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Abstract

The business literature and recent descriptive evidence show that exporting firms typically require the help of foreign trade intermediaries or need to set up own foreign wholesale affiliates. In contrast, conventional trade theory models assume that producers can directly access foreign consumers. This paper introduces intermediaries in an international trade model where producers differ with respect to productivity as well as regarding their varieties' perceived quality and tradability. We assume that trade intermediation is prone to frictions due to the absence of enforceable cross-country contracts while own wholesale subsidiaries require capital investment. We derive the sorting pattern of firms according to their degree of competitive advantage and show how the relative prevalence of intermediation depends on the degree of heterogeneity among producers, on the importance of market-specificity of goods, or on expropriation risk. We use US export data for 50 sectors and 133 destination countries to check the empirical validity of this predictions and find robust empirical support.

Keywords: Trade intermediation, international trade, heterogeneous firms, incomplete contracts.

JEL-Codes: F12, F23.

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1 Introduction

The international business literature (e.g., Peng and Ilinitch, 1998) has long emphasized that firms typically require an own wholesale affiliate or a trade intermediary in the foreign country to become successful exporters of final goods. The optimal organizational choice between these two major *export modes* is an important issue for firms' internationalization strategies. However, conventional trade models assume that exporters sell directly to foreign end-clients. This may be an innocuous assumption for many important questions. However, it bars a more profound understanding of those components of international trade costs that are unrelated to trade policy or geographical distance but are endogenously determined through the interaction of firms in the presence of frictions.[1]

Recent empirical evidence documents the importance of trade intermediation. Blum et al. (2010a) show that 41% of all Chilean imports are done by trade intermediaries (wohlesalers or retailers). Berndard et al. (2010c) document that 43% of U.S. exporting firms and 55% of importing firms are trade intermediaries; they amount to 9 and 16% of total trade volumes, respectively. These findings relate well to Akerman (2010), who studies Swedish firm level data and finds that 15% of total Swedish export volume is due to wholesalers. Abel-Koch (2010) draws on survey data from Turkey and reports that only about 51% of all exporters do not rely on trade intermediaries. While the empirical literature is still young, there is already impressive and detailed evidence in favor of our working hypothesis, namely, that trade intermediation is empirically relevant.

Based on these facts, a theoretical literature has begun to analyze the positive and the normative implications of trade intermediation; see the discussion of related papers below. We contribute to the positive strand of work and offer a theoretical as well as an empirical perspective. We suggest a simple theoretical framework in which exporters face a choice of *how to export* to foreign markets. That is essentially an organizational choice as domestic producers can either provide distribution services abroad through an own foreign wholesale affiliate, or

[1]Trade costs beyond transportation and tariffs are estimated to be substantial despite recent progress in transportation and communication technologies. For example, Anderson and van Wincoop (2004) report that retail and wholesale distribution costs are equivalent to an *ad valorem* tax of 55 percent, thereby dwarfing other types of trade costs.

through a specialized firm: a trade intermediary. In our model, due to the lack of enforceable cross-border contracts, intermediation entails a distortion that leads to lower export revenues. This is a disadvantage compared to the use of an own wholesale affiliate; however, intermediaries make capital investments of producers in the foreign country redundant, thereby offering savings in fixed distribution costs.

Our paper innovates along three lines: First, we cast the above choice of export modes in a Melitz (2003)-type model where firms differ with respect to the idiosyncratic components of variable distribution costs or preferences as well as with respect to their labor productivity. We derive a sorting pattern of monopolistic firms over different export modes. Second, embedding the organizational choice of producers into a multi-country trade model with trade-cost asymmetries, we show how the *relative prevalence of intermediation* depends on various exogenous variables. Third, we use US census data to provide an *empirical check* of our results.

We model trade intermediaries as important institutions in the operation of real-world international business. Trade intermediaries enjoy easier access to foreign markets due to better local knowledge and the exploitation of economies of scope. However, new advances in the literature on the boundaries of the firm (e.g., Antras and Helpman, 2004) stress the lack of enforceable contracts in international transactions. In the context of our model, the trade intermediary can hold-up the producer as customizing goods for foreign markets implies relationship-specific investment. Prices and quantities are determined in a game between producers and intermediaries: the optimal response of the producer is to restrict output for the export market, which drives up consumer prices and lowers transaction volumes. The trade-off between fixed-cost savings and lower revenue pins down the producers' optimal organizational mode of exporting.

