number of employees (reported once every year at a certain point in time), total fixed assets (which I denote as capital, this variable comes from the balance sheet data of firms). A firm in this dataset is classified according to its main business activity, and my analysis utilizes firms that are listed as 'wholesalers' and firms active in any of the manufacturing sectors.[15] The only restriction I make is to exclude firms with no employees. Because misreporting is prosecuted and these data are subjected to quality controls by statisticians at Statistics Sweden, measurement errors are most likely rare.

Through a common firm identifier, I match this data with a trade dataset collected by Swedish Customs (Tullverket) which records all trade flows per firm, product code (according to the Combined Nomenclature, CN, up to 8 digits) and destination country. The CN is a classification system used by the European Commission in its external statistics and it is based on the Harmonized System of product classification. I use only exporting firms (about 35% of both manufacturers and wholesalers export) and in 2005 there were 7,281 wholesaler firms exporting and 8,798 manufacturing firms. In total 469,437 transactions are reported over 8,283 CN8 categories and 194 destination countries. I only conduct a cross-sectional analysis in this study since a panel study with several years would only use variation in the definition of a firm's main business activity (which would not be very informative) or in the destination country characteristics and this variation is very small.

[15] Confidentiality requirements prevent me from giving specific examples of how firms are classified.

TABLE 1

Descriptive statistics (only exporting firms included)

	Wholesalers	Manufacturers		Wholesalers	Manufacturers
Number of firms	7 281	8 798			
Total exports (1000 SEK)			Capital intensity (%)		
Mean	14 973	76 065	Mean	21	24
10th perc.	7	9	10th perc.	0.6	1.0
Median	237	622	Median	4	11
90th perc.	16 454	65 547	90th perc.	40	47
Product scope (CN8)			Labor intensity $\left(\frac{\text{employees}}{\text{MSEK output}}\right)$		
Mean	11	8	Mean	1.3	0.8
10th perc.	1	1	10th perc.	0.5	0.3
Median	3	3	Median	1.0	0.7
90th perc.	22	18	90th perc.	2.0	1.4
Export destinations			Turnover (1000 SEK)		
Mean	4.2	7.5	Mean	26 500	160 000
10th perc.	1	1	10th perc.	969	2 235
Median	2	2	Median	5 721	16 600
90th perc.	11	22	90th perc.	42 000	185 000

Due to the extreme detail of the CN8 classification, I use the number of CN8 categories exported by a firm as a proxy for the number of products exported by a firm. As stated, I observe more than 8,000 product categories in the data. An example of its level of detail is the subcategory CN code 6601 containing umbrellas. These are divided into "Garden or similar umbrellas" and "Other umbrellas". The latter category is divided into umbrellas with a "telescopic shaft" and those without. These are then divided into umbrellas with a "cover of woven textiles" and those without. It therefore seems reasonable to view a CN8 category as a manufacturing variety (or a product, the two are equivalent in the model) in the analysis. CN4 categories (Combined Nomenclature at the four-digit aggregation level) are used as a control for a more aggregated sector classification. Any reference in the following text to 'sectors' therefore refer to CN4 aggregates. Moreover, I interpret the value of exports observed in my data as the export volume of firms. Of course, differences in pricing behaviour may then affect my results but it is impossible to differentiate between price differences due to differences in productivity, quality and markups (which are all likely to be correlated with eachother and also likely to affect prices).

The average number of CN8 product categories that a firm exported was 11 for wholesalers and 8 for manufacturers. However, manufacturers were much larger and accounted for 86% of aggregate export volumes (measured in SEK). As a reference point, 1 US dollar was worth between 6.9 and 8 SEK in 2005.

As for market size (GDP) and the institutional variables used, all data comes from the World Bank's World Development Indicators (WDI) and Doing Business databases. Distance measures are from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).

