Endogenous Export Modes*

Gabriel J. Felbermayr and Benjamin Jung†

Eberhard Karls University, Tübingen, Germany

June, 2007

Abstract

Empirical evidence and the business literature suggest that exporting requires either a foreign partner or an own foreign sales representation. Standard trade models abstract from this fact. We propose a general equilibrium business-to-business matching model in which heterogeneous producers may seek a foreign general importer. Alternatively, producers may establish a foreign affiliate. Exporters select into either of those modes depending on their productivity, brand reputation, and the tradability of their goods. Market access costs and the size of the non-tradables sector are endogenously determined. The additional trading friction sheds light on the "missing trade puzzle" discussed in the empirical literature.

Keywords: Heterogeneous firms, international trade, export modes, search externalities, business-to-business matching, double marginalization, missing-trade-puzzle.

JEL-Codes: F12, F15

---

*We are grateful to Julien Prat, Wilhelm Kohler, Horst Raff, Farid Toubal, Jörn Kleinert, and seminar participants at the ETSG Meeting 2006 in Vienna, and at a workshop at Tübingen university for comments and discussion. All remaining errors are ours. This is a preliminary draft; please do not circulate.

†E-mail: gabriel.felbermayr@uni-tuebingen.de; benjamin.jung@uni-tuebingen.de. Address: Economics Department, Eberhard Karls University Tübingen, Nauklerstrasse 47, 72074 Tübingen, Germany.

1 Introduction

Firms wishing to export their products to foreign markets either require a *local foreign partner*, who acts as a 'general importer' or a trade intermediator. Or they need deep pockets to set up an *own sales representation*. The choice of export modes plays a key role in strategic management decisions and has received considerable attention in the academic business literature.

A series of articles in the J*ournal of International Business Studies* has highlighted the overall importance of trade intermediation, and its relative prevalence across sectors (see, e.g., Peng and Ilinitch, 2002 and Trabold, 2004). There is also evidence on the huge importance of trade intermediation in history (Greif, 1993) and for small specialized economies such as Hong-Kong or Singapore (Feenstra and Hanson, 2004; Feenstra, Hanson, and Lin, 2004). On the other hand, Kleinert and Toubal (2005, 2006) document the empirical importance of wholesale affiliates as a specific form of foreign direct investment. Fryges (2007) reports that sizeable shares of firms select into different export modes. Recently, starting with Rauch (1999), there is a growing literature on the role of formal and informal networks for the determination of bilateral trade volumes. Empirical evidence presented by Rauch and Trindade (2002) and Combes et al. (2005) lends support to the idea that the international matching of buyers and sellers involves important frictions.[1]

Despite the strong empirical evidence, trade intermediation and wholesale affiliates do not play any role in canonical trade models. The older literature ignores trdae costs altogether; the new trade models pioneered by Krugman (1979) have taken variable trade costs serious. Only very recently, Melitz (2003) models fixed costs of foreign market access ('beachhead costs'; see Baldwin, 1988), which can be interpreted as foreign direct investment in wholesale affiliates. However, his model does not allow for trade intermediation as an alternative mode of exporting.[2]

In this paper we model the choice between the indirect (intermediated) and the direct

[1]Egan and Mody (1993), Hakansson (1982), and Turnbull and Cunningham (1981) provide descriptive studies on bilateral buyer-seller links in international trade. They report suggestive evidence on highly collaborative, long-lasting trade relationships between producers and intermediators in the manufacturing sector. Schröder et al. (2003) offer a partial equilibrium model of trade intermediation.

[2]There are a number of papers in the industrial organization tradition that study the choice of export modes in partial equilibrium (e.g., Raff and Kim, 2005). However, these models do not allow drawing conclusions on aggregate variables. Nor do they easily lend to empirical verification.

(through own sales affiliate) export modes. In the first mode, producers save on fixed market access costs but loose discretion over pricing in the foreign market to their partner. Moreover, searching for a partner is costly and takes time. In the second mode, producers have to set up a foreign affiliate. The advantage of that mode is that they retain control over the consumer price of their product. We model the search-and-matching process between business firms (*business-to-business (B2B) matching*) using a matching function approach familiar from the labor market literature Pissarides (2000). This approach has been introduced into international economics by Grossman and Helpman (2002), who focus on vertical supply chains. In that setup, search costs are a function of the tightness of the market, which, in turn, depends on the endogenous decisions of both, producers and general importers, to search for a partner. We embed the export mode choice in a general equilibrium trade model with heterogeneous firms à la Melitz (2003). We offer a slight generalization of Melitz, by allowing firms to differ in terms of the tradability of their goods, their strength of brand name, and their productivity. This framework allows to reproduce important stylized facts on the importance of trade intermediation relative to own affiliates for heterogenous firms. Our approach is formally related to Helpman, Melitz, and Yeaple (2004), who study horizontal FDI in a model of the concentration proximity tradeoff. Our approach is different since multinational enterprises do not engage in foreign production. Rather, the focus is on the matching between producers and general importers (henceforth GI), and on the relative prevalence of export modes.[3]

Matching between producers and specialized importers is not immediate. This fact has a crucial implication: when parties finally match, they are locked into a *bilateral monopoly* situation which makes them vulnerable to *hold-up* from the other partner. We assume that the only committment that producers can make is to engage in *exclusive dealership arrangements*. Otherwise, as in Grossman and Helpman (2002), no enforceable contracts exist. Hence, the price at which the producer sells to the GI is determined through bilateral Nash bargaining. While the GI has full discretion to set the price in the foreign market, the producer decides about the supplied quantity. The outcome of that game is that trade intermediation drives up the consumer price in the foreign market.

[3]Our framework is also related to recent work by Rauch and Watson (2003) and Rauch and Casella (2003), who stress the importance of B-2-B relationships. Compared to those papers, our model is dynamic, features heterogeneous firms, allows for firms to differ with respect to their preferred foreign export mode, and determines the number of general importers and exporters endogenously. Most importantly, our model endogenizes foreign market access costs, since the cost of searching for a foreign general importer is endogenous.

The additional markup is given by the inverse of the producer's bargaining power and measures how strongly the producer's quantity decision reaches through to the foreign consumer price. Hence, variable profits are lower when exporting involves a GI.

The rate at which producers and firms match depends on market tightness, i.e., the number of searching GIs relative to the number of searching producers. Tightness is driven by producers' and GIs' endogenous decisions to engage into costly search. As in all matching approaches, the matching friction involves a departure from first best, since there is an uninternalized search externality: entry of GIs (producers) drives up the expected cost of GIs (producers) to find a partner. This mechanism is a promising candidate to square theory with models, see the work of Alessandria (2004) and Drozd and Nosal (2007) in international real business cycle models, as well as Reed and Trask (2006) in a homogenous firms trade model.

The present paper contains two main results. First, in equilibrium, producers are endogenously selected into the two export modes according to the characteristics of their products. Firms with high levels of *productivity*, easily *tradable variants*, or strong *brand reputation*, establish own subsidiaries. Firms with intermediate values of the above characteristics choose to search for general importers. Along the steady state, only a fraction of those firms actually is matched and produces for the export market. Intermediation helps producers with good product characteristics to save on fixed foreign market access costs; however, this translates into lower overall export sales, thereby–at least partly–rationalizing the missing trade puzzle.

Second, we study how the endogenous segmentation of producers over different modes varies with different types of trade costs, search costs, the efficiency of the matching technology, relative bargaining power, and the fixed distribution costs. Export sales through own subsidiaries relative to sales through general importers depend (i) positively on general importers' bargaining power, (ii) positively on search costs, (iii) negatively on variable transport costs, and (iv) negatively on the ratio of beachhead costs relative to the joint costs of maintaining a match.

The remainder of the paper falls into four chapters. Chapter 2 gives a short overview over stylized facts. Chapter 3 introduces the analytical framework and derives a first lemma on the pricing behavior under trade intermediation. Chapter 4 shows the conditions under which a strictly positive share of the total mass of producers export through trade intermediation. Holding aggregate variables constant, it uses a graphical device to discuss the equilibrium sorting of firms obtained in our model. Chapter 5 the free entry conditions of producers and general importers. It provides a general proof of existence. Chapter 6 provides a calibration and simulatione exercise of the model. It carries out comparative statics with respect to key parameters related to different globalization scenarios. Finally, chapter 7 concludes.

2 Stylized facts

In this section we discuss a few striking stylized facts. Statistical information on the importance of different export modes is difficult to obtain. However, combining information from the MIDI Database entertained at the German Bundesbank, export sales data from the German Statistical Office, and data from a survey undertaken by the ZEW, a German research institute, we are able to sketch the broad picture. The key fact is that direct contact of a producer in one country with the end user in another country is quantitatively not important. Similar patterns exist in the U.S. (Bernard et al., 2006), or in France (Trabold, 2001).

Figure 1 shows the distribution of German manufactured goods export sales over different export modes. Sales via own affiliates in foreign countries amount to over 50% of total exports, with sales via foreign intermediators accounting for another 40%. The residual is direct exports that does not involve foreign direct investment nor a foreign general importer. There are a number of empirical problems, since total export sales by goods provided by the statistical office cannot exactly be mapped into the classification of sectors provided by the Bundesbank. In figure 1 we choose to present the conservative case, where producer-to-consumer exports are most likely overestimated.

Figure 1 also reports the share of actively exporting firms in each mode. This information draws on survey results presented in Fryges (2007). Most producers export either through an intermediator (49%) or directly to the final client in the foreign country (47%). Only 3% engage in FDI. At first glance, these results seem to contradict our findings on shares in in total export volumes. However, taking the data at face value, they imply that the largest share of exports is undertaken by a small number of firms. There is large empirical evidence that this is actually the case (Bernard et al., 2006).

Fryges (2007) documents another important fact, namely that the number of firms that maintains own sales affiliates in foreign countries has increased between 1997 and 2003. This finding comes from a survey of German firms, but it has been replicated in an independent study for the United Kingdom. While in general the number of firms per

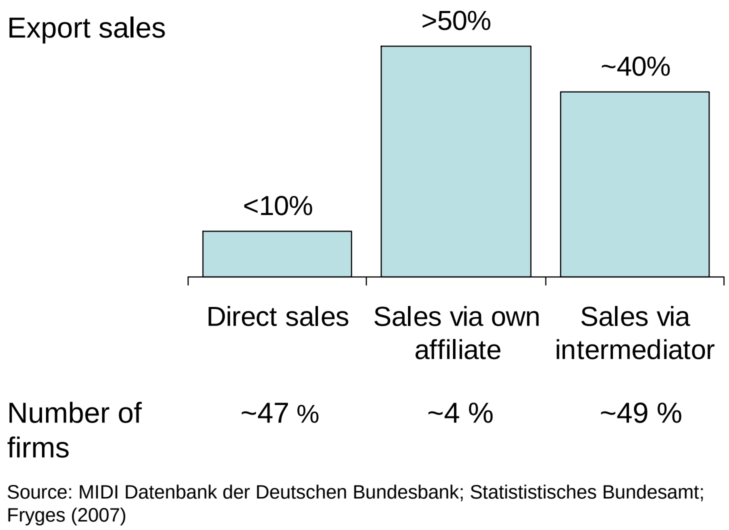


Figure 1: Relative prevalence of export modes, Germany, 2003

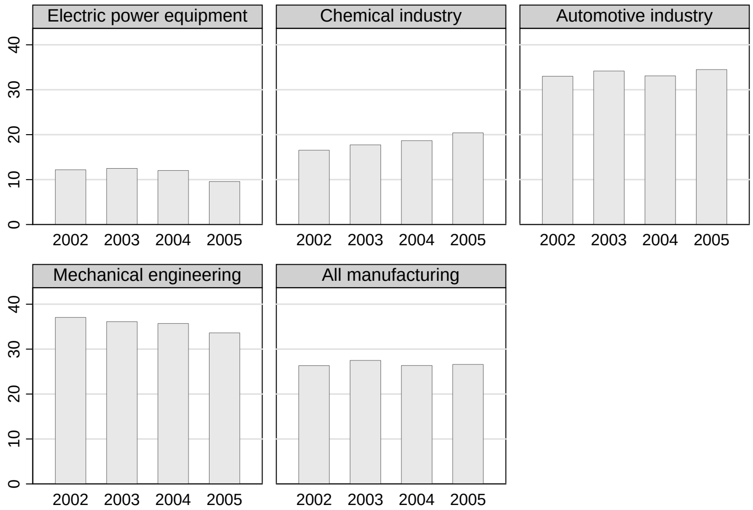
se is not indicative of the total export volume channelled through some export mode, the fact that own affiliates are the prevailing choice for large firms suggests that also the share of exports channelled through affiliates has increased over time.

The implications of figure 1 can be summarized as follows: (i) Direct sales from the producer to a foreign end client amount to less than 10% of German exports, and are therefore quantitatively negligable. Exporters require either an own foreign sales affiliation or a foreign partner. Moreover, the share of exports through own affiliates has increased over time. (ii) It follows that fixed costs of foreign market access must have important aggregate implications, since the largest share of exports involves some type of fixed costs. (iii) A few firms make up a large share of total export sales. This points to a strong degree of heterogeneity amongst exporters.

In 2005, the stock of outward FDI of the entire German manufacturing sector amounted to a total of 223 billion Euro. About half that sum (104 billion) was invested in some foreign affiliate active in the manufacturing sector. Some 32% (71 billion) was parked in holding companies, or financial affiliate. The remaining 17% (38 billion Euro) were held in affiliate trading companies. Taking out holding companies and the finance sector, German manufacturing firms held about a quarter (27%) of their total FDI in companies classified in the trading sector. While that number includes also investment into foreign purchasing units, it is largely dominated by sales representations, as vertical FDI makes up only a small share of total German outward FDI.

Looking at the sectoral distribution of the quantitative importance of FDI into sales affiliates, one finds that the share of FDI invested in sales affiliates relative to total non-finance investment is highest in the mechanical engineering sector (about 36% on average over 2002-2005) and the automotive sector (34% on average), while it is rather low in the chemical (18 percent) or the electric power equipment industries (11%). Figure 2 illustrates the cross-sectoral pattern and also shows that over 2001-2005 that pattern was fairly stable.

Figure 2: German outward FDI in sales affiliates in percent of industry (non-finance) total



Source: Deutsche Bundesbank, Bestandserhebung über Direktinvestitionen, April 2007, Table 1.4a; own calculations.

Regarding the geographical dimension of German outward FDI, the Bundesbank publication allows to distinguish between the stock of FDI invested in the USA, EU 25, and the rest of the world. Taking averages over the reported 2002-2005 time period, the share of investment in trade affiliates in total FDI of the manufacturing sector (again, excluding finance), amounts to about 27% for the EU 25, 26% for the US, and again 27% for the rest of the world.

We may summarize: A substantial share of total outward foreign direct investment (FDI) goes into the establishment or acquisition of foreign sales affiliates. There is little variation across the US, Europe, and the rest of the world, but significant sectoral variation.

Facts 1 and 2 establish the importance and relative prevalence of own sales affiliates. Empirical information on the role of general importers is more difficult to find. Trabold (2002) is amongst the rare studies that offer quantitative information. His empirical analysis draws on French customs data. His findings can be summarized as follows: Import intermediation by general importers is most prevalent (i) the farther away in terms of geography and culture an export market market is, and (ii) the lower the marketing-intensity of a product is. Moreover, (iii) the share of total exports that involve import intermediation has been falling during the 1980ies.