Facing a hold-up problem, producers may wish to internalize sales activities by setting up an own wholesale affiliate. Internalization forgoes the fixed-cost savings available with intermediation, but avoids relationship-specific distortions. We derive an interesting sorting pattern: firms with highly marketable goods, strong brand reputation, and high productivity internalize foreign sales activities, while those with medium realizations of those variables prefer to use trade intermediaries. The relevant firm characteristics correlate with firm size, so that the paper predicts selection of firms along their sizes.

Besides the predicted sorting pattern, our framework has additional testable implications. Thanks to the general equilibrium nature of our model, we can derive structural relationships that can be tested econometrically in a consistent way. First, and in contrast to the concentration-proximity trade-off, the prevalence of sales through trade intermediaries relative to sales through own wholesale affiliates does not depend on variable trade costs between two countries like tariffs or freight rates. Second, relative prevalence decreases in the strength of contractual imperfections (which may be good/sector-specific) but it increases in the (country-specific) risk of expropriation of physical capital in the foreign country. Third, relative prevalence increases as firms become more homogeneous in terms of their underlying characteristics (productivity, brand reputation, marketability of goods). We test these predictions on US export data for 50 sectors and 133 destination countries.

Our work is related to at least three important strands of literature. First, on the theoretical side, recent work has studied the organizational form of multinational firms. As Grossman and Helpman (2002) or Antras and Helpman (2004, 2008) we allow for the lack of enforceable cross-country contracts to affect the boundaries of firms while within-country or within-firm transactions are not subject to similar frictions.[2] Whereas their focus is on a sourcing decision which involves the location of *input* production, we analyze the pattern of sourcing *distribution services*.[3] More recently, Felbermayr and Jung (2009a) and Antras and Costinot (2010a, 2010b) use the matching function approach (already used by Grossman and Helpman (2002), albeit in a different context) to model frictions and rent sharing on the market for intermediation. This setup allows to derive the normative implications of intermediation. Finally, Petropoulou (2008a, 2008b) has developed models which do not rely on a matching function approach but rather study the endogenous emergence of networks that link producers and consumers.

[2] As in the afore-mentioned papers, we use a property-rights approach to contractual imperfections. Other authors have proposed agency-based mechanisms, see for example Horstmann and Markusen (1995). Intermediaries may possess better information on their markets than foreign producers which opens the possibility for the existence of informational rents as they required additional incentives to incur sales efforts. As in our setup, agency-based frictions would imply that intermediation pushes up prices in the foreign markets so that heterogeneous firms would sort into distribution modes much in the same way that is predicted by our model. The property-rights approach with its focus on contractability has the advantage that for many of its determinants empirically meaningful and established proxy variables exist.

[3] Lafontaine and Slade (2007) survey theory and evidence on the sourcing decision, and on retailing. Note that we do not explicitly model a retail sector but rather focus on organization of exports.

Second, a number of recent papers discusses the endogenous sorting of firms into different modes of serving foreign markets. In Helpman, Melitz, and Yeaple (2004) [henceforth: HMY] firms either *produce locally* and export to a foreign market, or they engage in horizontal FDI and *produce abroad*.[4] In contrast to the standard proximity-concentration trade-off, in our model no trade cost savings arise. More closely related to the present paper, Blum et al. (2010b) analyze the endogenous sorting of producers over distribution modes. In line with our results, they predict that exporters with low levels of productivity use intermediaries while the most productive ones engage in direct exports.[5] Akerman (2010) develops a theory of wholesalers in international trade based on economies of scope. He is able to endogenize the product breadth of wholesalers. However, he also finds that firms with average levels of productivity choose trade intermediation as the preferred international distribution mode.

Third, the theoretical model provided by HMY has been tested by HMY themselves and other authors using different data sources. Another related empirical study is the one by Bernard et al. (2010b) who provide evidence that products' revealed contractability plays a role in explaining the intra-firm share of imports. We also draw on Nunn (2007) who computes a measure that can be viewed as product specificity at a disaggregated level.

The remainder of the paper is organized as follows. Section 2 introduces the model and solves the game between the trade intermediary and the producer. Section 3 derives the key propositions of the paper: it shows how firms sort into different export modes according to their attributes and derives predictions on the relative prevalence of either export modes and the trade-FDI relationship in general equilibrium. Section 4 provides tentative empirical evidence, and Section 5 concludes.[6]

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[4]Krautheim (2010) proposes a similar model where firms can also engage in export-supporting FDI.

[5]Ahn et al. (2010) use a special case of our setup (the variable trade cost disadvantage of intermediation is assumed rather than micro-founded).