Table 1 reports descriptive statistics for exporting wholesalers and manufacturers. The main conclusion from this table is that manufacturing firms are much larger than wholesale firms on average, both in terms of turnover, number of workers and capital employed. Moreover, despite the smaller size of wholesalers, they export a larger number of products than manufacturers.[16]

3.2 Main assumption and predictions

This section will assess empirically the main assumption on which the model builds and also the four main hypotheses that it gives. The underlying assumption of the model is that the wholesale technology is characterized by economies of scope, while that of manufacturers is not. This is a somewhat stylized assumption used in order to focus on the dynamics linked to a case in which wholesalers have *more* economies of scope compared to manufacturers (that wholesalers have a comparative advantage in generating economies of scope in exporting). We already know from a vast literature that manufactures often sell more than one product and that firms doing so are often very important.[17] However, one way to see whether the assumption of this paper is reasonable is to look at whether wholesalers on average sell more

[16] The variables revenues, capital and employees come from the firm dataset. This information is reported annually by firms to Statistics Sweden and refer to the total annual revenues of a firm (in SEK), the total stock of fixed assets (in SEK) and a firm's total number of employees at a certain point in time every year. Capital intensity is calculated as the value of the stock of capital divided by total annual revenues.

[17] See, for example, Bernard, Redding, and Schott (2010).

products than manufacturers, generally and when controlling for different characteristics of these firms such as sector, export destinations and size. This is the first analysis performed in the empirical section.

The main empirical predictions of the model are:

1. Export sales per good are lower for wholesalers than for producers exporting on their own (Proposition 5).

2. A larger share of aggregate export volumes is handled by wholesalers to countries with high fixed costs of entry (Proposition 9).

3. A larger share of the number of exported goods is handled by wholesalers to countries with high fixed costs of entry (Proposition 9).

4. Producers sort according to productivity when choosing export mode (Proposition 4).

The first prediction originates from the fact that goods sold abroad through wholesalers are produced in a less productive way than other export goods and the fact that wholesalers charge an additional markup. The following two predictions, however, are both related to the core mechanism highlighted in the theoretical section: when fixed costs increase, the ability of wholesalers to generate economies of scope by spreading the fixed cost of entry across more goods becomes more valuable. Variation in both variables listed is therefore driven by the variation in fixed costs. Measures of fixed costs of entry are always imperfect but a reasonable proxy would be measures of institutional quality which relate to trade and these are used in the analysis.

Finally, one important prediction remains which I cannot test with the data currently at hand: that manufacturing firms sort according to productivity as regards export mode (Result 4). Due to the fact that intermediated exporting, as opposed to direct exporting, entails a lower fixed cost but a higher variable cost, it follows that, in a framework as in Melitz (2003), the most productive firms will choose to export on their own while firms with intermediate productivity will choose to export through a wholesaler. Since I cannot observe sales by manufacturers to wholesalers inside Sweden, I do not test the prediction of productivity sorting and export mode. However, early evidence by, for example, Abel (2011) and McCann (2010), build on a dataset provided by the World Bank which includes a sample of firms from several different developing countries. Interestingly, this data includes mode of export and both authors find robust evidence that the firms which choose direct exporting are more productive than those which choose indirect exporting.

3.3 Economies of scope

As stated, the underlying assumption of the paper is that the wholesale technology is characterized by economies of scope: wholesale firms are able to distribute more than one product internationally. We know, however, that many manufacturers in reality distribute more than one good but the theoretical section is set up such that the effect of a difference between wholesalers and manufacturers is seen in its simplest form. One way to test this assumption in the data, however, would be to see whether wholesalers, on average, export more products controlling for firm size, destination and sector effects. I do this by running the following OLS regression:

$$Scope_{isc} = \alpha + \beta W_i + \gamma size_i + f_s + f_c + \varepsilon_{ijl} \tag{35}$$

where $Scope_{isc}$ denotes the number of CN8 product codes exported by firm i to country c in sector s. W_i takes the value 1 if the product is sold by a wholesale firm and 0 if it is sold by a manufacturer. The variable $size_i$ denotes the logarithm of revenues of firm i and is included since it is well known that larger firms tend to produce and export a wider scope of products. To account for characteristics of specific product categories and specific markets, fixed effects are included for sectors, f_s, and destination countries, f_c. Otherwise, if wholesalers export within different categories than manufacturers, or serve different markets, the coefficient might be biased. Finally, it is quite possible that the errors are correlated within countries. This would yield artificially low estimates of the standard errors given that the number of destinations is relatively low (194 countries are included) but the number of observations fairly high (there are 96,273 combinations of firms and destinations).[18] The standard errors reported here are therefore clustered at the country level.