Our model can reproduce the stylized facts highlighted above. It is, however, also consistent with the broader evidence on the importance of networks, and search externalities discussed in the introduction.

3 Model setup

We study a model with C countries, indexed $i = 1, ..., C$, which are identical to each other up to their respective sizes. Following Helpman et al. (2004), in each country there are two active sectors: a perfectly competitive numéraire sector, with unit labor input coefficients and costless tradability; and a differentiated goods sector, with heterogeneous firms operating under conditions of monopolistic competition.

3.1 Demand structure

Each country i is populated by a representative household, which inelastically supplies L_i units of labor to a perfectly competitive labor market. The household derives utility from consuming z_i units of the numéraire good, and a basket of differentiated goods. We assume that preferences are separable over those two items, with an upper Cobb-Douglas nest, and the basket of differentiated goods a Dixit-Stiglitz aggregate:

$$U_i = (1-\mu)\ln z_i + \mu \ln \int_{\omega\in\Omega_i} \left[\zeta(\omega)\, x_{ij}(\omega)\right]^{1/\rho} \mathrm{d}\omega. \tag{1}$$

The household spends the share $0 < \mu < 1$ on differentiated goods and the remainder on the numéraire. The set of available varieties in country i is given by Ω_i, with ω denoting a generic variety. Varieties may be imported, so that the quantity $x_{ij}(\omega)$ denotes consumption of a variety produced in country $j, j = 1, ..., C$. The parameter $0 < \rho < 1$ describes the degree of substitutability of any each pair of varieties. However, unlike in the standard Dixit-Stiglitz representation, consumers may attach different weights $\zeta(\omega) \geq 0$ to different varieties, reflecting the fact that varieties may contribute asymmetrically to overall utility. We refer to $\zeta(\omega)$ as to the strength of variety $\omega's$ brand name or the reputation of the producer. It may also be held to denote quality. In any case, a higher value of $\zeta(\omega)$ means that the respective variety yields a higher contribution to utility.[4]

The only source of income for the household is from wages, which we can normalize to unity in all countries thanks to our assumptions on the numéraire sector. Hence, the budget constraint reads

$$L_i \geq z_i + \int_{\omega \in \Omega_i} p_{ij}(\omega)\, x_{ij}(\omega)\, \mathrm{d}\omega. \tag{2}$$

Maximizing (1) subject to (2), we find the following demand function for a variety ω from country j

$$x_{ij}(\omega) = H_i \frac{\zeta(\omega)^{\sigma-1}}{p_{ij}(\omega)^{\sigma}}, \tag{3}$$

where $H_i \equiv \mu L_i / \left(\int_0^{n_i} [\zeta(\omega)\, p_{ij}(\omega)]^{1-\sigma} d\omega \right)$ is proportional to country $i's$ market size L_i, n_i is the measure of the set Ω_i and $\sigma \equiv 1/(1-\rho) > 1$ is the elasticity of substitution between varieties.

3.2 Heterogeneous production firms and export modes

Firms in the differentiated goods sector differ with respect to a vector of characteristics $\{\zeta(\omega), \tau(\omega), a(\omega)\}$, where $a(\omega) > 0$ denotes the marginal cost of producing variety ω, and $\tau(\omega) \geq 1$ refers to variety-specific variable distribution costs of the iceberg type, which occur regardless of whether a good is traded internationally or not. Whenever one unit of a variety is to be delivered to a foreign partner, $\tau(\omega)$ units of that good have to leave the gates of the producer's factory. We see $\tau(\omega)$ as a short-hand way to introduce marketing and distribution costs that arise when a good is sold. There is no reason to assume that those costs are zero for transactions when the producer and the consumer happen to reside in the same country. However, in international transactions, total variable trade costs are $\tau_{ij}(\omega) = \bar{\tau}_{ij}\tau(\omega)$, where $\bar{\tau}_{ij} \geq 1$ accounts for transportation costs and may be thought of as a function of distance. We refer to $\bar{\tau}_{ij}$ to the systematic component of trade costs, and of $\tau(\omega)$ as the idiosyncratic component. Note that the systematic component magnifies the idiosyncratic part; hence, more marketing-intensive goods are also more expensive to deliver to foreign markets. The importance of that source of heterogeneity has been recently emphasized by Bergin (2007).[5]

[4] Combes et al. (2005) offer a similar formulation of preferences. However, their ζ is constant across varieties imported from a given country.

[5] However, in contrast to our formulation, his model has zero trade costs for deliveries within a same country.

Producers are also heterogeneous with respect to their marginal costs of production, $a(\omega)$. With the wage rate normalized to unity, $a(\omega)$ is equal to the labor requirement for one unit of output. Heterogeneity along this line has been shown to be empirically relevant, and is core in much recent work following Melitz (2003). For producing $y(\omega)$ units, the firm ω faces incurs total production costs $c(\omega) = a(\omega) y(\omega) + f^D$, where f^D denotes the fixed costs of production. Regarding their cost structure, firms do not differ across countries.

In much of our analysis, we can summarize the vector of characteristics $\{\zeta(\omega), \tau(\omega), a(\omega)\}$ in a single scalar $A(\omega) \equiv a(\omega) \tau(\omega) / \zeta(\omega)$, since $A(\omega)$ is a sufficient statistic to describe firm behavior (see details below). Higher values of $A(\omega)$ are equivalent to higher marginal costs of production, lower tradability, and a lower degree of brand reputation. Following Melitz (2003), the entry of producers requires payment of a cost f^E. Only after paying the entry fee do firms learn about their characteristics $A(\omega)$. We assume that $A(\omega)$ follows some c.d.f. $G(A)$. We can then rank firms with respect to their realization of A. The advantage of our broader definition of firm heterogeneity relative to the focus in the literature on productivity is that empirical evidence suggests that productivity (or, closely related to it, firm size) are poor predictors of exporting behavior once one controls for unobserved firm characteristics (such as $\zeta(\omega)$ or $\tau(\omega)$), see Fryges (2006).

A key object of the present paper is to understand the sorting of firms into different export modes along their A-dimension. The first mode–direct exports–requires the setup of a sales representation in the foreign country, which implies some additional fixed investment f^F. This is the situation studied by Melitz (2003). The investment f^F has been referred to by Baldwin (1988) as *beachhead costs*, and usually turns up in FDI statistics under the guise of wholly owned sales affiliates.[6]

The second export mode–indirect exports–requires a match with a specialized trade intermediator, which we call general importer (henceforth GI). GIs know the foreign market better than the foreign producer. Hence, fixed costs of market entry are lower for the GI. However, the producer has to invest into costly search for a GI and–once matched–looses control on the consumer price of its output. Along the A dimension, we focus on the empirically relevant case where producer with the lowest realizations of A (low marginal

[6] The empirical literature on foreign direct investment (FDI) stresses the importance of wholesale affiliates (Kleinert and Toubal, 2006). Somewhat surprisingly, this fact has not provoked theoretical research; in theoretical models, FDI relates to foreign production activities carried out by some multinational firm (see Helpman, 2006). Our paper offers a theory of FDI into wholesale affiliates.

costs, high reputation, high tradability) chose the direct export mode, producers with lower-intermediate realizations go for the indirect export mode, producers with upper-intermediate realizations do not find it optimal to export in either mode, and producers with the highest values of A quit the market upon drawing their vector of characteristics. Before turning to a detailed description of the of the indirect export mode, we briefly discuss the monopolists' pricing problem for domestic and indirect export sales.

Operating profits from *domestic sales* are $\tau(\omega) \cdot H_i [\tau(\omega) p(\omega)]^{-\sigma} \zeta(\omega)^{\sigma-1} \cdot [p(\omega) - a(\omega)] - f^D$. The first part in that expression, $\tau(\omega)$, reflects the fact that domestic sales of x require $\tau(\omega) x$ units of the respective variety to be produced. The second part, $H_i [\tau(\omega) p(\omega)]^{-\sigma} \zeta(\omega)^{\sigma-1}$, gives the level of demand that the household has for a variety ω with c.i.f. price $\tau(\omega) p(\omega)$. The third part, $[p(\omega) - a(\omega)]$, refers to the per unit margin of the price over marginal cost. To maximize profits, the firm sets the f.o.b. price $p(\omega) = a(\omega)/\rho$, where $1/\rho > 1$ is the markup over marginal costs. With our choice of preferences, the f.o.b. price does not depend on $\zeta(\omega)$. Inserting the optimal price in the monopolist's objective function, domestic profits can be written as

$$\pi_i^D(A) = B_i A^{1-\sigma} - f^D, \tag{4}$$

where it becomes apparant that profits depend only on $A(\omega)$ and not independently on the different components of $A(\omega)$. In the following we drop the dependence of A on ω since it is sufficient to know A in order to identify a specific producer. We follow Helpman, Melitz, and Yeaple (2004) and write profits in terms of $B_i \equiv (1-\rho) H_i \rho^{\sigma-1}$, which is an aggregate magnitude, that involves the endogenous price index and exogenous parameters. Clearly, profits from domestic sales decline in A since $1-\sigma$ is a negative number. They rise in B_i, which captures the size of the market, and fall in fixed costs of production, f^D.

The monopolist generates non-negative profits from *direct exporting*, if export revenues suffice to cover additional variable production costs and foreign investment f^F. The objective function now is $\tilde{\tau}_{ij}(\omega) \cdot H_j [\tilde{\tau}_{ij}(\omega) p(\omega)]^{-\sigma} \zeta(\omega)^{\sigma-1} \cdot [p(\omega) - a(\omega)] - f^F$. Maximum profits from direct exporting are

$$\pi_{ij}^F(A) = B_j (\bar{\tau}_{ij} A)^{1-\sigma} - f^F, \tag{5}$$

where the systematic part of trade costs (independent from A), $\bar{\tau}_{ij}$, appears as an additional determinant of variable profits, along with the foreign measure of market size B_j and the costs of investing abroad, f^F. Clearly, foreign profits are lower the higher the systematic component of trade costs.

3.3 Trade intermediation and general importers

Our slight generalization of the notion of firm heterogeneity apart, the setup discussed in section 3.2 above is the same as in Melitz (2003). In this section, we model the endogenous emergence of a new type of firms that misses in most standard trade models: trade intermediators or, using our preferred term, general importers (GIs). Following Spulber (1998, p. 3), an intermediator is "*...an economic agent who purchases from suppliers for resale or who helps sellers and buyers to meet and transact.*" We focus on the first function of a GI and on the matching problem between the GI and the producer of a certain variety. The second function refers to the activity of trade brokerage, where the intermediator confines to matching producers and consumers and does not incur any entrepreneurial risk. Trade brokers are empirically elusive institutions that are difficult to model.[7]

We can think of the GI as a firm that is located in a foreign market and has superior knowledge of local market conditions, legal institutions, idiosyncratic consumer preferences, etc. Hence, we assume that the GI has lower fixed costs of market access, f^M, than the direct exporter would have $\left(f^F\right)$. Without loss of generality, we may set $f^M = 0$, but refrain from doing so for the time being.[8]

A key complication when using a GI is that relationship-specific investment is needed. This comes in terms of search costs. Conceptually, search costs are essential to allow for a meaningful sorting of firms along the A dimension; if a producer would have free access to GI's comparative advantage (low market access costs), every active producer would use that opportunity. We model the emergence of GIs in equilibrium as an explicit trade-off between costs and benefits. In particular, we assume that both GIs and producers have to search for foreign varieties to import, and that this search is costly. Search costs arise due to the participation at international trade fairs, correspondance and direct contact to potential partners, etc. Search costs are endogenous, as they depend on the number of searching firms and GIs. When a search is successful, GIs and producers find themselves

[7]The *raison d'être* of trade brokers is the existence of asymmetric information. This is an interesting issue in itself, which we take up in Felbermayr and Jung (2007).

[8]One could also think that the GI's specific knowledge of the foreign market translates into lower variable (distribution) costs. While this is a theoretical possibility, it is clear the largest portion of variable distribution costs consists in tariffs and transportation costs, which in principle are the same across export modes. However, one could allow for the idiosyncratic component of trade costs $\tau(\omega)$ to differ across export modes. We discuss this extension in the conclusions.

in a bilateral monopoly situation which endows the GI with market power that allows to recoup the search costs.

We assume that all firms are *single product firms*. While this is in line with most recent trade models, this assumption is not very realistic. In reality, many GI's have diversified product portfolios, possibly originating from different countries. In principle, the GI should take this fact into account when deciding about which price to charge to consumers, at least if the different goods are substitutes. If the GI in some country j controls a sufficiently large share of the market, it would internalize the cannibalization effect induced by additional varieties and charge a higher markup (Feenstra and Hong, 2007). In turn, this constitutes an incentive for GIs to expand. Apart from the pricing issue, multiproduct GIs may also benefit from economies of scope. The endogenous emergence of multi-product GIs is certainly worth to look at. However, it also lends to a number of additional complications, so that in the present paper we rule this possibility out.

To endogenize search costs, we follow the standard practice in search and matching models of unemployment (Pissarides, 2000) and assume the existence of a matching function. This approach has been fruitfully applied by Grossman and Helpman (2002) in a model of vertical supply chains. Our model differs in that we study exporting rather than sourcing behavior and allow for heterogeneous firms. Let n_{ij}^S be the number of country i's producers searching for an opportunity to export to country j, and n_{ij}^G the corresponding number of GIs searching for an opportunity to import goods from i to j. As long as they are unmatched, producers and GIs incur per-unit-of-time search costs c^P and c^G, respectively. At each instant, $N(n_{ij}^S, n_{ij}^G) \leq \min\left\{n_{ij}^P, n_{ij}^G\right\}$ trade relationships are formed, where $N(.,.)$ is linear-homogenous, as well as increasing and strictly concave in both arguments.

We model GIs as *ex ante* identical; moreover, since producers differ with respect to their characteristics A, GIs are *ex post* heterogeneous. Firms' heterogeneity does not have any bearing on search costs, so that the rate at which a searching producer is matched with a GI does not depend on A. With our assumptions on the matching technology, matching rates depend only on the degree of *market tightness* $\theta_{ij} \equiv n_{ij}^G/n_{ij}^P$, i.e., the number of searching GIs relative to searching producers. Exploiting the properties of $N(.,.)$, we can write the rate at which a producers are matched to a GI as $\eta(\theta_{ij}) \equiv n_{ij}^M(1, \theta_{ij})$ and the rate at which GIs are matched to producers as $\eta(\theta_{ij})/\theta_{ij}$. Clearly, the concavity of $N(.,.)$ implies that $\eta(\theta_{ij})$ strictly increases in θ_{ij} while $\eta(\theta_{ij})/\theta_{ij}$ falls. This illustrates the standard search externality associated to entry of producers and GIs on their respective peers.