[6]Proofs of our results, intermediate steps of calculations, and a number of supplementary tables are contained in the working paper version of this paper (Felbermayr and Jung, 2009b).

2 Model setup

In this section we describe a model with heterogeneous firms akin to Melitz (2003) in which we introduce the endogenous emergence of trade intermediaries. Besides its focus on firms' choice of export mode, our model differs from existing treatments in that it allows for a broader characterization of firm heterogeneity. Our general equilibrium approach has the advantage that it generates closed-form relationships between the relative prevalence of export modes and its observable exogenous determinants, thereby allowing for econometric validation of the model's predictions.

The world consists of N countries, indexed $j = 1, ..., N$, which may differ according to the size of their labor forces. In each country, heterogeneous firms produce varieties of a differentiated good and interact under conditions of monopolistic competition. We allow for exogenous firm turnover, so that in a stationary environment at each instant of time a measure $\bar{\delta} > 0$ of firms dies and enters. Firm death is the only source of discounting.

2.1 Demand structure

Each country j is populated by a representative household who inelastically supplies L_j units of labor to a perfectly competitive labor market. Preferences are a CES aggregate of differentiated goods, each indexed by ω:

$$U_j = \left[\int_{\omega \in \Omega_j} \left[\zeta(\omega) \, x_{ij}(\omega) \right]^{\rho} \mathrm{d}\omega \right]^{1/\rho}. \tag{1}$$

The parameter $\rho \in (0, 1)$ describes the degree of substitutability between any pair of varieties. Ω_j is the set of available varieties in country j. The quantity $x_{ij}(\omega)$ denotes consumption of a variety produced in country $i, i = 1, ..., N$. Our specification slightly generalizes the standard CES case in that it adds the parameter $\zeta(\omega) \geq 0$ which captures the *brand reputation* of variety ω as perceived by the household.[7] The larger $\zeta(\omega)$, the bigger is the contribution of variety ω

[7] Combes et al. (2005) introduce a similar weighting factor in their representation of utility.

to overall utility.[8]

Each variety is produced by a single firm. Despite the existence of operational profits of successful firms, ex ante expected profits are driven to zero by free entry. In equilibrium, aggregate operational profits are exactly matched by firms' total setup costs. Thus, labor is the only source of income.

Maximizing (1) subject to the respective budget constraint, we find the following demand function for a variety ω from country i

$$x_{ij}(\omega) = H_j \frac{\zeta(\omega)^{\sigma-1}}{p_{ij}(\omega)^{\sigma}}, \tag{2}$$

where $H_j \equiv w_j L_j P_j^{\sigma-1}$. $P_j = \left(\int_0^{n_j} [p_{ij}(\omega)/\zeta(\omega)]^{1-\sigma} d\omega\right)^{1/(1-\sigma)}$ is the price index dual to (1), n_j is the measure of the set Ω_j, $\sigma \equiv 1/(1-\rho) > 1$ is the elasticity of substitution between varieties, and w_j denotes the wage rate.

2.2 Product heterogeneity and exporting via own wholesale affiliates

Monopolistically competitive producers differ with respect to a vector of characteristics $\{\zeta(\omega), \tau(\omega), a(\omega)\}$, where $\zeta(\omega)$ is the parameter for brand reputation introduced above, $a(\omega) > 0$ denotes the labor input requirement for producing one unit of variety ω, and $\tau(\omega) \geq 1$ refers to variety-specific variable distribution costs of the iceberg type, which measure the ease at which a variety is brought to the consumer (marketability). Realistically, we assume that this cost occurs regardless of whether a good is traded internationally or not. 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 from country i to country j and may be thought of as a function of distance. We refer to $\bar{\tau}_{ij}$ as to the *systematic* component of trade costs, and of $\tau(\omega)$ as the *idiosyncratic* component.[9]

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[8] In principle, our setting allows to read equation (1) as a CES production function of a competitive final output good producer. Then, we study trade in inputs rather than in final goods. The predictions of the model do not hinge on the interpretation. This conceptual flexibility facilitates the empirical exercise of Section 4, since the data do not allow to distinguish trade in final goods from trade in inputs.

[9] Bergin and Glick (2007) also discuss variety-specific trade costs.

Firm ω's variable cost function in country i is given by $c_i(\omega) = y(\omega) a(\omega) w_i$ where $y(\omega)$ is the quantity of output. Regarding their cost structure, firms do not differ across countries. We map the vector of firm characteristics $\{\zeta(\omega), \tau(\omega), a(\omega)\}$ into a scalar measure of effective firm-level productivity $\Phi(\omega) \equiv \zeta(\omega) / [a(\omega) \tau(\omega)]$. It turns out that $Q \equiv \Phi^{\sigma-1}$ is a measure of *competitive advantage* which fully characterizes firm behavior.