The coefficient β measures how much larger the product scope per country is for wholesalers compared to manufacturers. The assumption used in the paper would correspond to β being positive. Table 2 reports the results.

[18] See Donald and Lang (2007) for a discussion.

TABLE 2

	(1)	(2)	(3)
Dep. variable: Product scope per firm and destination (in logarithms)			
Wholesale dummy	0.144***	0.0976*	0.443***
	(0.0493)	(0.0414)	(0.0463)
Firms size (in logarithms)			0.216***
			(0.0099)
Fixed effects			
Destination	NO	YES	YES
Observations	96 273	96 273	96 130
R^2	0.005	0.052	0.194

The dependent variable is the logarithmic value of the number of CN8 products exported by each firm. The explanatory variables are (i) a dummy for whether the firm is classified as a wholesaler according to Statistics Sweden and (ii) the logarithmic value of firms' revenues. Standard errors are clustered at the country level and reported in parentheses. All regressions include destination specific effects.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

It can be seen that estimated difference in scope is positive and significant in all columns, which supports the main assumption used in the theoretical section. When the size of firms is not included, the difference is not too large and around 10%. But when I take into account that wholesalers are much smaller in size, on average, by including the logarithm of firms' revenues, the estimated difference is fairly large, around 0.43 (translating into a 56% difference). This is a fairly large number given that the average product scope of firms is around 10. I therefore conclude that there is an important difference in terms of scope between wholesalers and manufacturing firms.

3.4 Export sales per product

This part examines whether sales per good are lower for wholesalers than manufacturers. The theoretical motivation for this is that wholesalers handle goods that are produced with lower productivity than manufacturers and are therefore more expensive. Moreover, wholesalers need to charge an extra markup which exporting manufacturers do not.

As noted, manufacturers account for 86% of aggregate exports which gives an indication that this prediction holds. However, to account for effects that are specific for products and destination countries, a regression analysis using fixed effects for these variables is carried out.

The regression equation is:

$$x_{ipc} = \alpha + \beta W_i + \gamma size_i + f_p + f_c + \varepsilon_{ipc} \tag{36}$$

where x_{ipc} is the logarithm of the value of exports of product p by firm i to country c. The coefficient β therefore measures the difference in export levels *per good* between wholesalers and manufacturers. It is possible that the error terms are correlated within countries and the standard errors reported here are therefore clustered at the country level. It is, of course, possible, that the errors are correlated at the product level too but since the product categories are of such detail (there are 8,283 CN8 categories) this is most surely of less worry than any correlation at the country level. Indeed, the standard errors are substantially smaller when they are clustered at the product level instead of the country level. Table 3 lists the result of these regressions.

TABLE 3

	(1)	(2)	(3)	(4)	(5)
Dep. variable: Log(export value)					
Wholesale dummy	-0.687***	-0.399***	-0.770***	-0.540***	-0.543***
	(0.0562)	(0.0403)	(0.0563)	(0.0475)	(0.0828)
Firm size (in logarithms)					-0.00186
					(0.0276)
Fixed effects					
Product	NO	YES	NO	YES	YES
Destination	NO	NO	YES	YES	YES
Observations	469 437	469 437	469 437	469 437	468 710
R^2	0.013	0.236	0.033	0.464	0.465

The dependent variable is the logarithmic form of the value of exports of firms for each product and destination. The explanatory variables are (i) a dummy for whether the firm is classified as a wholesaler according to Statistics Sweden and (ii) the logarithmic value of firms' revenues. Standard errors are clustered at the country level and reported in parenthesis. All regressions include fixed effects as specified.