The empirical work of Besedes and Prusa (2007) suggests that in trade relations there is a substantial amount of turnover. We introduce this fact into our analysis by allowing for some exogenous separation rate $\delta^G > 0$. Moreover, to ensure convergence to an ergodic equilibrium distribution of productivities, we require an exogenous death shocks for producers, δ^P. If δ^G and δ^P are independent, the total rate of match destruction is $\delta \equiv \delta^P + \delta^G$.[9]

3.4 The game between producers and general importers

Expected search costs are $c^P/\eta(\theta_{ij})$ from the producer perspective and $c^G\theta_{ij}/\eta(\theta_{ij})$ from the perspective of a generic GI. When a match happens to be formed, these costs are sunk. This implies that both parties find themselves in a situation of bilateral monopoly. Producers can credibly commit to a single promise: to stick to exclusive dealership arrangements. Without this committment, intermediated trade can only be an equilibrium outcome under very special circumstances. Otherwise, we follow Pissarides (2000) and Grossman and Helpman (2002), and assume that no enforcable contracts can be written. This implies the following staging: First, the producer decides about the quantity of output to provide to the GI. Second, both parties bargain about the f.o.b. transaction price at which the GI purchases the good from the producer. Third, the GI decides about the price that she wishes to charge the consumers, thereby realizing some revenue. We denote the price set by the GI and faced by foreign consumers by $p_{ij}^G(\omega)$ and the transaction price determined by Nash bargaining between the producer and the GI by $p_{ij}^M(\omega)$. We take both prices as inclusive of transportation costs

Solving the game backwards, we first determine the consumer price set by the GI. Country j's demand for a variety ω imported from country i is $x_{ji}\left[p_{ij}^G(\omega)\right]$ so that the GI's sales revenues are $p_{ij}^G(\omega)\,x_{ij}\left[p_{ij}^G(\omega)\right]$. The GI's purchasing costs are $p_{ij}^M(\omega)\,x_{ij}\left[p_{ij}^G(\omega)\right]$. Using the demand function (3), the profit maximizing price p_{ij}^G is just

$$p_{ij}^G(\omega) = \frac{1}{\rho} p_{ij}^M(\omega), \tag{6}$$

with $1/\rho > 1$ the markup over marginal costs.

[9]Time is continuous. Hence, destruction rates and rates of match creation take values on the entire real line. The matching rates refer to the rate by which a match occurs in the next infinitesimally short time period. The death rates δ^P and δ^G relate to the survival rate into the next infinitesimally short time period.

The GI's pricing behavior determines the size of the *ex post* joint surplus achieved in the match, which is equal to total sales in the foreign market minus potential match-specific fixed costs f^M. Denoting the joint surplus by $J_{ij}(\omega)$, we have $J_{ij}(\omega) = p_{ij}^G(\omega) x_{ij}\left[p_{ij}^G(\omega)\right] - f^M$. At the time of the bargain, variable production costs (which also account for transportation costs) have already been incurred, so that they do not turn up in the *ex post* surplus. The Nash bargaining results in a sharing of the joint surplus according to the two parties' relative bargaining powers. Writing $\beta \in (0,1)$ for the bargaining power of the producer, the producer appropriates $\beta J_{ij}(\omega)$, and the general importer $(1-\beta) J_{ij}(\omega)$.

Finally, the producer choses her optimal output level. Clearly, in our monopolistic setting, the quantity choice is equivalent to a price choice. The producer internalizes the effect that her decision has on the transaction price achieved in the bilateral bargaining problem, and on the resulting surplus. She also takes into account that in order to supply a quantity x_{ji} to the GI, she has to produce $\tilde{\tau}_{ij}(\omega) x_{ij}$ units of her variety, where $\tilde{\tau}_{ij}$ denotes the total iceberg transportation costs from shipping abroad. The producer effectively chooses $p_{ij}^M(\omega)$ to maximize $\beta J_{ij}(\omega) - a(\omega)\tilde{\tau}_{ij}(\omega) x_{ij}\left[p_{ij}^G(\omega)\right]$. Plugging in the expressions for $J_{ij}(\omega)$ and $p_{ij}^G(\omega)$, and using the demand function (3), the first order condition of the producer yields a pricing rule $p_{ij}^M(\omega) = a(\omega)\tilde{\tau}_{ij}(\omega)/\beta$. Importantly, the effective markup charged by the producer is equal to her inverse bargaining power $1/\beta$. We can now state the following lemma:

Lemma 1 *The price charged for imports by a general importer (GI) is given by*

$$p_{ij}^G(\omega) = \frac{1}{\beta\rho} a(\omega)\tilde{\tau}_{ij}(\omega), \tag{7}$$

with $(\beta\rho)^{-1} > 1$ *the total markup over effective marginal costs.*

Proof. See the Appendix. ■

As in Grossman and Helpman (2002), the consumer price indicated in Lemma (1) reflects the presence of *double marginalization*: the price paid by the foreign consumer is driven up by the usual markup $1/\rho$ earned by the GI, and by the markup $1/\beta$ that results from Nash bargaining. Note that the additional distortion depends on β : the larger the producer's bargaining power, the closer (7) comes to the price obtained if the producer would sell directly to the foreign market, i.e., $a(\omega)\tilde{\tau}_{ij}(\omega)/\rho$. Also note that the bargained transaction price is independent from the market tightness θ_{ij}, which is a direct corollary from the fact that both parties' outside options are driven to zero on the one hand by free entry of GIs and on the other hand by the absence of any alternative use of the output quantity delivered by the producer to the market j.

The value of the joint surplus can be obtained by substituting (7) into the definition of $J_{ij}(\omega)$:

$$J_{ij}(A) = \sigma \bar{\tau}_{ij}^{1-\sigma} B_j \left(\frac{\beta}{A}\right)^{\sigma-1} - f^M. \tag{8}$$

The joint surplus is larger the bigger the size of the export market adjusted for transportation costs $\bar{\tau}_{ij}^{1-\sigma} B_j$, and the smaller the match-specific fixed costs f^M. The surplus is larger the stronger the producer's bargaining power β : the closer β is to unity, the smaller is the detrimental effect of double marginalization. Clearly, higher marginal costs, lower tradability and lower brand reputation also reduce the surplus, since they translate into a higher value of A.

Similarly, we can now express the additional profits from *selling abroad through a general importer* by inserting $p_{ij}^G(\omega)$ into the producer's objective function:

$$\pi_{ij}^{MP}(A) = \beta^\sigma B_j (\bar{\tau}_{ij} A)^{1-\sigma} - \beta f^M. \tag{9}$$

Note that we use the superscript MP to make clear that only matched producers have access to those profits. When talking about producers' choice of export modes, we will have to link $\pi_{ij}^{MP}(A)$ to the additional profits that a producer expects to make when engaging into the costly search for a partner.

Comparing (9) to $\pi_{ij}^F(A)$, the profits of direct exporting to the foreign market, it is clear that the term $B_j (\bar{\tau}_{ij} A)^{1-\sigma}$ appears in both expressions. But, since $\beta^\sigma < \beta < 1$ for given distance-adjusted market size $B_j \bar{\tau}_{ij}^{1-\sigma}$ and firm characteristics A, intermediated exporting (9) involves lower variable profits than direct exporting (5). However, fixed costs of direct exporting have to be shouldered by the producer alone, while fixed costs (if any) are shared by both parties in the indirect mode.

4 Choice of export modes with given market tightness

4.1 Zero cutoff profit conditions

Firms select endogenously into different export modes. However, as in the standard Melitz (2003) model, the presence of fixed production costs implies that some firms with the highest realizations of A will choose not to start production at all, and some firms with high values of A prefer to sell only on the domestic market. Finally, firms willing to export face a choice between direct exporting, which is fixed cost intensive but yields high unit revenues, and indirect exporting via a GI, which saves fixed costs but involves lower unit revenues. Hence, we expect that firms with intermediate realizations of A_i prefer indirect exports and those with lowest A sell directly through own sales affiliates. Under conditions to be made explicit below, there is a unique sorting of firms along their A characteristics, with all possible regimes being active in equilibrium. Firms with realizations $A > A_i^D$ have so high marginal costs, low brand reputation and tradability, that their revenue generated from the domestic market cannot suffice to cover the fixed costs of production. *A fortiori*, they cannot find it optimal to export, neither. Firms with characteristics $A_{ij}^{SP} < A \leq A_i^D$ produce only for the domestic market. Either way of serving the foreign market inovles too high entry costs and too little revenue. Firms with characteristics $A^F < A \leq A^{SP}$ find it optimal to start searching for a GI. At any point in time, a fraction of those firms will be matched and therefore generating export revenues in top of domestic income. Firms with $A \leq A_{ij}^F$, that is the best firms (with lowest marginal costs, highest tradability and strongest brand names) establish own sales affiliates.[10] Note that the same firm can find it optimal to serve different markets using different modes.

The thresholds A_i^D, A_{ij}^{SP}, and A_{ij}^F are determined by a series of indifference conditions, which, given the sorting described above, can be described by *zero cutoff profit conditions.* The marginal firm A_i^D that finds entry into operations worthwhile is defined by setting domestic profits (4) zero:

$$\left(A_i^D\right)^{1-\sigma} = \frac{f^D}{B_i}, \forall i. \tag{10}$$

That threshold A_i^D is lower the higher f^D and the lower B_i, reflecting the fact that higher fixed costs and smaller market sizes make it harder for firms with bad (i.e., high) realizations to survive.

The value of A below which firms find it worthwhile to search for producers (and ultimately be matched to a GI) is slightly more involved to pin down, because of the inherently dynamic nature of the search and matching process: searching for a GI involves an uncertain investment, as the duration of costly search is uncertain. Hence, the producer

[10] To break ties, we assume that firms that are indifferent between two regimes, chose the next highest (in terms of the ranking of regimes discussed above).

has to trade off immediate search costs against future profits from foreign sales. Denote the value of a country i producer that searches for a GI in country j by V_{ij}^{SP} and the value of a matched producer by V_{ij}^{MP}. Then, we can establish the following system of value equations:

$$\delta^P V_{ij}^{SP}(A) = -c^P + \eta(\theta_{ij})\left[V_{ij}^{MP}(A) - V_{ij}^{SP}(A)\right], \tag{11}$$

$$\delta^P V_{ij}^{MP}(A) = \pi^{MP}(A) + \delta^G\left[V_{ij}^{SP}(A) - V_{ij}^{MP}(A)\right]. \tag{12}$$

Since δ^P is the only source of discounting from the producer's perspective, $\delta^P V_{ij}^{SP}$ is the flow return to searching. That return has to be equal to the flow costs of searching $-c^P$ and the expected capital gain when the search has been successful. That gain $\left[V_{ij}^{MP}(A) - V_{ij}^{SP}(A)\right]$ occurs with Poisson rate $\eta(\theta_{ij})$ so that equation (11) follows. In turn, the flow value of a matched producer $\delta^P V_{ij}^{MP}$ is given by the flow profits of selling through a GI, $\pi^{MP}(A)$ and the expected capital loss of being separated from the GI, $\delta^G\left[V_{ij}^{SP}(A) - V_{ij}^{MP}(A)\right]$.

We can solve for V_{ij}^{SP} from the system (11) and (12), which yields an expression for the flow value of a searching producer:

$$V_{ij}^{SP}(A) = s(\theta_{ij})\,\pi^{MP}(A) - [1 - s(\theta_{ij})]\,c^P, \tag{13}$$

where the term $s(\theta_{ij}) \equiv \eta(\theta_{ij})/[\delta + \eta(\theta_{ij})]$ denotes the average fraction of time that a producer expects to be matched and earning profits π^{MP} and $1 - s(\theta_{ij})$ is the fraction of time that she is searching and hence incurring search costs c^P. We determine the producer, who is just indifferent between engaging into searching for a GI and concentrating on exclusively domestic sales, by the condition $V^{SP}\left(A_{ij}^{SP}\right) = 0$. Using the expression for profits $\pi^{MP}(A)$, (9) in (13), we obtain the zero cutoff profits condition for entry into search as

$$\left(A_{ij}^{SP}\right)^{1-\sigma} = \frac{\bar{\tau}_{ij}^{\sigma-1}}{\beta^\sigma B_j}\left[\frac{c^P}{\eta(\theta_{ij})} + \beta f^M\right], \forall j \neq i. \tag{14}$$

The effective fixed costs of foreign market access consist of two terms: expected total search costs $c^P/\eta(\theta_{ij})$ and the producer's share of match-specific fixed costs βf^M. The threshold A_{ij}^{SP} is lower the higher the sum of those fixed costs is; i.e., the marginal searching producers needs to exhibit lower marginal costs, higher tradability and a stronger brand name. If the distance-adjusted market size $\bar{\tau}_{ij}^{1-\sigma} B_j$ goes up, the threshold goes up. Similarly, when the size of the double marginalization distortion, captured by β, falls (i.e., β goes up), the threshold rises, and the marginal searching producer can features a worse realization of A.

Finally, we determine the remaining cutoff level, A_{ij}^F, by solving $V^{SP}\left(A_{ij}^F\right) = V^F\left(A_{ij}^F\right).$ The marginal direct exporter is exactly indifferent between searching for a GI or establishing her own subsidiary. Equating (13) and (5), and using (9) one gets

$$\left(A_{ij}^F\right)^{1-\sigma} = \frac{\bar{\tau}_{ij}^{\sigma-1}}{B_j} \frac{f^F - \left[1 - s\left(\theta_{ij}\right)\right] c^P}{1 - \beta^\sigma s\left(\theta_{ij}\right)}, \forall j \neq i. \tag{15}$$

Again, higher distance-adjusted market size $\bar{\tau}_{ij}^{1-\sigma} B_j$ allows for firms with worse (i.e., higher) realizations of A to select into direct exporting. The higher the term $f^F - \left[1 - s\left(\theta_{ij}\right)\right] c^P$, the higher are the opportunity costs of direct exporting relative to the next best alternative, and the lower the maximum realization of A can be. Also, the lower β, the larger is the double marginalization problem that arises in the indirect export mode, and the lower the threshold A_{ij}^F becomes.[11]

4.2 Equilibrium sorting of firms over export modes

Before turning to a full general equilibrium analysis with θ_{ij} and B_i endogenous, it is worthwhile to illustrate the sorting of firms over different regimes as a function of their characteristics $A^{1-\sigma}$ in Figure 3, which is a modified version of figure 1in Helpman, Melitz, Yeaple (2004). Expressing flow profits as annuities using the producers' discount rate, we associate an 'expected profit line' $\delta^P V_{ij}^{mode}$ to each mode, where *mode* either takes the value D (domestic sales only), SP (search for a GI) and F (direct exports through an own affiliate). Note that for modes D and F we have $\delta^P V_{ij}^{mode} = \pi_{ij}^{mode}$; this is however not true for the SP mode. The figure plots (4), (5), and (13), taking aggregate variables B_i, B_j and θ taken as constant.