Following the structure of the entry process introduced by Hopenhayn (1992) and simplified in Melitz (2003), prospective entrants are uncertain about their respective values of Φ. Only after entry, which requires sinking the cost f^E, Φ is revealed and remains constant afterwards. We assume that Φ follows the Pareto distribution. More precisely, we let the c.d.f. be $G(\Phi) = 1 - \Phi^{-k}$, with a shape parameter $k > \max\{2, \sigma - 1\}$ and the support $[1, +\infty)$.[10] Note that we need not restrict in any way the stochastic processes that govern the components of $\Phi(\omega)$.

Along with variable distribution costs $\tau(\omega)$, there are also fixed distribution costs. These costs are associated to warehousing, the maintenance of customer relations, or regulatory burdens. Without loss of generality, given perfect capital markets, we can express investment costs as flow costs. Flow fixed distribution costs are expressed in terms of labor and are given by $f_j = f w_j$, where f is the labor requirement that is constant over all countries. We assume, that a firm from country i has to pay f_i when selling to its home market, but that the cost of an own foreign representation is given by $f_{ij} = \phi_{ij} f_j$, with $\phi_{ij} > 1$ for $i \neq j$, and $\phi_{ii} = 1$, so that firms' fixed distribution costs in the foreign country are higher than in the home economy. In contrast, trade intermediaries are assumed to originate in country j so that they enjoy cheaper access to foreign markets than foreign producers. Whenever $i \neq j$, we call f_{ij} wholesale FDI.[11]

The fact that producers face higher fixed distribution costs abroad may have two reasons. First, trade costs may simply have a firm-specific fixed component which is larger in foreign markets due to additional costs associated to linguistic, legal or informational issues. Second,

[10] The Pareto assumption has been made in a large number of related papers (e.g., HMY, Chaney (2008), Helpman et al. (2008), Bernard et al. (2010a)). The Pareto allows for closed form solutions. The assumption $k > 2$ makes sure that the variance of the productivity distribution is well-defined, and $k > \sigma - 1$ guarantees that the equilibrium distribution of firm sizes has a finite mean. The dispersion of firms' competitive advantages is inversely related to the shape parameter.

[11] In principle, the sales representative could also be located domestically. However, our preferred interpretation allows to view f_{ij} as wholesale FDI. Krautheim (2010) uses the term *export-supporting FDI* instead of wholesale FDI. Essentially, this is just a reinterpretation of the fixed costs of exporting in the original Melitz (2003) model.

ϕ_{ij} may represent the risk that a foreign government expropriates the affiliate (i.e., its offices, warehouses, etc.). To see this, let δ_{ij} denote the Poisson rate of expropriation, and assume that $\delta_{ii} = 0$ for the sake of simplicity and without loss of generality. Then, ϕ_{ij} would be equal to $\left(\bar{\delta} + \delta_{ij}\right) / \bar{\delta}$ which is a strictly increasing function of δ_{ij}. Hence, the risk of expropriation works just as a higher depreciation rate on foreign assets.

We want to understand how differences in terms of competitive advantage Q across producers determine their choice of foreign market entry mode: through wholly owned foreign sales affiliates or through trade intermediaries. For that purpose, we first briefly show how profits achieved through foreign sales affiliates depend on Q. Discussion of profits through intermediation is less standard and discussed in more detail in the next section.

The monopolist generates non-negative profits from *exporting via an own wholesale affiliate*, if export revenues suffice to cover the annuitized costs of foreign investment $\phi_{ij} f_j$ and the additional variable production costs.[12] Profits from exporting through an own wholesale affiliate are $\tau_{ij}(\omega) \cdot H_j \left[\tau_{ij}(\omega) p(\omega)\right]^{-\sigma} \zeta(\omega)^{\sigma-1} \cdot \left[p(\omega) - a(\omega) w_i\right] - \phi_{ij} f_i$. Using the monopolist's optimal pricing rule, this gives

$$\pi_{ij}^{A}(Q) = \left(w_i \bar{\tau}_{ij}\right)^{1-\sigma} B_j Q - \phi_{ij} f_j, \tag{3}$$

where the systematic part of trade costs $\bar{\tau}_{ij}^{1-\sigma}$ appears as a determinant of variable profits, along with the measure of foreign market size B_j, and the costs of investing abroad, $\phi_{ij} f_j$. Profits increase in the degree of competitive advantage Q and market size B_j; they fall in effective unit costs $w_i \bar{\tau}_{ij}$, additional costs associated to linguistic, informational, or legal issues ϕ_{ij}, and the fixed costs of maintaining the foreign distribution network f_j.[13]

2.3 Trade intermediation

Assumptions. An intermediary is "*...an economic agent who purchases from suppliers for resale or who helps sellers and buyers to meet and transact*" (Spulber, 1996). We view trade intermediaries as wholesale agents that facilitate transactions between producers and consumers

[12] Recall the assumption of perfect capital markets.