*** p<0.01, ** p<0.05, * p<0.1.

The regressions indicate that wholesalers, on average, sell between 33% and 54% less of a given product to a given country. The negative effect is significant at the 1% level for all four combinations of fixed effects. The results therefore suggest that the prediction holds: wholesalers sell less per good than producers. The change in magnitude of the estimated difference, when I include fixed effects, is of some magnitude (which means that there is some selection of firms, especially as regards product categories). This effect, however, is not large and the results are qualitatively similar. The effect of including the size of firms does not influence the outcome either.

3.5 Importance of wholesalers and fixed costs in destination countries

Regarding predictions 2 to 3, the explanatory variable is the fixed cost of entry in both cases. Therefore, these predictions will be examined in the same context in this section. The theory states that a higher fixed cost increases the importance of the wholesalers' ability of generating economies of scope. Wholesalers are able to spread the fixed cost across several products and are therefore better equipped to export to markets where the fixed cost is high. They therefore also control a larger share of export volumes and export scope to markets with higher fixed costs of entry.

Since observable measures of variation in fixed entry costs across countries do not exist, I have to use proxy variables. These variables have to fulfill two criteria: (i) they have to be a relevant proxy for fixed costs in international trade, and (ii) they have to be available for a large enough number of countries. This leads me to use measures of institutions relating to international trade as proxy variables for fixed costs of foreign market entry, and more specifically the following measures from the World Bank: (i) the time required to start a business, (ii) the number of procedures needed to open a warehouse, (iii) the time required to open a warehouse, and (iv) the cost, time and number of documents needed to import.[19] These variables have been used in other studies for this purpose, for example Ahn, Khandelwal, and Wei (2010) and Bernard, Grazzi, and Tomasi (2011), and are often argued to be reasonable proxies for the type of fixed costs present in the model. This argument is based on the assumption that the costs of the bureaucracy, and possible corruption, involved when institutions are poor are much more fixed than variable in nature, such as the costs of obtaining the initial permits to enter the market or constructing the buildings and infrastructure needed for a viable distribution network.

To see the effect that fixed costs have on the importance of wholesalers, the following regressions are used:

$$\left(\frac{V_W}{V_W + V_X}\right)_{sc} = \beta_0 + \beta_1 Q_c + \beta_2 \log(Y_c) + \beta_3 \log(dist_c) + f_s + \varepsilon_i \quad (37)$$

$$\left(\frac{N_W}{N_W + N_X}\right)_{sc} = \beta_0 + \beta_1 Q_c + \beta_2 \log(Y_c) + \beta_3 \log(dist_c) + f_s + \varepsilon_i \quad (38)$$

where $\left(\frac{V_W}{V_W+V_X}\right)_{sc}$ denotes wholesalers' share of aggregate export volumes in sector s (a

[19] The first three variables (reported in Table 4a) are collected from the World Bank's World Development Indicators and the last three (Table 4b) are from the World Bank's Doing Business Survey. The last three variables were not available for 2005 so instead data from 2006 is used.

sector here is a CN4 category) to destination country c, $\left(\frac{N_W}{N_W+N_X}\right)_{sc}$ the share of CN8 products handled by wholesalers in sector s which are exported to country c, Q_c the institutional measure for country c (logarithmic values are used), Y_c the level of GDP of country c, $dist_c$ the distance from Sweden to country c and f_s a sector fixed effect. Both GDP and distance are in logarithms as well. Fixed effects are used here to control for technological differences in export mode across sectors. In this and the following section, only product and destination pairs where wholesalers are active are included in the analysis, since this is the situation on which the model focuses.

As regards the error terms, these are likely to be correlated both within countries as well as within sectors. I therefore apply the multiway clustering method as described in Cameron, Gelbach, and Miller (2011) and cluster on both destination and sector.