The lines differ with respect to their respective intercepts (representing fixed costs) and slopes (representing net revenues for unit productivity). In the figure, the flow profits (4) associated to purely domestic operations have an intercept of $-f^D$ and slope B_i. Expected additional (on top of the profits from the home market) flow profits of searching for a GI involve expected fixed costs consisting of the producer's share in match-specific fixed costs and expected search costs, $\left[\beta\eta(\theta_{ij}) f^M + \delta c^P\right] / \left[\delta + \eta(\theta_{ij})\right]$, and a slope $B_j \bar{\tau}_{ij}^{1-\sigma} \beta^\sigma \eta\left(\theta\right) / \left[\delta + \eta\left(\theta\right)\right]$. Finally, additional profits (5) from direct export sales involve fixed costs f^F and a slope $B_j \bar{\tau}_{ij}^{1-\sigma}$. Clearly, the slope of the $\delta^P V_{ij}^{SP}$ line is smaller than

[11] For (15) to be well defined, i.e., $\left(A_{ij}^F\right)^{1-\sigma} > 0$, we need that $f^F - \left[1 - s\left(\theta_{ij}\right)\right] c^{SP} > 0$. This implies $\delta c^{SP} / \left[\delta + \eta\left(\theta\right)\right] < f^F$, a condition that will be verified in Lemma 2 below.

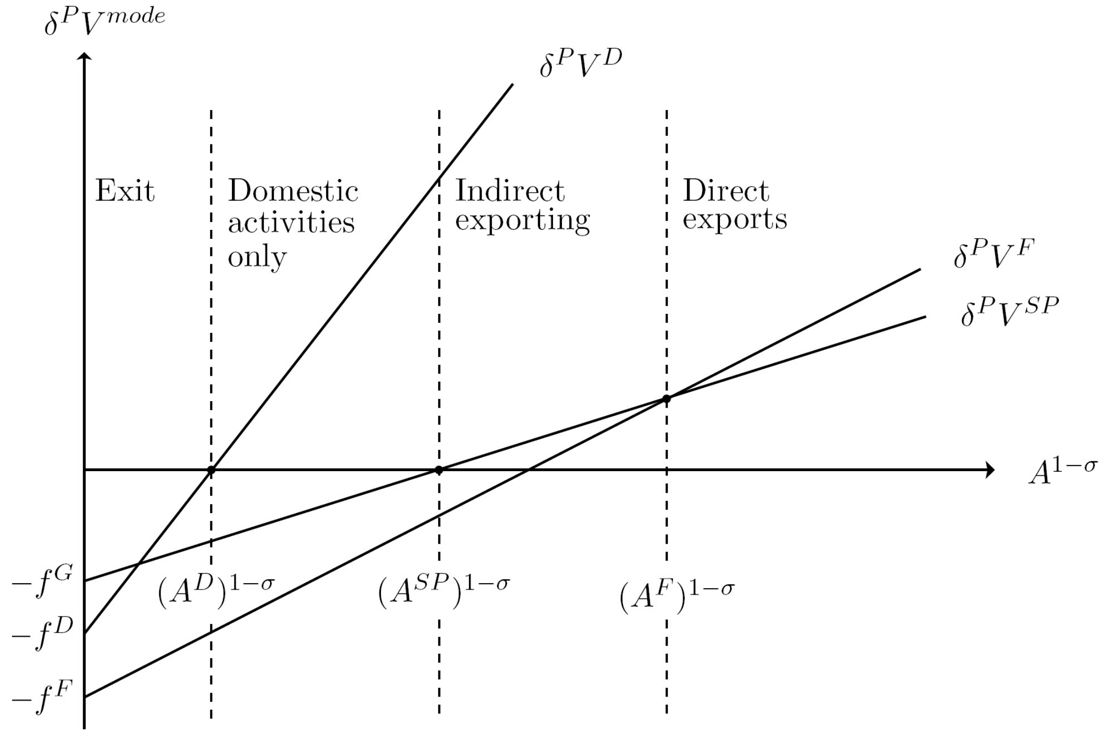


Figure 3: Equilibrium sorting for given tightness

the one of the $\delta^P V_{ij}^F$ line due to the existence of double marginalization, $\beta^\sigma < 1$ and due to the fact that positive sales revenue accrues only if the producer is actually matched to a GI, which is not always the case. If $B_i = B_j$, the $\delta^P V_{ij}^D$ line is steepest: compared to the other regimes, marginal net revenues are higher as there are no transportation costs.

For given θ, a non-zero mass of firms is active in each of the three regimes (D, SP, F) if the hypothesized ranking $\left(A_i^D\right)^{1-\sigma} < \left(A_{ij}^{SP}\right)^{1-\sigma} < \left(A_{ij}^F\right)^{1-\sigma}$ holds. This requires that the effective fixed costs of searching for a GI lie in a bracket between the fixed production costs f^D and the costs of establishing an own foreign sales affiliate f^F.

Lemma 2 *For given market tightness θ_{ij} and hence matching rate $\eta(\theta_{ij})$, if the condition*

$$\frac{B_j}{B_i}\bar{\tau}_{ij}^{1-\sigma} f_D < \beta^{-\sigma}\left[\beta f^M + \frac{\delta c^P}{\eta(\theta_{ij})}\right] < f^F$$

holds, then a partial sorting equilibrium exists. That is, strictly positive non-overlapping masses of producers find it optimal to sell domestically only and to sell both domestically and in the foreign market j. Among exporters, there are strictly positive, non-overlapping masses of producers that search for a general importer and that own foreign sales subsidiaries.

Proof. See the Appendix. ■

This lemma follows directly from using the definitions of $\delta V^D, \delta V^F$, and δV^{SP} in Figure 3. Note that for a segmentation of firms into non-exporters and owners of own sales affiliates, it is enough that $\bar{\tau}_{ij}^{1-\sigma} f_D < f^F$, which is exactly the respective condition in Melitz (2003). Also as in Melitz, we do not require the existence of variable trade costs $\bar{\tau}_{ij} > 1$; neither the sorting of firms into exporters and non-exporters, and the sorting of exporters into direct and indirect exporters hinges on $\bar{\tau}_{ij}$. The only reason to allow for $\bar{\tau}_{ij} > 1$ is for the purpose of conducting comparative statics.

Lemma 2 has a fairly intuitive interpretation. The term in square brackets amounts to the expected effective costs of accessing the foreign market j through a GI, since βf^M are match-specific fixed costs to be borne by the producer, and $\delta c^P / \eta(\theta_{ij})$ are the expected, annuitized search costs. The term $\beta^{-\sigma}$ that premultiplies effective expected search costs is related to the elasticity of expected profits of a searching producer with respect to $A^{1-\sigma}$. Hence, the lemma requires that adjusted expected costs of market access in the intermediate mode should neither be too larger nor too small. Clearly, we can restate Lemma 2 in terms of market tightness θ_{ij}. If θ_{ij} is high, producers find GIs quickly, expected search costs fall, and so do total effective GI-mediated access costs. However, as long as $f^M > 0$, indirect exporting remains viable, at least for some combinations of parameters, even if θ_{ij} approaches infinity. However, if θ_{ij} falls to zero, search costs become infinite and so do GI-mediated access costs: indirect exporting is no longer feasible. Hence, from the producers' perspective, Lemma 2 implies a lower bound for θ_{ij}. However, for high θ_{ij}, fewer GIs find it optimal to enter, which puts an upper bound on the equilibrium θ_{ij}.

Note the difference of the proposed theory to the *proximity-concentration* model in Helpman et al. (2004). There, the sorting of firms into foreign direct investment and exports depends crucially on systematic transportation costs. In their model, as transportation costs fall, exporting becomes more attractive relative to local production. This is an empirically counter-factual implication (Neary, 2007), that our model does not have. Rather, a change in systematic transportation (distance) costs does not directly affect the sorting of firms into different export modes, but would has indirect implications through the market tightness (see below). However, since we allow firms to differ with respect to the genuine tradability of their varieties, we can make statements on how the idiosyncratic (variety specific) transportation costs affect the sorting of firms. We do so in the following proposition.

Proposition 1 *Under the condition stated in Lemma 2, producers endogenously select* *into export modes according to their product characteristics. Firms with high levels of productivity, easily tradable variants, or a strong brand reputation, establish own subsidiaries, while those with intermediate values of the above characteristics search for general importers. Firms with low values of the above characteristics do not export.*

Proof. Directly follows from Lemma 2 and Figure 3. ■

Figure 4 looks at the comparative statics of an increase in θ_{ij}. From (13), both the slope and the intercept of the $\delta^P V^{SP}(A)$ line change. The reason is that a higher θ_{ij} implies a higher matching rate for producers. Hence, the fraction of time that any producer is actually matched goes up. This leads to a stronger marginal effect of a change in $A^{1-\sigma}$: as firms have better characteristics, their export profits rise faster if they are more frequently matched. Hence, the slope of the (13) line is steeper if θ_{ij} goes up. The effect on the intercept, however, is ambiguous. On the one hand, a higher θ_{ij} rises the fraction of time in which a firm with characteristics $A_{ij}^F < A \leq A_{ij}^{SP}$ is matched and hence paying its share of match-specific costs βf^M. On the other hand, a higher θ_{ij} also means that the firm finds itself less frequently paying search costs c^P. Whether the first effect dominates the latter depends on the sign of $\beta f^M - c^P$. Since $f^M = 0$ is perfectly compatible with a meaningful equilibrium but $c^P = 0$ is not, we set $f^M = 0$ in the following analysis.

Corollary 1 *If $f^M = 0$, an increase in market tightness θ_{ij} makes indirect exporting more attractive relative to both, the purely domestic mode, and direct exports through own affiliates. That is, the lower cutoff in the indirect exports mode, $\left(A^{SP}\right)^{1-\sigma}$, falls while the upper cutoff, $\left(A^{F}\right)^{1-\sigma}$, rises.*

Proof. See the Appendix. ■

4.3 Intermediation, the missing trade puzzle, and other implications

We can use figure 4 to discuss a number of interesting implications that result from the option of producers to export via GIs. To that end, we compare the standard Melitz (2003) model, in which intermediation is not a feasible option, to a model where that latter option exists. Lemma 2 suggests that there are several ways to render indirect exporting an option which is always dominated either by non-exporting or by exporting through own affiliates: either β is too small, or c^P and/or f^M are too high, or θ is too

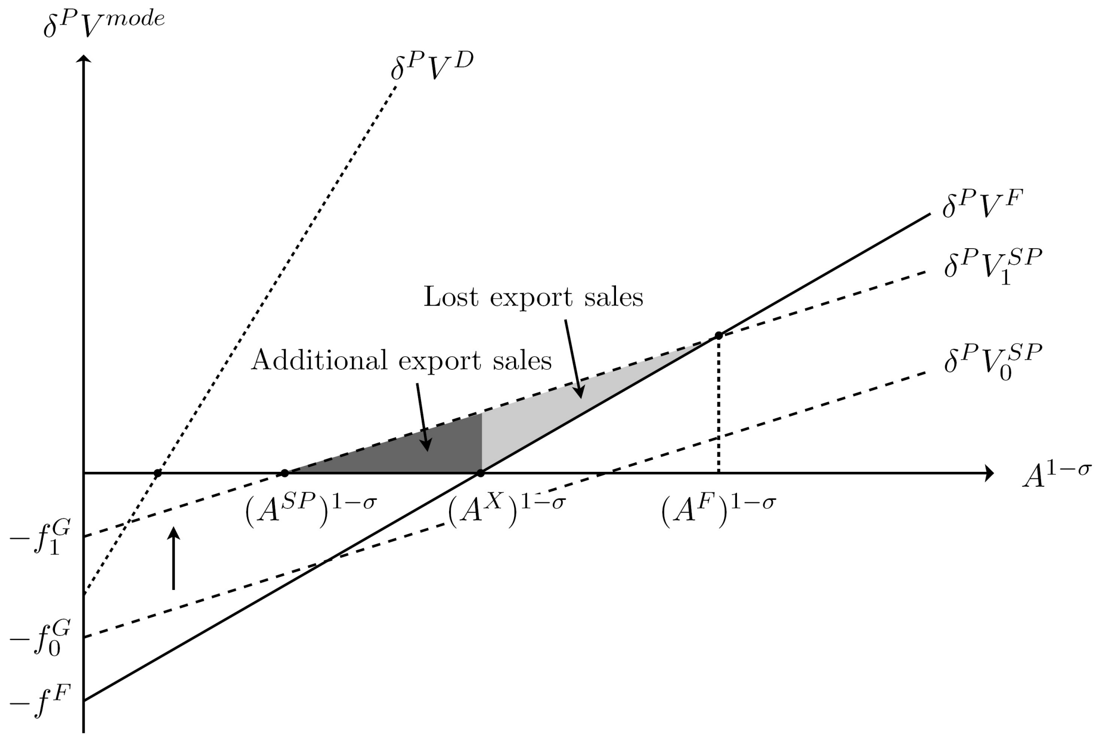


Figure 4: Increasing tightness and equilibrium sorting

low. In all those cases, the intercept of the $\delta^P V^{SP}(A)$ line in figure 4 is so large (in absolute values), that the cutoff level $\left(A^{SP}\right)^{1-\sigma}$ does not exist. We focus on the case of a reduction in search costs c^P, either through technogical change (the improvement of information and communication technologies) or through measures of indirect trade promotion (e.g., through the construction and public maintenance of trade fairs, or trade missions in consulates or embassies).[12] There is ample empirical evidence for both facts, see Cummins and Violante (2002) and Rose (2007).

In figure 4, if c^P is prohibitively high, only three regimes exist: firms with the lowest values of A export, firms with intermediate values of A are active only domestically, and firms with the highest A never take up operations. Hence, the cutoff $\left(A^D\right)^{1-\sigma}$ is not affected by the parameter c^P. However, if c^P is prohibititively high, the exporting cutoff $\left(A_0^F\right)^{\sigma-1}$ is determined by the condition $\delta^P V^F\left(A_0^F\right) = 0$. This is the case where the $\delta^P V^{SP}(A)$ line cuts the x-axis.

[12]Any change in c^P triggers an adjustment in θ if it is not offset otherwise. However, there exists a scalar λ such that $dc^P = \lambda dc^G$ for which θ remains constant even in full general equilibrium.

When c^P falls, the intercept of the $\delta V^{SP}(A)$ starts to fall in absolute values, and at some point indirect exporting becomes an option for firms. This has two consequences. First, the 'best' firms (those with high $A^{1-\sigma}$) that have not exported before start selling abroad. This generates additional exports. Second, the 'worst' firms that have been exporting through an own affiliate before now prefer to use the GI instead. This switch of mode is optimal for producers: they give up some variable revenue, but in turn save fixed market entry costs (associated to FDI). Holding $A^{1-\sigma}$ constant, firms achieve higher export sales in the direct relative to the indirect mode. Hence, the switch into indirect exporting leads to a contraction of trade. The overall effect of the fall in c^P on total export values–new firms take up exporting, while switchers export less–is a priori ambiguous. Our simulation results show that a positive export effect is very likely. In contrast to received wisdom; ignoring the existence of GIs and the mechanism discussed in this paper, the effect of technological or institutional change on trade can be smaller (and, theoretically, negative).

Another implication of the existence of GIs is that variance in c^P (or any other exogenous determinant of the $\delta^P V^{SP}(A)$ line) affects the exporting behavior of different types of firms differently. Business surveys reveal that there is sizeable cross-country variance in the export behavior of firms of given productivity. For example, while in Germany medium-sized companies are very active exporters, in France this is much less the case: only 5 percent of all small and medium sized firms in France export, while that number is 18 percent in Germany (The Economist, Feb 8th, 2007). On the other hand, large firms seem to achieve higher international sales in France than in Germany. Our model can relate this emprical fact to cross-country heterogeneity in the drivers of the expected fixed costs of exports through GIs. Exporters that for some reason face high expected costs of market access through GIs have less exporting firms, but those that export are on average more productive and, hence, larger.