[13] Note that domestic sales are nested with $\bar{\tau}_{ii} = \phi_{ii} = 1$.

from different countries. The scope of the present paper being on the sorting behavior of heterogeneous producers over distribution modes, we keep the intermediation sector as simple as possible and abstract from interesting features such as strategic behavior amongst intermediaries (see Petropoulou (2008a,b) on this) or their organizational structure. Trade intermediaries benefit from *economies of scale* since there are fixed distribution costs. They have the same fixed distribution costs as producers in that country would have, $f_j = fw_j$, since they are incorporated in the foreign country.[14] We do not explicitly model a retail sector; our assumption of variable trade costs accruing also for domestic sales capturing in a parsimonious way the cost of retailing when there are no specific contractual or strategic interactions between wholesalers and retailers (which we rule out in this paper).

Our model accommodates trade intermediaries that have *diversified product portfolios.* Under general circumstances, the pricing and the product range choice of intermediaries interact in a complicated way due to a cannibalization effect. However, under monopolistic competition, intermediaries do not internalize the effect of an additional variety on demand of the other varieties, such that pricing and product-range decisions are independent; see Bernard et al. (2010a) for a related model of multi-product producers. We may also reconcile our model with *economies of scope*. When fixed costs of distribution depend on the number of varieties sold, intermediaries determine their product range such that those costs are minimized. Assuming an interior solution to this problem, we may think of f as the minimum fixed distribution cost. As intermediaries are identical in our model, they all share the same fixed costs.[15]

Finally, we assume that producers and intermediaries cannot write enforceable *cross-country* contracts on quantities and prices and that the variety to be exchanged features some export market specificity. This might be the case if the product has to meet some specific technical standards that prevent it from being fully 'recycled' on a different market.[16] The lack of *ex*

[14]The intermediary's specific knowledge could also translate into lower variable (distribution) costs. However, the largest portion of variable distribution costs such as transportation services, taxes, etc. are the same across export modes.

[15]Felbermayr and Jung (2009a) study fixed market access costs which depend on the tightness of the matching market between producers and intermediaries.

[16]This 'recycling' process may be, of course, a metaphor for many things: sales in the foreign market may require market-specific adjustments, so that selling a shipment elsewhere requires undoing these changes; one could also think about a situation where, in case of disagreement, a delivery needs to be shipped back from the foreign country to the producer, thereby causing additional transportation costs.

ante contracts exposes the producer to potential hold-up: the intermediary can deny the order *ex post*, i.e., after production has taken place. This assumption is crucial in that it provides an endogenous rationale for lower variable revenues when the producer opts for the intermediated export mode. Variants of this assumption have been used by Grossman and Helpman (2002) or in Antras and Helpman (2004, 2008) in the context of vertical relations between final goods and intermediate inputs producers (outsourcing).[17]

The game between producers and trade intermediaries. As in Antras and Costinot (2010a), there is an infinitely elastic supply of trade intermediaries in every country. Each producer P who finds it optimal to export via a trade intermediary M, makes a take-it-or-leave-it offer, which specifies an upfront-fee for participation $T(\omega)$ in the relationship that has to be paid by M. This fee can be positive or negative, and may be interpreted as a franchising fee paid by M to P or as a down-payment of P to M towards financing fixed foreign distribution costs.[18] There is full information on product characteristics ω, so that prospective intermediaries would know that a variety offered by some producer is already sold by another intermediary. In that case, both intermediaries would see their operative profits driven to zero by Bertrand competition and would thereby not be able to recover T. It follows that all producer-dealer relationships in equilibrium must be *exclusive dealership* arrangements in that each producer is matched to at most one intermediary in every market.