TABLE 4a

	(1)	(2)	(3)	(4)	(5)	(6)
	Share of total exports handled			Share of scope handled		
Dep. variables:	by wholesalers			by wholesalers		
Time to start	0.0203**			0.0191***		
business	(0.00993)			(0.00695)		
Procedures to		0.0396**			0.0273***	
open a warehouse		(0.0173)			(0.00914)	
Time to open a			0.0212			0.0157
warehouse			(0.0137)			(0.00969)
GDP	-0.0558***	-0.0575***	-0.0574***	-0.0364***	-0.0382***	-0.0380***
	(0.00495)	(0.00506)	(0.00491)	(0.00325)	(0.00348)	(0.00343)
Distance	0.0477***	0.0490***	0.0498***	0.0271***	0.0288***	0.0292***
	(0.0127)	(0.0127)	(0.0131)	(0.0101)	(0.0103)	(0.0107)
Fixed effects						
Sector (CN4)	YES	YES	YES	YES	YES	YES
Observations	21 779	21 779	21 779	21 779	21 779	21 779
R^2	0.50	0.50	0.50	0.51	0.50	0.50

The dependent variable is the relative importance of wholesalers relative to manufacturing firms in exporting, both in terms of total value of exports as well as product scope. The explanatory variables are the logarithmic values of institutional measures from the World Bank as well as GDP and distance. All regressions are run at the sector (CN4) and destination level. Standard errors in parentheses. These are clustered on both destination and sector (CN4) according to the multiway clustering method described in Cameron, Gelbach and Miller (forthcoming). All regressions include fixed effects at the CN4 sector level.

*** p<0.01, ** p<0.05, * p<0.1.

TABLE 4b

	(1)	(2)	(3)	(4)	(5)	(6)
	Share of total exports handled			Share of scope handled		
Dep. variables:	by wholesalers			by wholesalers		
Documents to	0.0791***			0.0505***		
import	(0.0203)			(0.0153)		
Cost to import		0.0260			0.0320**	
		(0.0218)			(0.0151)	
Time to import			0.0672***			0.0463***
			(0.0138)			(0.00960)
GDP	-0.0539***	-0.0566***	-0.0490***	-0.0353***	-0.0364***	-0.0318***
	(0.00502)	(0.00525)	(0.00461)	(0.00342)	(0.00364)	(0.00315)
Distance	0.0343***	0.0473***	0.0303***	0.0189***	0.0255***	0.0153*
	(0.0119)	(0.0136)	(0.0115)	(0.00948)	(0.0109)	(0.00895)
Fixed effects						
Sector (CN4)	YES	YES	YES	YES	YES	YES
Observations	21 707	21 707	21 707	21 707	21 707	21 707
R^2	0.50	0.50	0.51	0.51	0.50	0.51

See Table 4a.

Tables 4a and 4b report the regression result for equations (37) and (38). All the measures of institutional qualities have positive signs in the regression and almost all are significant. [20] If these variables are good proxies of the fixed cost of entering a specific market, then the regression results mean that wholesalers are more important, both in quantity and scope, for entering markets characterized by large fixed costs.

Distance appears to significantly affect the importance of wholesalers and with a positive sign. Regarding the effect of GDP, I find that wholesalers account for a smaller share to larger countries. Analyzing the effect of distance and GDP through the lens of my model, where they only affect the outcome variable through the fixed cost, would indeed mean that a larger distance is associated with a larger fixed cost of entry and that larger markets are associated with smaller fixed costs. Regarding distance, it is not unlikely that the fixed cost of entering a foreign market does indeed increase with distance since cultural barriers,

[20] If the standard errors are not clustered, all coefficients are significant at the one percentage significance level, indicating that the errors are to some extent correlated within countries and sectors.

supervision costs etc. are obviously larger in markets far away than those close to the home country of a firm. As regards GDP, a number of studies (see for example Mayer and Ottaviano (2008)) have found that larger economies attract more exporters which suggest a smaller fixed cost of entry. Arkolakis (2010), for example, argues that this depends on decreasing returns to scale in the technology of market entry and that exporters with a low productivity can enter a foreign market by just targeting a limited share of the consumers in that market. It might also be the case that the fact that many firms export to a larger market in some way causes "knowledge spillovers" among firms about how to enter that market which makes it relatively easier to enter a larger market.