Finally, and related to the last observation, we can use our model to make claims on the aggregate productivity of countries. Closing down $\tau(\omega)$ and $\zeta(\omega)$ heterogeneity, the emergence of GI intermediated exports makes large exporters that switch from the direct to the indirect mode achieve smaller export sales. Therefore, they contribute less to per capita GDP (which is proportional to a measure of average productivity). On the other hand, some relatively small firms that have preferred to sell domestically only, now find it optimal to export. They receive additional weight in the calculution of average GDP. Again, the overall effect is ambiguous and needs to be simulated. However, there is the possibility that the emergence of GIs actually lowers the aggregate productivity level. In other words, export promotion need not be good for GDP even if there are more exports. *A fortiori*, a welfare perspective that accounts for resources used in foreign market access, delivers an even bleaker picture.

5 General equilibrium

In the above discussion, we have treated θ_{ij} and real income levels B_i and B_j as given. However, θ_{ij} is itself an important endogenous variable, since it reflects the entry of GIs and producers into searching mode. Moreover, free entry of both GIs and producers is crucial to close the model: the free entry conditions hold in expectations so that entry occurs until expected profits are zero.

5.1 Free entry of GIs

Free entry of GIs implies that in an equilibrium situation, the expected gains from starting a new GI firm are just zero. That condition pins down the equilibrium number of GIs. When GIs decide to start searching for a foreign producer, they incur search costs. They are matched according to the matching technology described above, with $\eta\left(\theta_{ij}\right)/\theta$ the Poisson arrival rate of a successful match. However, any GI faces *ex ante uncertainty* since the characteristics of the producer that it will ultimately be matched to are known only when the match has occurred. Clearly, since the size of the joint surplus is strictly decreasing in A, a GI is strictly better off with a partner featuring a lower A.

The value equations of a GI can be written as

$$\delta^G E[V_{ij}^{SG}] = -c^G + \frac{\eta(\theta_{ij})}{\theta_{ij}} \left(E[V_{ij}^{MG}] - E[V_{ij}^{SG}]\right), \qquad (16)$$

$$\delta^G E[V_{ij}^{MG}] = (1-\beta) E\left[J_{ij}(\omega)\right] + \delta^P \left(E[V_{ij}^{SG}] - E[V_{ij}^{MG}]\right), \qquad (17)$$

where $E[V_{ij}^{SG}]$ denotes the expected value of a searching GI and $E[V_{ij}^{MG}]$ that of a matched GI. As with producers, there is no discounting other than through the exogenous separation rate δ^G, which measures the rate at which a match is broken and the GI goes out of business. Equation (16) shows that the expected flow return to searching consists of a flow search costs $-c^G$, and a positive capital gain $E[V_{ij}^{MG}] - E[V_{ij}^{SG}]$, which materializes when the GI switches from searching to being matched. This happens with Poisson rate $\eta\left(\theta_{ij}\right)/\theta$. Equation (17) shows that the expected flow value of a matched GI consists of the GI's share of the joint surplus generated in the match, $(1-\beta) E[J_{ij}(\omega)]$, and the capital loss $E[V_{ij}^{SG}] - E[V_{ij}^{MG}]$, which happens when the producer is hit by an exogenous exit shock δ^P.

Free entry implies that the GIs' ex ante value of searching for a producer is zero. Using equation (17), this implies that the expected value of a matched GI is just equal to the GI's share of the joint surplus, appropriately discounted $E[V_{ij}^{MG}] = \frac{1-\beta}{\delta} E[J_{ij}(\omega)]$.

Defining the truncated p.d.f. relevant for the GI's expected surplus as $\mu(A) \equiv g(A) / \left[G\left(A^{SP}\right) - G\left(A^{F}\right)\right]$ one finds the free entry condition for GIs:

$$\frac{c^G}{\eta(\theta_{ij})/\theta_{ij}} = \frac{1-\beta}{\delta} \left[B_j \sigma \left(\frac{\beta}{\bar{\tau}_{ij}} \right)^{\sigma-1} \int_{A_{ij}^F}^{A_{ij}^{SP}} A^{1-\sigma} \mu(A)\, dA - f^M \right]. \tag{18}$$

This condition equates the expected search costs of a GI on the left-hand-side with the present value of the expected share of the surplus that accrues to the GI.

Note that the GIs' entry decision is formally isomorphic to the producers decision whether or not to pay the fixed costs that reveal their characteristics A. However, while the producers draw from a sampling distribution $G(A)$, GIs sample the characteristics of their partners from a distribution that is endogenously truncated by the producers' decisions whether or not to search for a GI. Hence, the relevant sampling distribution is $\mu(A)$. Producers who have drawn characteristics $A \leq A^F$ find it optimal to establish a foreign sales representation. Firms with characteristics $A > A^D$ do not find it worthwhile to take up operations at all: their entry fee is simply foregone. In contrast, GIs always find it optimal to start cooperating with the producer that they have been randomly matched with. The reason for this is straightforward. A necessary and sufficient condition for producers to search for a GI is that their share of the surplus is larger than expected search costs, i.e., $\beta J_{ij}(A) \geq \delta^P \left[c^P/\eta(\theta_{ij})\right] > 0$. GIs, in turn, take up cooperation with their producer if their share of the ex post surplus is non-negative, i.e. $(1-\beta) J_{ij}(A) \geq 0$. Hence, the producers' condition is also sufficient for GIs not to refuse cooperation with a randomly matched producer. Search specific fixed costs f^M are collectivated in the bargaining process and are therefore paid by both parties in the match. It follows that in a rational expectations equilibrium, the criterion of producers to enter into searching for a GI, and of GIs not to reject a successfully matched producer, coincide. We summarize this finding in the following lemma.

Lemma 3 *In equilibrium, a general importer never finds it optimal to reject a producer* *once a match has occurred.*

Proof. In the text. ■

At this point, the crucial assumption that producers can credibly commit to *exclusive dealership arrangements* becomes clear. The problem without such an arrangement is that producers have an incentive to sell to more than one GI, since competition among GIs would allow them to sell larger quantities to the foreign market. However, if one variety is sold by at least two importers, they would enter into Bertrand competition. This would annihilate any ex post profits so that GIs' would never find it worthwhile to start searching for a producer in the first place. Hence, the mode of exporting through a GI can only exist if producers can credibly commit to *exclusive dealership arrangements*, that grant the GI the exclusive right to sell the producers specific variety in the foreign market.

5.2 Free entry of producers

Free entry of producers ensures equality between the present value of average profit flows of a potential entrant and the entry costs f^E. This condition can be expressed as

$$\begin{aligned} \delta^P f^E &= \int_0^{A_i^D} \left(A^{1-\sigma} B_i - f^D\right) dG(A) \\ &+ \sum_{j\neq i} \int_{A_{ij}^F}^{A_{ij}^{SP}} \left\{\chi(\theta_{ij}) \left(\beta^\sigma \bar{\tau}_{ij}^{1-\sigma} B_j A^{1-\sigma} - \beta f^M\right) - \left[1-\chi(\theta_{ij})\right] c^P\right\} dG(A) \\ &+ \sum_{j\neq i} \int_0^{A_{ij}^F} \left(\bar{\tau}_{ij}^{1-\sigma} A^{1-\sigma} B_j - f^F\right) dG(A) \,. \end{aligned} \quad (19)$$

The first line of the above expression reflects the expected flow value of domestic operations. The second line takes account of the possibility that a producer ends up searching and being matched to a GI, where along the steady state, the fraction of time being matched is given by $\chi(\theta_{ij})$, where we anticipate that this fraction will be a function of market tightness θ_{ij}. Finally, the third line collects profits obtained from exporting through an own subsidiary. The summation sign in the penultimate and last lines is due the fact that producers may export to a number of countries.

5.3 Steady-state conditions

Let M_i be the mass of existing producers in each country i. As in Melitz (2003), a stationary equilibrium requires the mass of successful entrants $G\left(A_i^D\right) M_i^E$ to replace the mass $\delta^P M_i$ of firms that are hit by a bad shock and exit. The aggregate stability condition translates to the intermediate range G_{ij} where producers either search for a trading partner or are currently matched. Let respectively $\chi_{ij}\left(\theta_{ij}\right)$ and M_{ij}^G denote the fraction of matched producers and the mass of producers in range G_{ij}. Then the evolution of the mass of unmatched producers is given by

$$\frac{d}{dt}\left[1-\chi\left(\theta_{ij}\right)\right] M_{ij}^G = bM_{ij}^G - \eta(\theta_{ij})\left[1-\chi\left(\theta_{ij}\right)\right] M_{ij}^G + \delta^G \chi\left(\theta_{ij}\right) M_{ij}^G - \delta^P M_{ij}^G$$

where b denotes the rate at which new producers are created and is a function of all cutoffs. In a steady state, birth rate and death rate have to be equal. This does not imply additional conditions on the endogenous variables from the assumption that the net birth rate is zero as endogenous variables are assumed not to change in a steady state. However, we obtain a condition from assuming the fraction of matched producers to be stationary

$$\frac{d}{dt}\left[1-\chi\left(\theta_{ij}\right)\right] = b - \eta(\theta_{ij})\left[1-\chi\left(\theta_{ij}\right)\right] + \delta^G \chi\left(\theta_{ij}\right) - \delta^P - \frac{\left[1-\chi\left(\theta_{ij}\right)\right] \dot{M}_{ij}^G}{M_{ij}^G}.$$

By stationarity, the net birth rate is zero. Accordingly, the birth rate equals the death rate. Now consider steady states, where the number of matched producers does not change. Then we find that the fraction of matched producers along the steady state is given by

$$\chi\left(\theta_{ij}\right) = \frac{\eta(\theta_{ij})}{\eta(\theta_{ij}) + \delta^G}. \tag{20}$$

Condition (20) relates the degree of market tightness θ_{ij} and the fraction of matched producers. It is a perfect analogon to the Beveridge curve in search and matching models in the labor market literature. It follows that we can express the model equivalently either in terms of χ_{ij} or θ_{ij}.

5.4 Definition, existence and uniqueness of a steady state

The free entry conditions of producers and GIs being fairly complicated functions of the threshold values A_i^D, A_{ij}^{SP},A_{ij}^F, we use the the aggregation operator introduced by Helpman et al. (2004) $\Lambda\left(A\right) \equiv \int_0^A \left[y\left(\xi\right)\right]^{1-\sigma} dG\left(\xi\right)$, where $y\left(\xi\right)$ is some continuous, differentiable

Table 1: Equilibrium conditions

Zero profit cutoff conditions		
Domestic	$\left(A^{D}\right)^{1-\sigma} = \frac{f^{D}}{B}$	(ZPC 1)
Searching producers	$\left(A^{SP}\right)^{1-\sigma} = \frac{\bar{\tau}^{\sigma-1}}{\beta^{\sigma} B}\left[\frac{c^{SP}}{\eta(\theta)} + \beta f^{M}\right]$	(ZPC 2)
Own sales affiliate	$\left(A^{F}\right)^{1-\sigma} = \frac{\bar{\tau}^{\sigma-1}}{B}\frac{[\delta+\eta(\theta)]f^{F}-\delta c^{SP}-\eta(\theta)f^{M}}{\delta+\eta(\theta)(1-\beta^{\sigma})}$	(ZPC 3)
Free entry conditions		
Searching GIs	$\frac{c^{SG}}{\eta(\theta)/\theta} = \frac{1-\beta}{\delta}\left[B\sigma\left(\frac{\beta}{\bar{\tau}}\right)^{\sigma-1}\frac{\Lambda\left(A^{SP}\right)-\Lambda\left(A^{F}\right)}{G(A^{SP})-G(A^{F})} - f^{M}\right]$	(FE 1)
Producers	$\delta^{P} f^{E} = \Lambda\left(A^{D}\right)B + \chi(\theta)\beta^{\sigma}\bar{\tau}^{1-\sigma}\Lambda\left(A^{SP}\right)B + \bar{\tau}^{1-\sigma}\left[1-\chi(\theta)\beta^{\sigma}\right]\Lambda\left(A^{F}\right)B - f^{D}G\left(A^{D}\right) - \left[\left(1-\chi(\theta)\right)c^{SP} - \chi(\theta)\beta^{\sigma+1}\bar{\tau}^{1-\sigma}f^{M}\right]G\left(A^{SP}\right) - \left[f^{F} - \chi(\theta)\beta^{\sigma+1}\bar{\tau}^{1-\sigma}f^{M} - \left(1-\chi(\theta)\right)c^{SP}\right]G\left(A^{F}\right)$	(FE 2)

function, to rewrite those conditions. Also following the literature, we assume that $\bar{\tau}_{ij} = \tau$, i.e., the systematic component of transportation costs is the same between each pair of countries. Finally, for the sake of tractability, we assume that there are just two countries. Under these circumstances, the system of equilibrium conditions (10), (14), (15), (18) and (19) implies the same cutoffs A^{D}, A^{SP}, A^{F}, the same $B_i = B_j = B$, and the same $\theta_{ij} = \theta_{ji} = \theta$ for i, j. We can then define the general equilibrium as the solution to the system of equations (ZPC 1) - (FE 2) summarized in Table 1.

In condition (FE 2), $\chi(\theta)$ is the fraction of matched producers along the steady state, see equation (20). Since that fraction depends only on the tightness measure θ and the match destruction rage δ^{G}, it does not convey any additional information and does not constitute an independent equilibrium condition.

The next lemma characterizes the solution of the general equilibrium.

Lemma 4 *If A follows the Pareto distribution with shape parameter $k > \sigma + 1$, the zero cutoff profit conditions (ZPC 1)-(ZPC 3) plus the free entry condition of GIs, (FE 1) solve for the equilibrium cutoff points A^{D}, A^{SP} and A^{F} as well as for the market tightness*

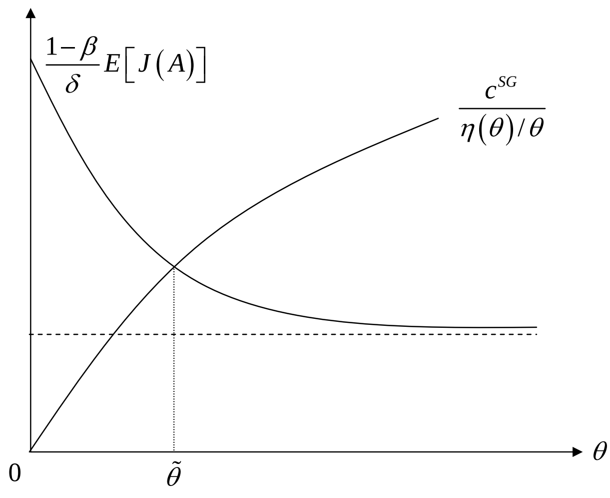


Figure 5: Determination of equilibrium market tightness θ

θ independently from the level of technology A_0, τ, and B. The value of B then adjusts such that the free entry condition of producers (FE 2) is met.

Proof. See the Appendix. ■

Given Lemma 4, in order to prove existence and uniqueness of the equilibrium, it is sufficient to substitute the zero cutoff profit conditions (ZPC 1)-(ZPC 3) into the GIs' free entry condition and search for the value of θ that solves that equation. The next proposition states the conditions under which an equilibrium exists.