With the supply of M infinitely elastic, M's profits from the relationship net of the participation fee in equilibrium are equal to its outside option, which we have set zero. Hence, $T(\omega)$ will indeed differ across varieties: the higher the competitive advantage of a variety, the larger the fee that the producer can extract from the trade intermediary. However, while perfect competition for producers leaves trade intermediaries without rents ex post, they can still hold

[17]The fact that intermediation is a variable cost intensive mode can be rationalized differently as well. It may be possible for the producer to buy insurance against hold-up risks from banks that offer trade credit. Then, the fee for this insurance appears as variable trade costs. On a competitive financial market, that fee will factor in the possibility that the intermediary can hold up the bank. The scope for such behavior again depends on things like product specificity and contractual incompleteness.

[18]We assume an infinitely elastic supply of intermediaries plus fixed participation fees for convenience rather than realism. Otherwise we could not treat intermediaries as footloose but would have to make (necessarily arbitrary) decisions on where intermediaries spend their profits. For this, it is also necessary to make T variety-specific.

up the producers. Due to the lack of enforceable contracts, the producer cannot be sure to receive adequate payment for the output delivered to the trade intermediary. The latter can refuse delivery until the price is low enough. We assume that the countervailing incentives of producers and intermediaries are sorted out via the usual asymmetric Nash bargaining process, where $\bar{\beta}_{ij} \in [0,1]$ is the bargaining power of a producer from country i with a trade intermediary located in country j. At the bargaining stage, the producer is particularly vulnerable since production costs are sunk at the time of bargaining. If bargaining fails, the producer can recycle the goods that were meant for exports, thereby partly recovering a fraction $\lambda_{ij} \in [0,1]$ of the inputs used in production.[19]

We may summarize the sequencing of the game between the intermediary M and the producer P. First, the producer P effectively auctions an exclusive dealership relationship with a trade intermediary. Second, if some M has accepted the offer, P decides about the quantity $\tau_{ij}(\omega) x_{ij}^{M}(\omega)$ to produce for the purpose of exports.[20] Finally, P delivers the goods to M, M sells the goods, and P and M bargain about sharing of revenues (and, thereby, implicitly, about a transaction price).[21]

As usual, the game is solved by backward induction. The joint surplus generated on the foreign market is given by

$$J_{ij}(\omega) = p_{ij}^{M}(\omega) x_{ij}^{M}\left[p_{ij}^{M}(\omega)\right] - \tilde{\pi}_{ij}^{P}(\omega) - f_j, \tag{4}$$

where $x_{ij}^{M}\left[p_{ij}^{M}(\omega)\right]$ is the level of foreign demand at a c.i.f. price $p_{ij}^{M}(\omega)$ and $f_j = f w_j$ is fixed foreign costs of distribution incurred by M.

The producer's outside option $\tilde{\pi}_{ij}^{P}(\omega)$ is the amount of the numeraire input that firm ω can

[19] Note that λ_{ij} measures how specific the product is to the respective export market.

[20] $x_{ij}^{M}(\omega)$ is the quantity demanded by foreign consumers, which implies the production of $\tau_{ij}(\omega) x_{ij}^{M}(\omega)$ units due to loss in transit.

[21] An alternative approach would be to consider a repeated game between intermediaries and producers. To make things interesting, one would have to assume heterogeneity among intermediaries; see Aeberhardt et al. (2010).

recover when bargaining fails

$$\tilde{\pi}_{ij}^{P}(\omega) = \lambda_{ij}\tau_{ij}(\omega)\, x_{ij}^{M}(\omega)\, a(\omega)\, w_i, \tag{5}$$

where $\tau_{ij}(\omega)\, x_{ij}^{M}(\omega)$ is the amount of production required to deliver the quantity x_{ij}^{M} to the foreign market. If $\lambda_{ij} = 0$, there is no alternative use for the goods delivered to the foreign market; if $\lambda_{ij} = 1$, production can be entirely and costlessly unwinded.

The Nash solution of the bargaining problem between the producer and the intermediary requires that M receives a pay-off $\left(1 - \bar{\beta}_{ij}\right) J_{ij}(\omega)$, while the producer gets $\bar{\beta}_{ij} J_{ij}(\omega) + \tilde{\pi}_{ij}^{P}(\omega)$. Predicting its share of the surplus at the bargaining stage, the producer chooses the optimal quantity to supply to the intermediary. She solves

$$\max_{x_{ij}^{M}(\omega)} \bar{\beta}_{ij} J_{ij}(\omega) + \tilde{\pi}_{ij}^{P}(\omega) - x_{ij}^{M}(\omega)\, \tau_{ij}(\omega)\, a(\omega)\, w_i \tag{6}$$

subject to the demand function (2). The quantity choice of the producer finally determines the price that the consumer in the foreign country ends up paying. The following lemma states that price.