4 Conclusion

The paper presents a model that gives a rationale for the presence of wholesalers and intermediaries in international trade. Wholesalers possess a technology that allows them to use their international distribution network to handle more than one good (although the fixed cost increases in the number of goods they handle), while the producers of these goods (manufacturing firms) can only export their own good. In order to cover the fixed cost of exporting, wholesalers charge a markup between the price at which they procure the good and the final price that they charge in the foreign country. This markup causes manufacturing firms to export on their own as long as they are productive enough to cover the fixed cost of doing so. However, if they are not productive enough, they will instead try to sell their good to the foreign market through a wholesaler's distribution network. This process results in productivity sorting in the choice of export mode: the most productive firms export on their own while less productive firms export through wholesalers. The least productive firms do not export at all.

When aggregated, this generates new results for what affects the importance played by wholesalers in international trade, especially for the share of exports as well as the share of products that are shipped through wholesalers' networks. The fixed cost of exporting plays an important role: the higher the fixed cost of exporting, the more important are wholesalers. This is the case since wholesalers can spread the fixed cost over several goods, as opposed to manufacturing firms, which need to incur one fixed cost for their single good. As fixed costs become more important, firms shift to exporting through wholesalers (which expand the number of goods they handle) to benefit from the lower fixed costs per good exported. Wholesalers therefore assist those firms which are not productive enough to export on their own to do so.

This microeconomic foundation is also used to derive equilibrium price indices in a multicountry framework. It is found that the presence of wholesalers lowers price indices in countries with which they trade. Therefore, wholesalers increase welfare and competition in these countries. Finally, the presence of wholesalers mitigates the effect of fixed costs on price levels.

The empirical section supports the main assumption and predictions of the model. First, Swedish wholesalers export a broader range (56%) of products than manufacturers. Second, wholesalers export smaller amounts of each product, even when the effect of which particular product it concerns or which country the good is exported to is controlled for. Finally, wholesalers are more important, both in quantity and scope, for markets characterized by high fixed costs. The empirical analysis therefore supports the notion that wholesalers play a larger role in exporting to countries characterized by larger fixed costs of entry.

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A Appendix

A.1 Proof to Proposition 6

I define

$$v \equiv \log\left(\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\right) = \sigma \log\left(\frac{\sigma-1}{\sigma}\right).$$

This means that:

$$\begin{aligned} v' &= \log\left(\frac{\sigma-1}{\sigma}\right) + \frac{1}{\sigma-1} \\ v'' &= -\frac{1}{\sigma\left(\sigma-1\right)^2}. \end{aligned}$$

Therefore:

$$\begin{aligned} \lim_{\sigma\to 1^+} v &= -\infty \\ \lim_{\sigma\to\infty} v &= \lim_{\sigma\to\infty} v' = 0 \end{aligned}$$

where l'Hôpital's rule is used in the second equality. To find the sign of v', I note that

$$v'' = -\frac{1}{\sigma\left(\sigma-1\right)^2} < 0.$$

The limit values of v' are

$$\begin{aligned} \lim_{\sigma\to 1^+} v' &= \infty \\ \lim_{\sigma\to\infty} v' &= 0. \end{aligned}$$

Since we know that v' decreases in σ at all possible values of σ (because $v'' < 0$) and approaches zero when $\sigma \to \infty$, it must therefore always be strictly positive in the space $\sigma \in (1, \infty)$. Therefore, we know that v always increases in σ. Furthermore, we know that $\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \in (0,1)$ since $\lim_{\sigma\to 1^+} e^{v(\sigma)} = 0$, $\lim_{\sigma\to\infty} e^{v(\sigma)} = 1$ and $v' > 0 \quad \forall \sigma \in (1,\infty)$. ■