Proposition 2 *If $\sigma > 2$ and the probability density function of A, $g(A)$, is weakly monotonically increasing in A, then there exists a unique value of the market tightness parameter θ for which a sorting equilibrium $0 < A^F < A^{SP} < A^D < A_0$ exists.*

Proof. See the Appendix. ■

Proposition 2 states the conditions, under which the sorting hypothesized in figures 3 and 4 is supported by an equilibrium value of θ. Both conditions are fairly innocous. The requirement that $\sigma > 2$ strengthens the usual $\sigma > 1$ which is needed in any model of monopolistic competition. Here, we require a somewhat stronger condition, which makes sure that the profits and revenues are convex in A, i.e., that the second derivative is negative. The condition on $g(A)$ stated in Proposition 2 is trivially satisfied in most distribution functions usually used in the literature on firm heterogeneity, e.g., the Pareto, Lognormal, Exponential, or Frêchet distributions. It implies that the distribution from which firms sample their A statistics has not less mass at bad (high) realizations that at low (good) ones.

6 Globalization and the relative prevalence of different export modes

How do observed trends in underlying exogenous variables, such as fixed and variable trade costs, the costs of international communication, or the bargaining power of producers affect the equilibrium degree of openness of the economy and the relative importance of indirect versus direct exporting? In this chapter we provide some comparative statics results and offer a perspective on their quantitative importance in a simulation exercise.

6.1 International openness and the relative prevalence of export modes

One of the attractive properties of the Melitz (2003) framework is that the model allows for the endogenous emergence of a sector of non-traded goods. The innovation of the present paper is that market access costs are partly endogenous; how costly it is to search for a trade partner depends on the market tightness, which is itself a function of producers' and GIs' entry entry behavior. Hence, the relative importance of the non-traded sector is also endogenous and depends on all kinds of exogenous and endogenous trade costs.

To understand how the relative importance of the non-traded goods sector depends on underlying fundamental variables, is helpful to relate domestic firms' revenue from sales to domestic consumers with revenue generated by selling to foreign consumers (i.e., export revenue). Using the variable s to denote those sales, and employing the superscripts D, F, and G, to describe sales to domestic consumers, sales to foreigners through own affiliates, and sales to foreigners through GIs, respectively, the relative importance of domestic revenue can be written as φ as follows

$$\varphi\left(\theta\right) \equiv \frac{s^D}{s^F + s^G} = \bar{\tau}^{\sigma-1}\frac{1}{\sigma}\frac{\int_0^{A^D} A^{1-\sigma}g(A)dA}{\int_0^{A^F} A^{1-\sigma}g(A)dA + \chi(\theta)\beta^{\sigma-1}\int_{A^F}^{A^{SP}} A^{1-\sigma}g(A)dA}. \tag{21}$$

There are a couple of noteworthy things: Importantly, under the assumption that the statistic of firm characteristics A is Pareto distributed, the endogenous variable B does not play any direct role in determining φ. Moreover, we have seen in section 5.4 that the equilibrium degree of market tightness θ does not depend on the systematic component of variable iceberg trade costs $\bar{\tau}$. Hence, it is immediately clear that higher variable trade costs increase domestic sales relative to foreign sales.

Since $s^D + s^F + s^G$ is just equal to total sales in the differentiated goods sector, we can define the degree of openness of an economy as export sales $\left(s^F + s^G\right)$ in total sales as

$$openness = \frac{\varphi}{\varphi + 1} \tag{22}$$

It directly follows that openness decreases as $\bar{\tau}$ goes up.

In the introduction we have noted that the share of exports channeled through sales affiliates has increased over time. Hence, the relative prevalence of sales intermediation has fallen. In this section we discuss how such changes could occur within our model. We can write the ratio of intermediated export sales relative to sales through an own affiliate as

$$\upsilon\left(\theta\right) \equiv \frac{s^G}{s^F} = \frac{\chi(\theta)\beta^{\sigma-1} \int\limits_{A^F}^{A^{SP}} A^{1-\sigma} g(A) dA}{\int\limits_{0}^{A^F} A^{1-\sigma} g(A) dA}. \tag{23}$$

It is a direct implication of Lemma 4 that υ has to be independent of $B, \bar{\tau}$ and A_0, since θ is independent of this variables, too. This means that changes in variable trade costs do not alter the relative prevalence of different export modes in terms of market shares. Hence, to match the empirical fact of a dedlining υ, one needs to search for different candidate explanations. Our preferred channel operates directly through market tightness θ: If more producers find it optimal to search for a GI, they exert a search externality on each other, which drives down θ and therefore also $\chi\left(\theta\right)$, the share of producers matched to a GI along the steady state.

Figure 6 provides a graphical illustration of the key trade-off in the present model. It plots combinations of f^F and β which give rise to the same level of υ, which we label υ_0. The trade-off between the costs of establishing an own sales affiliate and the producer's market power exists only to the extent that a sorting equilibrium exists; this explains the lower and upper bounds on β, $\left[\underline{\beta}, \bar{\beta}\right]$. Outside this interval, the bargaining power of the producer is either so large that GIs cannot recoup their sunk investment costs and

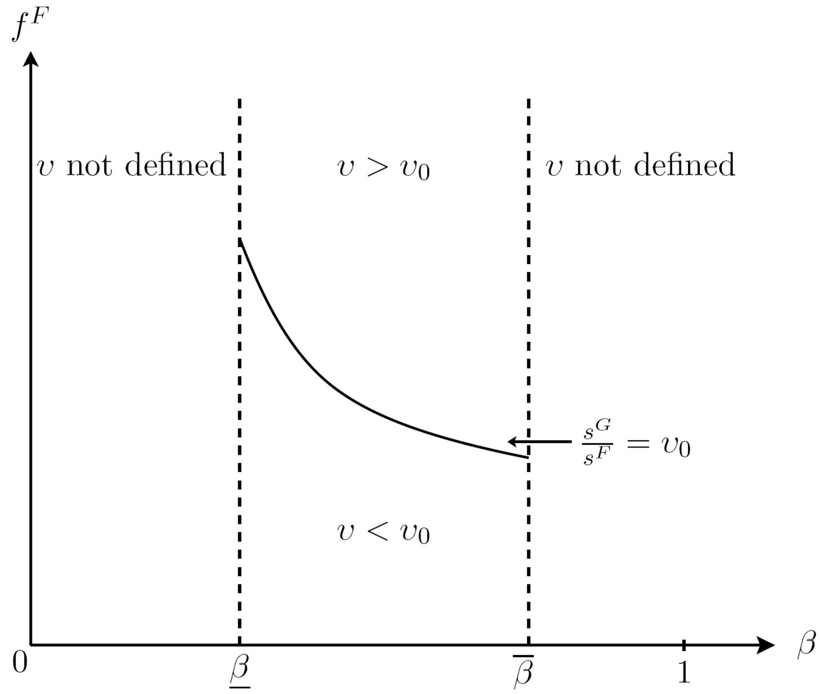


Figure 6: The relative prevalence of GI-intermediated versus direct exports

hence do not find it optimal to enter or so small that producers do not expect positive profits from searching for a GI. The locus υ_0 is downward-sloping: as β increases, the relative attractiveness of intermediated exports rises for the producer. To make this fact compatible with constant prevalence level υ_0, the costs of an own sales affiliate must fall. For given β, higher levels of f^F than the mirror image of β on υ_0 imply that the relative prevalence of intermediated sales goes up; lower levels of f^F imply that it goes down.

We may write the fraction of total export sales undertaken by GIs as

$$GIs\prime\ export\ share = \frac{\upsilon}{\upsilon + 1}, \tag{24}$$

which is also a direct function of θ. In turns out that direct analysis of υ and φ is fairly involved algebraically. Hence in the following section we calibrate and simulate the model. The calibration is justified also on grounds of proving that the equilibrium emergence of GIs is not confined to unlikely combinations of model parameters but is indeed fairly likely to happen.

6.2 Calibration

In order to calibrate the model, we need to make an assumption on the distribution of the statistic A. Following the literature (Helpman et al, 2004; Bernard et al., 2006), we assume that A follows a Pareto distribution with support $0 < A < A_0$, and shape parameter $k > \sigma - 1$. Hence,

$$G(A) = \left(\frac{A}{A_0}\right)^k. \tag{25}$$

We also need a functional form for the matching function, which we take to be Cobb-Douglas with the (Hicks-neutral) matching efficiency given by the parameter $m_0 > 0$. Hence, the rate at which producers meet GIs is given by $\eta(\theta) = m_0\theta^\gamma$. The rest of the model is fairly standard to calibrate. As far as possible, we follow the recent example by Bernard (2007); details are provided in table 2.

There is ample direct evidence on the elasticity of substitution between different varieties; see the survey of Anderson and van Wincoop (2004). We use the widely cited estimated $\sigma = 3.79$ from Bernard et al. (2003). That study also provides information on the rate of producer exit δ^P which in the U.S. takes the value of 10 percent by year, and matches the total rate of firm failure. That value has also been chosen by Ghironi and Meltitz (2004) in a recent numerical exercise. In order to meet the empirical observation that the average trade relationship lasts 3 years (Besedes and Prusa 2007), we set $\delta = 1/3$ which implies $\delta^G \approx 0.23$. Concerning variable ad valorem trade costs, we follow Anderson and van Wincoop (2004) and set $\bar{\tau} = 1.5$. This value corresponds to the unexplained average border costs that arise in trade between the U.S. and Canada.

From the above analysis we know that the equilibrium sorting is independent of A_0. We can then set $A_0 = 1$ without loss of generality. We set the shape parameter $k = 4.8$. Both the elasticity of the matching function and the distribution of bargaining power across producers and general importers is unknown. In the absence of estimates, we set the the elasticity equal to the bargaining power of producers ($= \gamma = \beta$)[13] and calibrate the parameters. Moreover, we calibrate the matching efficiency m_0 from the model. Finally, we are free to choose the level of fixed costs of domestic production, which we set to $f^D = 0.75$. We have $f^F = 1$ which clearly meets the condition $f^F > \tau^{1-\sigma} * f^D$.

The simulation of the model yields an equilibrium market tightness of 1.11; i.e., for each

[13] The equality of bargaining power and matching function elasticity is known in the search-matching literature as the "Hosios condition".

Table 2: Calibration: moments to be matched and implied parameter values

Parameter	Interpretation	Value	Source
	Parameters from economic literature		
σ	Elasticity of substitution	3.79	Bernard et al. (2003)
k	Decay of distribution	4.79	Bernard et al. (2003)
δ^P	Rate of producer exit	0.10	Bernard et al. (2003)
$\bar{\tau}$	Trade costs	1.50	Anderson&Wincoop (2004)
f^D	Fixed costs of production	0.75	Bernard et al. (2007)
f^F	Fixed costs of sales subsidiary	1.00	Bernard et al. (2007)
	Empirical moments to be matched		
δ	Rate of match destruction	0.33	Besedes and Prusa (2007)
β	Bargaining power (producer)	γ	Hosios condition
$\frac{s^G}{s^F}$	Indirect over direct export sales	0.50	Bernard et al. (2007)
$\frac{s^X}{s^D+s^X}$	Openness	0.20	U.S. trade statistics
$\frac{c^G}{\eta(\theta)/\theta}$	Exp. search costs (GI)	0.50	Plausibility
$\chi(\theta)$	Share of matched producers	0.90	Plausibility
	Calibrated parameters		
δ^G	Rate of GI exit	0.23	
m_0	Matching efficiency	2.01	
γ	Elasticity of matching	0.64	
β	Bargaining power (producer)	0.64	
c^P	Flow search costs (producer)	0.10	
c^G	Flow search costs (GI)	0.98	
	Benchmark results		
θ	Market tightness	1.11	
$\frac{c^P}{\eta(\theta)}$	Exp. search costs (producer)	0.05	

searching producer, there are 1.11 searching GIs. We view this as a credible magnitude. The model also implies expected search cost from the producer perspective of 0.05. Note that this number is by an order of magnitude smaller than the one assumed for GIs. This model outcome is the intuitive implication of the fact that intermediated exports require sufficient fixed cost savings for the producer. Hence, the total cost of market access, which might be seen as the sum of both parties' access costs need to be distributed with a bias.

6.3 Simulation results

Figures 7 and 8 report some straight forward simulation results. In the present paper, simulation is not a substitute for analytical solutions since we are able to solve for comparative statics, at least if we assume that the Q-statistic is distributed according to the Pareto distribution. However, the objective of the simulation is to shed light on the magnitudes and to compare different scenarios of trade liberalization.

Figure 7 reports the effect of variation in the systematic component of trade costs on the degree of openness of the economies, and on the relative prevalence of the intermediated export mode. Clearly, openness increases as $\bar{\tau}$ goes down. However, even if $\bar{\tau}$ attains its minimum at unity, openness is not total: the existence of strictly positive foreign market access costs forebear that all firms export. Starting from the benchmark value of $\bar{\tau} = 1.5$ documented by Anderson and van Wincoop (2003), cutting trade costs by half to $\bar{\tau} = 1.25$, almost doubles the degree of openness of the economy. Note that this effect is way stronger than the one usually found in calibrated versions of the standard Krugman (1980) model. Hence, our model is able to shed light on the "*missing trade puzzle*" also regarding the elasticity of distance on the volume of exports.

Regarding the relative prevalence of the intermediated export mode, the simulation exercise confirms the theoretical prediction that $\bar{\tau}$ should have no impact: variation in $\bar{\tau}$ affects both the FDI and the GI mode of exporting similarly; hence, the relative importance of the two modes does not change.