Lemma 1 (Pricing behavior) *The c.i.f. price charged for imports from country i into the foreign market j is given by*

$$p_{ij}^{M}(\omega) = \frac{1}{\beta_{ij}} \frac{1}{\rho} \tau_{ij}(\omega)\, a(\omega)\, w_i, \tag{7}$$

where $\frac{1}{\beta_{ij}} = \frac{1-\lambda_{ij}\left(1-\bar{\beta}_{ij}\right)}{\bar{\beta}_{ij}} \geq 1$ is an additional markup over marginal costs. $\frac{1}{\beta_{ij}}$ measures the severity of the distortion caused by the lack of contracts.

The foreign price is determined as effective marginal costs $\tau_{ij}(\omega)\, a(\omega)\, w_i$ multiplied by a *total* markup $1/(\beta_{ij}\rho) \geq 1$ over effective marginal costs $\tau_{ij}(\omega)\, a(\omega)\, w_i$. The markup $1/\rho$ usually arises in a model with monopolistic competition and CES preferences. However, it is magnified by an additional factor $1/\beta_{ij}$ that arises due to the export market specificity of the product and lack of enforceable contracts. It is endogenously pinned down by the parameters governing the bargaining process and by the ease at which products can be recycled. The intuition for the additional markup is the following: At the bargaining stage, the producer appropriates only a share $\bar{\beta}_{ij}$ of the surplus. Therefore the firm optimally restricts the output below the level that would be optimal without intermediation.

If the producer has all the bargaining power (i.e., $\bar{\beta}_{ij} = 1$) or if she can recycle the output at no costs, then the additional markup vanishes. If output, however, is totally specialized, the additional markup factor is only driven by the bargaining power.[22] In the limiting case where the producer has no clout in the bargaining, the additional markup goes to infinity regardless of the recycling rate. [23] Moreover, the additional markup is decreasing in the bargaining power $\bar{\beta}_{ij}$ and in the recycling rate λ_{ij} for any given $\lambda_{ij} \in [0, 1)$ and $\bar{\beta}_{ij} \in (0, 1)$, respectively.

If the producer has incomplete bargaining power (i.e., $\bar{\beta}_{ij} > 1$) or her products are not fully recyclable, the c.i.f. price charged for imports via trade intermediaries is larger than the one for imports via wholesale affiliates: $p_{ij}^{M}(\omega) > p_{ij}^{A}(\omega)$. One may relate the pricing rule (7) to the *double marginalization* problem that appears in vertical relationships of monopolistic firms.[24] Both, higher trade costs $\bar{\tau}_{ij}$ and the hold-up problem imply a higher consumer price. However, there is a crucial difference between iceberg-type trade costs and the effect of frictions $1/\beta_{ij}$. The former drives up the c.i.f. price as the delivery of a good to a foreign market requires the use of specific services which require resources in proportion to the price of the good. In contrast, the holdup problem drives up the c.i.f. price because producers optimally reduce supply, thereby moving up the demand schedule.

Finally, potential intermediaries compete for contracts with producers, so that they end up bidding their entire ex post profits $\left(1 - \bar{\beta}_{ij}\right) J_{ij}(\omega)$ as participation fees $T(\omega)$. The profits that a producer P makes on the foreign market using an intermediary are given by the optimal value of (6) plus the participation fee $T(\omega)$ that the producer receives. The producer's pay-off from the bargaining stage, plus income from the participation fee, minus variable production costs, all evaluated at the optimal price $p_{ij}^{M}(\omega)$, give her total profit from exporting via a trade

[22] These statements immediately follow from the definition of β_{ij}.

[23] $\lim_{\bar{\beta}_{ij} \to 0} \beta_{ij} = 0$.

[24] In Grossman and Helpman (2002), a similar pricing rule emerges in the context of outsourcing with homogeneous firms.

intermediary as

$$\pi_{ij}^{M}\left(Q\right)=\left(\frac{w_{i}\bar{\tau}_{ij}}{\tilde{\beta}_{ij}}\right)^{1-\sigma}B_{j}Q-f_{j},\tag{8}$$

where we have replaced the firm index ω with Q. The term $\tilde{\beta}_{ij}\equiv\left[\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right]^{\frac{1}{\sigma-1}}\beta_{ij}\in\left[\beta_{ij},1\right]$ is endogenously determined as a function of effective bargaining power $\beta_{ij}\left(\bar{\beta}_{ij},\lambda_{ij}\right)$ and the elasticity of substitution σ.