A.2 Proof to Proposition 10

Equation (29) can be rewritten as

$$u\left(\frac{\varphi_X}{\varphi_W},\sigma\right)=\theta(\sigma)\,v(\sigma)$$

where

$$\begin{aligned}
u\left(\frac{\varphi_X}{\varphi_W},\sigma\right) &\equiv \frac{\left(\frac{\varphi_X}{\varphi_W}\right)^k-1}{\left(\frac{\varphi_X}{\varphi_W}\right)^{k-(\sigma-1)}-1}\\
v(\sigma) &\equiv \frac{1}{\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{2(\sigma-1)}\\
\theta(\sigma) &\equiv \frac{1}{\left(1-\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}\right)}\frac{k}{k-(\sigma-1)}F_X^{\frac{1}{\gamma}}.
\end{aligned}$$

Then, the total derivative of equation (29) can be formulated as

$$\begin{aligned}
u_{\frac{\varphi_X}{\varphi_W}}d\left(\frac{\varphi_X}{\varphi_W}\right)+u_\sigma d\sigma &= \left(\theta_\sigma v+\theta v_\sigma\right)d\sigma\\
\frac{d\left(\frac{\varphi_X}{\varphi_W}\right)}{d\sigma} &= \frac{\theta_\sigma v+\theta v_\sigma-u_\sigma}{u_{\frac{\varphi_X}{\varphi_W}}}.
\end{aligned} \tag{39}$$

We know that $u_{\frac{\varphi_X}{\varphi_W}}$ is positive from the proof to Proposition 9. Then,

$$u_\sigma=\frac{\left(\frac{\varphi_X}{\varphi_W}\right)^k-1}{\left(\left(\frac{\varphi_X}{\varphi_W}\right)^{k-(\sigma-1)}-1\right)^2}\left(\frac{\varphi_X}{\varphi_W}\right)^{k-(\sigma-1)}\log\left(\frac{\varphi_X}{\varphi_W}\right)>0$$

since $\frac{\varphi_X}{\varphi_W}>1$ and $k>(\sigma-1)$.

Turning to v_σ, evaluating the sign of the derivative of $\log v(\sigma)$ instead of $v(\sigma)$ is equivalent since the logarithm is a monotonic transformation.

$$\begin{aligned}
\log v(\sigma) &= -\log\sigma + 2(\sigma-1)\log\left(\frac{\sigma-1}{\sigma}\right) \\
\frac{\partial}{\partial\sigma}\log v(\sigma) &= 2\log\left(\frac{\sigma-1}{\sigma}\right) + \frac{1}{\sigma} \\
\frac{\partial^2}{\partial\sigma^2}\log v(\sigma) &= \frac{\sigma+1}{\sigma^2(\sigma-1)} \\
&= \frac{1}{\sigma^2}\left(\frac{\sigma+1}{\sigma-1}\right) > 0
\end{aligned}$$

since $\sigma > 1$. Since the second derivative is always positive, the first derivative will have its maximum when σ approaches infinity. The first derivative must therefore always be negative since $\lim_{\sigma\to 1^+} \frac{\partial}{\partial\sigma}\log v(\sigma) = -\infty$ and $\lim_{\sigma\to\infty} \frac{\partial}{\partial\sigma}\log v(\sigma) = 0$. Therefore, $\frac{\partial}{\partial\sigma}\log v(\sigma) < 0$ and also $\frac{\partial}{\partial\sigma}v(\sigma) < 0 \quad \forall\sigma \in (1,\infty)$.

However, we also know that $\theta_\sigma > 0$ since

$$\frac{\partial}{\partial\sigma}\left(\frac{1}{\left(1-\left(\frac{\sigma-1}{\sigma}\right)^\sigma\right)}\right) > 0$$

from the proof to Proposition 6. This means that the net effect in the numerator in equation (39) is unclear since $\theta_\sigma > 0$ but v_σ and $-u_\sigma$ are negative. ■