The degree of openness goes down slightly when the cost of FDI, f^F goes up. This is not surprising, since variation of f^F affects only firms that are already exporting. The effect of first order is that some firms that have preferred the intermediated modus now establish own sales affiliates. This tends to increase trade, but only by minor quantities. In contrast to a change in $\bar{\tau}$, when f^F increases, the relative prevalence of the intermediated export mode goes up. This effect is quite pronounced: Doubling f^F from the benchmark

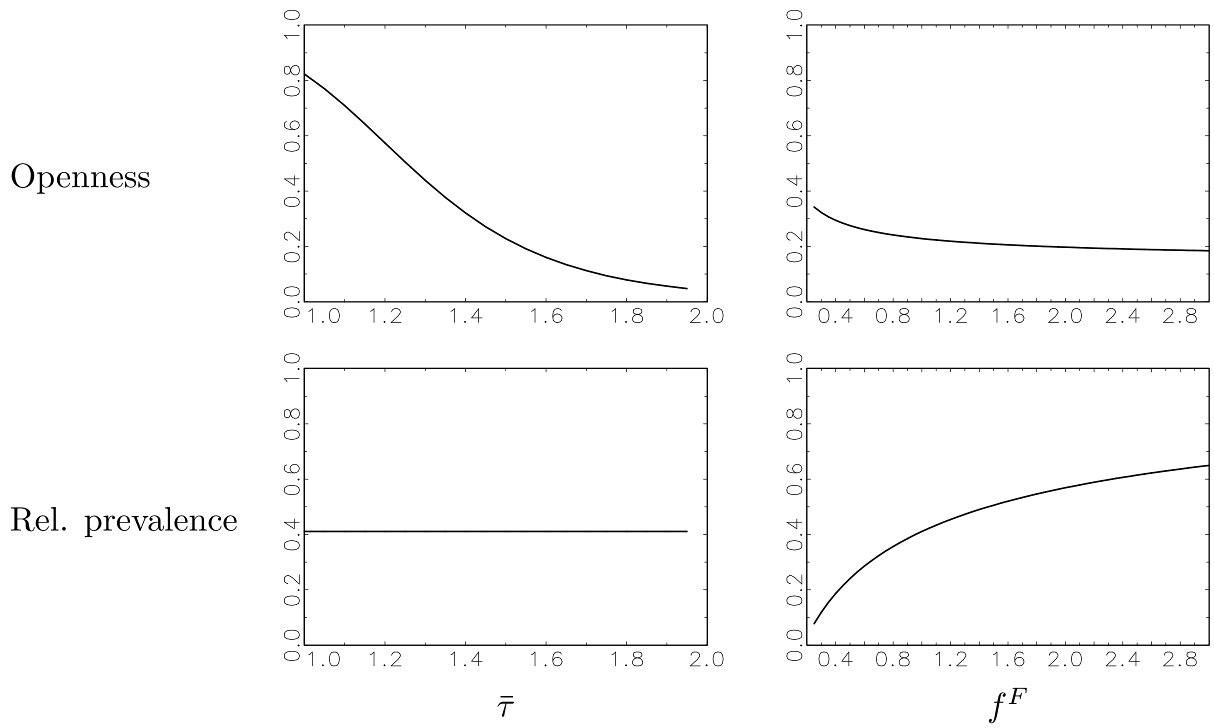


Figure 7: Simulation results: Variable trade costs and FDI costs

value of 1, almost doubles the relative export sales channelled through GIs.

Figure 8 turns to the effect of variation in search costs on trade openness and the prevalence of the intermediated export mode. The interesting conclusion is that the quantitative importance of changes in search costs depends very much on the distribution of these costs across agents: our calibration exercise implies that c^P is by an order of magnitude smaller than c^G: It follows that doubling c^P has a much more dramatic effect on both openness and relative prevalence than doubling c^G.

Table 3 summarizes the comparative statics. It also adds a column on the effect on total productivity, which, for reasons of space, we have refrained from illustrating graphically. Aggregate productivity goes up when variable trade costs fall. This is standard in the literature with heterogeneous firms: small firms with low values of $A^{1-\sigma}$ exit, while firms with high $A^{1-\sigma}$ either achieve higher export sales or start exporting for the first time. The ensuing effect on aggregate effect is positive. Lower search costs, on the other hand, have a negative effect on aggregate productivity: firms with low realizations of $A^{1-\sigma}$ find it interesting to search for a GI and export. Some firms with high $A^{1-\sigma}$, in turn, switch from FDI to intermediated exporting. The overall productivity effect is negative. Finally, lower FDI costs have a positive effect on aggregate productivity: more firms export via

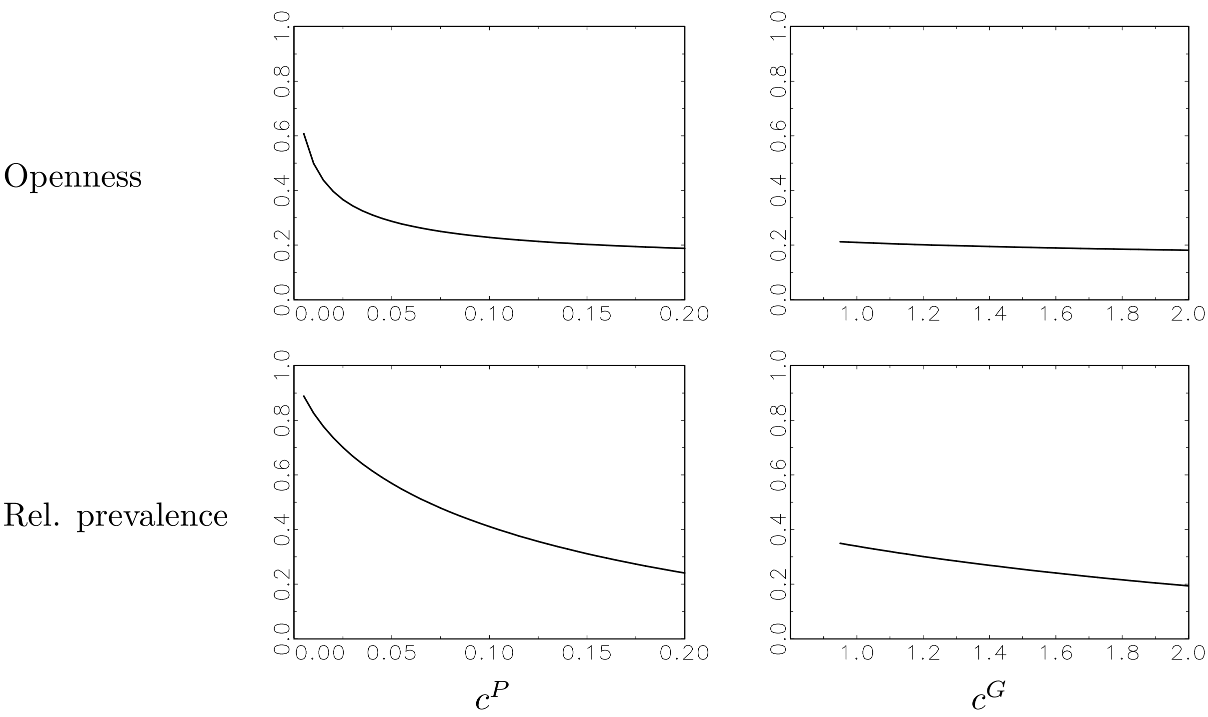


Figure 8: Simulation results: Per-unit-of-time search costs

Table 3: General equilibrium comparative statics results

	Intermediated over FDI-channelled export sales (φ)	Export sales over GDP (υ)	Aggregate 'productivity' $\left(\bar{A}^{1-\sigma}\right)$
Lower variable trade costs (τ)	/	+	+
Lower search costs $\left(\hat{c}^G = \hat{c}^P\right)$	+	+	-
Lower FDI costs $\left(f^F\right)$	-	+	+

FDI, and variable net revenues from doing so are larger.

7 Conclusions

This paper provides a general equilibrium framework with heterogeneous firms, in which trade in goods may occur in an indirect mode, via specialized general importers, or directly, via producers' sales affiliates in foreign countries. We therefore offer a theoretical explanation for a key stylized fact, namely, the existence of trade intermediation. This fact has not been explored systematically in the recent trade literature.[14]

In our extension of the Melitz (2003) model, producers have the option to search for foreign general importers and use them as trade intermediaries or access the foreign market through an own sales affiliate. Relative to the second option, the first option saves fixed costs but requires sharing profits with the intermediary. Importantly, our model partly endogenizes trade costs, since expected the expected costs of searching for a general importer are endogenous in the model and determined by the entry decisions of both producers and importers. Hence, our framework contributes towards a better understanding of trade costs that are not covered by tariffs or transportation costs and that may differ systematically across countries.

Compared to the received literature, we broaden the notion of firm heterogeneity and allow firms to differ with respect to the degree of tradability of their goods, the strength of their brand names, and their marginal costs of production. Our key result shows that exporting via a general importer is an attractive way to access foreign markets when firm characteristics lie in an intermediate range.

Another central result of the paper is that, quite unexpected, any change in the underlying exogenous variables that triggers an increase in the prevalence of intermediated exports to the expense of export sales through own affiliates is bad for aggregate productivity. This reflects the effect of firms switching from the high-exports, high-productivity FDI mode to the cheaper mode of intermediated exports, which, however, implies lower exports per firm and involves less productive firms.

The present paper is close to the frontier of analytical tractability. Hence, theoretical extensions require to reduce complexity in some elements, and enrich the model in some other areas. We believe that there are two main avenues of developing the model further. First, general importers usually are multi-product firms. This is true for producers, too, but the incentives to develop product portfolios is stronger for GIs. Eckel and Neary (2006) and Feenstra and Hong (2006) offer promising frameworks to tackle this extension. Second, we have not modeled the rich incentive problems that arise when a general importer has to exert effort to sell a producer's goods to a foreign market. A formalization of that issue is promising since the fruits of investment in marketing and sales promotion would be shared with the producer. Third, and related to the second potential extension, in the present paper, we have restricted our analysis to the case where contracts are

[14] There are, of course, some notable exceptions, e.g., Schröder et al. (2005).

not enforceable altogether. A natural extension lies in a more flexible approach, where the degree of contractability is variable. In reality there is a rich panoply of different arrangements between producers and foreign retailers, ranging from licensing to franchising agreements. All this alternative forms of interaction involve some way of solving the double marginalization problem inherent in our analysis. We believe that bringing the rich industrial organization literature into a model of our type could further cast light on the structure of trade costs between two countries.

Regarding empirical analysis, the present paper would motivate a formal econometric study that analyzes the choice of export modes in the presence of heterogeneous firms. As firm level data becomes more widely available for a larger array of countries and a richer set of variables, empirical analysis of our mechanism should become viable in the close future.

References

[1] Alessandria, George (2004). International deviations from the law of one price: the role of search frictions and market share. *International Economic Review* **45**(4): 1263–1291.

[2] Anderson, James E., and Eric van Wincoop (2004). Trade Costs. *Journal of Economic Literature* **42**(3): 691-751.

[3] Baldwin, Richard E. (1988). Hysteresis in Import Prices: The Beachhead Effect. *American Economic Review* **78**(4): 773-785.

[4] Baldwin, Richard E. (2005). Heterogeneous Firms and Trade: Testable and Untestable Properties of the Melitz Model. *NBER Working Paper* 11471.

[5] Bergin, Paul R. (2007). Tradability, Productivity, and Understanding International Economic Integration. *Journal of International Economics*. forthcoming

[6] Bernard, Andrew, J. Bradford Jensen, and Peter K. Schott (2006). Transfer Pricing by U.S.-Based Multinational Firms. *Tuck School of Business Working Paper* 2006-33.

[7] Bernard, Andrew, J. Stephen Redding, and Peter K. Schott (2007). Comparative Advantage and Heterogeneous Firms. *Review of Economic Studies* **74**(1): 31-66.

[8] Besedeš, Tibor, and Thomas J. Prusa (2007). Ins, Outs, and the Duration of Trade. *Canadian Journal of Economic* (forthcoming).

[9] Casella, Alessandra, and James E. Rauch (2002). Anonymous Markets and Group Ties in International Trade. *Journal of International Economics 58:19-48.*

[10] Chalmin, Philippe (1987). Traders and Merchants. Panorama of International Commodity Trading. Chur: Harwood Academic Publishers.

[11] Combes, Pierre-Philippe, Miren Lafourcade, and Thierry Mayer (2005). The Trade Creating Effects of Business and Social Networks: Evidence from France. *Journal of International Economics* **66**: 1-29.

[12] Cummins, John, and Gianluca Violante (2002). Investment-Specific Technical Change in the U.S. (1947-2000): Measurement and Macroeconomic Consequences. *Review of Economic Dynamics* **5**(2): 243-284.

[13] Drozd, Lukasz A., Jaromir B. Nosal (2006). Marketing Frictions and International Pricing Anomalies. Mimeo: University of Minnesota.

[14] Eckel, Carsten, and Peter Neary (2006). Globalization and Multi-product Firms. Mimeo: Oxford University.

[15] Egan, M.L. and A. Mody (1993). Buyer Seller Links in Export Development. *World Development* **20**(3): 321-334.

[16] Feenstra, Robert C. Gordon H. Hanson, and Songhua Lin (2004). The Value of Information in International Trade: Gains to Outsourcing through Hong Kong. *Advances in Economic Analysis & Policy* **4**(1): Article 7.

[17] Feenstra, Robert C. Gordon H. Hanson, (2004). Intermediaries in Entrepôt Trade: Hong Kong Re-Exports of Chinese Goods. *Journal of Economics and Management Strategy* **13**: 3-36.

[18] Feenstra, Robert C. and Hong Ma (2007). Multiproduct Firms Under Heterogeneous Costs and Monopolistic Competition. Mimeo: University of California, Davis.

[19] Felbermayr ,Gabriel, and Benjamin Jung (2007). Business News, Bayesian Updating, and Bilateral Trade. Mimeo: University of Tübingen.

[20] Felbermayr, Gabriel, and Julien Prat (2007). Product Market Regulation, Firm Selection, and Unemployment. *IZA Working Paper* 2754.

[21] Fryges,Helmut (2006). Hidden Champions–How Young and Small Technology-Oriented Firms Can Attain High Export-Sales Ratios. ZEW Discussion Paper No. 06-045.

[22] Fryges, Helmut (2007). Change of Sales Modes in International Markets: Empirical Results for German and British High-Tech Firms, *Progress in International Business Research* **1:** 139-185.

[23] Greif, A. (1993), Contract enforceability and economic institutions in early trade: the Maghribi traders' coalition, *American Economic Review* **83**(3): 525-548.

[24] Grossman Gene M., and Elhanan Helpman (2002). Integration Versus Outsourcing in Industry Equilibrium. *Quarterly Journal of Economics*: 85-120.

[25] Hakansson, Harald. (1982). International Marketing and Purchasing of Industrial Goods. IMP Project Group, Wiley and Sons.

[26] Helpman, Elhanan (2006). Trade, FDI, and the Organization of Firms. *Journal of Economic Literature* **44**: 589-630.

[27] Helpman, Elhanan, Marc Melitz, and Stephen R. Yeaple (2004). Export Versus FDI with Heterogeneous Firms. *American Economic Review* **94**(1): 300-316.

[28] Kleinert, Jörn, and Farid Toubal (2005). A Structural Model of Export versus Affiliates Production. *Tübingen Discussion Paper* 288.

[29] Kleinert, Jörn, and Farid Toubal (2006). Dissecting FDI. Mimeo: *Hitotsubashi University Tokyo.*

[30] Melitz, Marc (2003). The Impact of Trade on Intraindustry Reallocations and Aggregate Industry Productivity. *Econometrica* **71**: 1695-1725.

[31] Neary, Peter (2007). Trade Costs and Foreign Direct Investment. Mimeo: Oxford University.

[32] Pissarides, Christopher A. (2000). *Equilibrium Unemployment Theory.* Cambridge, MA.: MIT Press.

[33] Raff, Horst, and Young-Han Kim, 2005. Optimal export policy in the presence of informational barriers to entry and imperfect competition. *Journal of International Economics* **49:** 99-123.

[34] Rauch, James E. (1999). Networks versus markets in international trade. *Journal of International Economics* **48**:7–35.

[35] Rauch, James E., and Vitor Trindade (2002). Ethnic Chinese Networks in international trade. *Review of Economics and Statistics* **84**(1):116-130.

[36] Rauch, James E., and Watson, Joel (2003). Starting Small in an Unfamiliar Environment. *International Journal of Industrial Organization* **21**(7): 1021-1042.

[37] Reed, Robert R., and Trask, Kathleen A. (2006). Decentralized International Exchange. *Canadian Journal of Economics* **39**(2): 516-543.

[38] Rose, Andrew (2007) The Foreign Service and Foreign Trade: Embassies as Export Promotion. *World Economy* **30**(1): 22-38.

[39] Schröder, Philipp J.H, Harold H. Trabold, and Parvati Trübswetter (2005). Intermediation in Foreign Trade: When do Exporters Rely on Intermediaries? *Applied Economics Quarterly* **51**: 2005.

[40] Spulber, Daniel (1999). Market Micro-structure: Intermediaries and the Theory of the Firm. Cambridge, UK: Cambridge University Press.

[41] Trabold, Harald (2002). Export Intermediation. An Empirical Test of Peng and Ilinitch. Journal of International Business Studies **33** (2): 327–344.

[42] Turnbull, P.W. and M.T. Cunningham (1981). International Marketing and Purchasing. Palgrave Macmillan.

[43] Wagner, Joachim (2007). Exports and Productivity: A Survey of the Evidence from Firm Level Data. *The World Economy* **30**(1): 60-82.

A Appendix (Not for publication)

Proof. **Lemma 1.**

We solve the pricing problem by *backward induction.* The Problem of general importers (GIs) is to set the price on the foreign market. Hence,

$$p_{ij}^{G}(\omega)=\arg\max\left[p_{ij}^{G}(\omega)-p_{ij}^{M}(\omega)\right]x_{ij}\left[p_{ij}^{G}(\omega)\right]. \tag{26}$$

Using the demand function implied by our demand system, the first order condition

$$H_i\left[\zeta(\omega)\right]^{\sigma-1}\left[p_{ij}^{G}(\omega)\right]^{-\sigma}=\sigma\left[p_{ij}^{G}(\omega)-p_{ij}^{M}(\omega)\right]H_i\left[\zeta(\omega)\right]^{\sigma-1}\left[p_{ij}^{G}(\omega)\right]^{-\sigma-1} \tag{27}$$

implies $p_{ij}^{G}(\omega)=\frac{1}{\rho}p_{ij}^{M}(\omega)$.

The next step is to study the outcome of the Nash-bargaining giving the pricing behavior of the GI. The joint surplus is given by $J_{ij}(\omega)=p_{ij}^{G}x_{ij}\left(p_{ij}^{G}\right)-f^{M}$, where according to their bargaining powers the producer appropriates $\beta J_{ij}(\omega)$, and the general importer $(1-\beta)J_{ij}(\omega)$.

Finally, the producer chooses the production quantity. Rather than in terms of quantities, we can cast the producer problem in terms of the transaction price $p_{ij}^{M}(\omega)$. Hence, the producer problem is

$$p_{ij}^{M}(\omega)=\arg\max\left[\beta\frac{1}{\rho}p_{ij}^{M}(\omega)-a(\omega)\tilde{\tau}_{ij}(\omega)\right]x_{ij}\left[\frac{1}{\rho}p_{ij}^{M}(\omega)\right]$$

The associated first order condition is

$$\beta\frac{1}{\rho}H_i\left[\zeta(\omega)\right]^{\sigma-1}\left[\frac{1}{\rho}p_{ij}^{M}(\omega)\right]^{-\sigma}=\sigma\left[\beta\frac{1}{\rho}p_{ij}^{M}(\omega)-a(\omega)\tilde{\tau}_{ij}(\omega)\right]H_i\left[\zeta(\omega)\right]^{\sigma-1}\left[\frac{1}{\rho}p_{ij}^{M}(\omega)\right]^{-\sigma-1}, \tag{28}$$

which implies $p_{ij}^{M}(\omega)=\frac{a(\omega)\tilde{\tau}_{ij}(\omega)}{\beta}$. Inserting back into the result for p_{ij}^{G}, we get the claim stated in Lemma 1 $p_{ij}^{G}(\omega)=\frac{1}{\beta}\frac{1}{\rho}a(\omega)\tilde{\tau}_{ij}(\omega)$. ∎

Proof. **Lemma 2.**

We need to establish the parameter restriction that ensures that for given θ_{ij} ensures a interior solution to the equilibrium sorting problem. We can write the flow profits associated to each mode of operation, $mode\in\{D,SP,F\}$ as the following set of equations:

$$\delta^{P}V_{ij}^{SP}(A)=s(\theta_{ij})\beta^{\sigma}B_j(\bar{\tau}_{ij}A)^{1-\sigma}-\left\{s(\theta_{ij})\beta f^{M}+\left[1-s(\theta_{ij})\right]c^{P}\right\} \tag{29}$$

$$\pi_{ij}^{F}(A)=B_j(\bar{\tau}_{ij}A)^{1-\sigma}-f^{F} \tag{30}$$

$$\pi_{i}^{D}(A)=B_iA^{1-\sigma}-f^{D}, \tag{31}$$

We establish a lower and an upper bound, $\underline{f}$ and $\bar{f}$, respectively, to the expected fixed costs of the search mode SP. First, to pin down $\underline{f}$, we search for the intercept of $\delta^{P}V_{ij}^{SP}(A)$ that solves $\delta^{P}V_{ij}^{SP}(A_D)=0$. That condition yields $s(\theta_{ij})\beta^{\sigma}B_j(\bar{\tau}_{ij}A)^{1-\sigma}-\underline{f}=B_iA_D^{1-\sigma}-f^{D}$. Recognizing from (10) that $A_D^{1-\sigma}=f_D/B_i$, we find the lower bound

$$\underline{f}=s(\theta_{ij})\beta^{\sigma}\frac{B_j}{B_i}\bar{\tau}_{ij}^{1-\sigma}f_D.$$

The upper bound is found by finding the intercept $\bar{f}$ for which $\delta^{P}V_{ij}^{SP}\left(\tilde{A}\right)=0$ with $\tilde{A}$ determined by the condition $\pi_{ij}^{F}\left(\tilde{A}\right)=0$. We have $s(\theta_{ij})\beta^{\sigma}B_j\left(\bar{\tau}_{ij}\tilde{A}\right)^{1-\sigma}-\bar{f}=0$. Recognizing from (5) that $\tilde{A}=\bar{\tau}_{ij}^{\sigma-1}f^{F}/B^{j}$, we find the upper bound

$$\bar{f}=s(\theta_{ij})\beta^{\sigma}f^{F}.$$

Collecting results, the condition on the intercept of 29 $-\underline{f}< s(\theta_{ij})\beta f^M + [1-s(\theta_{ij})]c^P < \bar{f}$ can be written as

$$\frac{B_j}{B_i}\bar{\tau}_{ij}^{1-\sigma} f_D < \beta^{-\sigma}\left[\beta f^M + \frac{\delta c^P}{\eta(\theta_{ij})}\right] < f^F, \tag{32}$$

where we have made use of the definition $s(\theta_{ij}) \equiv \eta(\theta_{ij})/[\delta+\eta(\theta_{ij})]$. Condition (32) is the one that appears in Lemma 2.

■

Proof. **Corollary 1.**

Consider how an increase in θ_{ij} affects the $\delta^P V_{ij}^{SP}(A)$ locus (29): first, the locus becomes steeper since $s'(\theta_{ij}) > 0$; second, the locus shifts up (down) if $\beta f^M < (>) c^P$. Focusing on the case where $f^M = 0$, the locus always shifts up.
Using 'hats' to denote proprtional changes, the cutoff levels A_{ij}^{SP} and A_{ij}^F change as follows:

$$\hat{A}_{ij}^{SP} = \frac{\gamma}{\sigma-1}\hat{\theta}_{ij}, \tag{33}$$

where γ is the elasticity of the matching function with respect to the number of searching GIs. Similarly, we have

$$\hat{A}_{ij}^{F} = -\frac{\gamma}{\sigma-1}\frac{\delta}{\delta+\eta(\theta)}\beta^\sigma\hat{\theta}_{ij} < -\hat{A}_{ij}^{SP}, \tag{34}$$

where the inequality follows from the fact that both $\delta/[\delta+\eta(\theta)]$ and β^σ are strictly smaller than unity. ■

Proof. **Lemma 4.**

The independence of θ of the demand level B, the homogeneous part of the trade costs $\bar{\tau}$, and the upper bound of the distribution A_0 directly follows from inserting the cutoff profit conditions $(ZPC\ 1)-(ZPC\ 3)$ into $(FE\ 1)$ using the Pareto distribution. Under Pareto, $\Lambda(A)$ becomes

$$\begin{aligned}\Lambda(A) &= \int_0^{A^*} kA^{1-\sigma+k-1}A_0^{-k}dy \\ &= \frac{kA_0^{1-\sigma}}{k-(\sigma-1)}\int_0^{A^*}\tilde{k}A^{\tilde{k}}A_0^{-\tilde{k}}dy = \frac{kA_0^{1-\sigma}}{k-(\sigma-1)}\tilde{G}(A^*)\end{aligned} \tag{35}$$

where $\tilde{G}(A^*)$ is itself Pareto with scale parameter A_0 and shape parameter $\tilde{k} = k-(\sigma-1)$. A has a finite variance if and only if $\tilde{k} > 2$. We therefore assume $k > \sigma+1$. Then (8) can be written as

$$\begin{aligned}\frac{c^G}{\eta(\theta)/\theta} &= \frac{1-\beta}{\delta}\left[B\sigma\left(\frac{\beta}{\bar{\tau}}\right)^{\sigma-1}\frac{\Lambda(A^{SP})-\Lambda(A^F)}{G(A^{SP})-G(A^F)} - f^M\right] \\ &= \frac{1-\beta}{\delta}\left[B\sigma\left(\frac{\beta}{\bar{\tau}}\right)^{\sigma-1}\frac{k}{\tilde{k}}\frac{(A^{SP})^{\tilde{k}}-(A^F)^{\tilde{k}}}{(A^{SP})^{k}-(A^F)^{k}} - f^M\right] \\ &= \frac{1-\beta}{\delta}\left[\sigma\beta^{\sigma-1}\frac{k}{\tilde{k}}\frac{\left(\beta^{-\sigma}\left[\frac{c^P}{\eta(\theta)}+\beta f^M\right]\right)^{\frac{\tilde{k}}{1-\sigma}} - \left(\frac{f^F-[1-s(\theta)]c^P}{1-\beta^\sigma s(\theta)}\right)^{\frac{\tilde{k}}{1-\sigma}}}{\left(\beta^{-\sigma}\left[\frac{c^P}{\eta(\theta)}+\beta f^M\right]\right)^{\frac{k}{1-\sigma}} - \left(\frac{f^F-[1-s(\theta)]c^P}{1-\beta^\sigma s(\theta)}\right)^{\frac{k}{1-\sigma}}} - f^M\right]\end{aligned} \tag{36}$$

which solves for θ independently of B, $\bar{\tau}$, and A_0. ■

Proof. **Proposition 2.**

The average surplus achieved in a match is given by

$$E[J(\theta)] = \int_{A^F(\theta)}^{A^{SP}(\theta)} J(A)\frac{dG(A)}{G[A^{SP}(\theta)]-G[A^F(\theta)]}$$

Using the definition of the surplus given in (8), we may rewrite

$$\underbrace{\frac{1}{B_j\sigma\beta^{\sigma-1}\bar{\tau}_{ij}^{1-\sigma}}E[J(\theta)]}_{L(\theta)} = \underbrace{\frac{1}{G[A^{SP}(\theta)]-G[A^F(\theta)]}}_{R(\theta)}\underbrace{\int_{A^F(\theta)}^{A^{SP}(\theta)} A^{1-\sigma}dG(A).}_{I(\theta)} \tag{37}$$

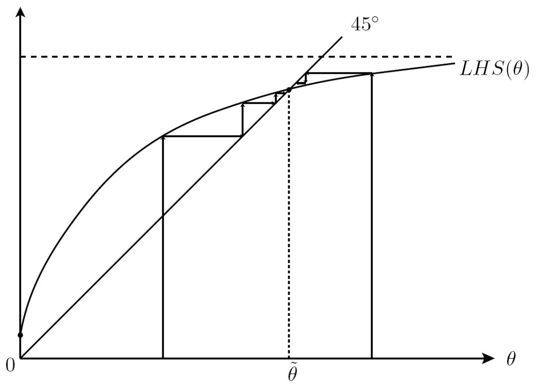


Figure 9: Existence, uniqueness, and stability of the equilibrium.

Hence, the elasticity of $E[J(\theta)]$ in θ depends exclusively on the properties of the right-hand-side of (37). Leibnitz' rule implies that

$$\begin{aligned}
\frac{\partial I(\theta)}{\partial \theta}\frac{\theta}{I(\theta)} &= \frac{\left[A^{SP}(\theta)\right]^{2-\sigma}}{I(\theta)}\frac{\partial A^{SP}}{\partial \theta}\frac{\theta}{A^{SP}} - \frac{\left[A^{F}(\theta)\right]^{2-\sigma}}{I(\theta)}\frac{\partial A^{F}}{\partial \theta}\frac{\theta}{A^{F}} \\
\hat{I} &= \frac{\left[A^{SP}(\theta)\right]^{2-\sigma} - \left[A^{F}(\theta)\right]^{2-\sigma}}{I(\theta)}\frac{\gamma}{\sigma-1}\left(1+\frac{\delta}{\delta+\eta(\theta)}\beta^{\sigma}\right)\hat{\theta}
\end{aligned}$$

Hence, under the (realistic) assumption that $\sigma > 2$, the sorting $A^{SP} > A^{F}$ implies that $\hat{I}/\hat{\theta} < 0$.
Turning to $R(\theta)$, we have that

$$\hat{R} = \frac{\gamma}{\sigma-1}R(\theta)\left[g\left(A^{F}\right)A^{F}\frac{\delta}{\delta+\eta(\theta)}\beta^{\sigma} - g\left(A^{SP}\right)A^{SP}\right]\hat{\theta}.$$

The sign of $\hat{R}/\hat{\theta}$ is a priori ambiguous. However, if one assumes that A follows a p.d.f. that is monotonically declining in A, such as the Pareto, exponential, log-Normal, or Frêchet distributions, $g\left(A^{F}\right)A^{F} < g\left(A^{SP}\right)A^{SP}$. Since $\frac{\delta}{\delta+\eta(\theta)}\beta^{\sigma} < 1$, it follows that $\hat{R}/\hat{\theta} < 0$.

We may now summarize: Since $\widehat{E[J(A)]} = \hat{R}(\theta) + \hat{I}(\theta)$, if $\sigma > 2$ and a monotonically declining p.d.f., the average match quality declines in θ. ■

Proof. **Details on the openness measure.**
Solving the integrals in (21) using the Pareto distribution, one can write domestic revenue relative to export revenue as

$$\varphi = \frac{\bar{\tau}^{\sigma-1}}{\sigma}\frac{\left(A^{D}\right)^{k-(\sigma-1)}}{\left[1-\chi(\theta)\beta^{\sigma-1}\right]\left(A^{F}\right)^{k-(\sigma-1)} + \chi(\theta)\beta^{\sigma-1}\left(A^{SP}\right)^{k-(\sigma-1)}} \tag{38}$$

Using Proposition 1, by which θ is independent of τ, and since φ has to be strictly positive, we immediately have that $\partial\varphi/\partial\bar{\tau} > 0$; i.e., the relative importance of domestic sales increases in transport costs. ■