In general, the lack of complete contracts reduces the slope of the profit function $\pi_{ij}^{M}\left(Q\right)$ in a similar way than an increase in iceberg trade costs $\bar{\tau}_{ij}$ would. For given Q, the variable component of profits is always smaller when the producer chooses a trade intermediary than when the producer establishes an own wholesale affiliate. Despite the fact that the producer does not directly lay out the fixed cost expenditure f_j in the foreign market, those costs are nevertheless entirely deducted from the producer's profit. This is due to the fact that the producer extracts all profits from the intermediary when setting the participation fee T. Hence, fixed distribution costs are fully rolled-over from the intermediary to the producer.

3 The choice of export modes

3.1 Sorting of firms

Firms partition endogenously into different modes along their degree of competitive advantage. The weakest firms do not even take up domestic production as they generate insufficient revenue to cover fixed domestic distribution costs f_i. The firm that is exactly indifferent between serving the domestic market or not is identified by the condition $Q_i^D=w_i^{\sigma-1}f_i/B_i$. Firms may export and do so using different export modes. The producer that is indifferent between exporting through a trade intermediary and selling on the domestic market only is given by the condition $\pi_{ij}^{M}\left(Q_{ij}^{M}\right)=0$, which can be solved for the cutoff value Q_{ij}^{M}:

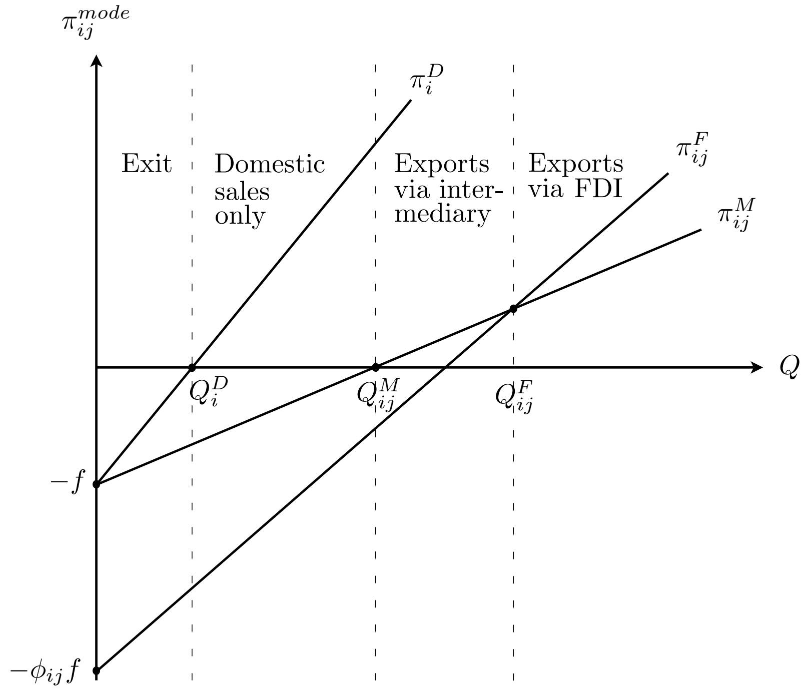
$$Q_{ij}^{M}=\left(\frac{w_{i}\bar{\tau}_{ij}}{\tilde{\beta}_{ij}}\right)^{\sigma-1}f_{j}B_{j}^{-1}.\tag{9}$$

Finally, the producer with competitive advantage Q^F_{ij} achieves identical profits from serving the foreign market in either export modes: $\pi^M_{ij}\left(Q^F_{ij}\right) = \pi^F_{ij}\left(Q^F_{ij}\right)$. This indifference condition pins down a second cutoff level

$$Q^F_{ij} = (w_i \bar{\tau}_{ij})^{\sigma-1}\left(\frac{\phi_{ij}-1}{1-\tilde{\beta}^{\sigma-1}_{ij}}\right) f_j B^{-1}_j. \tag{10}$$

Figure 1 relates the firms' sorting pattern to their degree of competitive advantage.[25]

Figure 1: Firms sort into different export modes according to competitive advantage Q



If the foreign market becomes larger, firms with low competitiveness start exporting through trade intermediaries. Moreover, it becomes attractive for some of the existing exporters to set up own wholesale affiliations. Hence, both cutoffs Q^M_{ij} and Q^F_{ij} move into the same direction. The same holds true if the fixed costs of exporting f_j, the wage rate w_j, or variable transport costs $\bar{\tau}_{ij}$ decline. In contrast, an increase in the risk of expropriation does not affect entry into exporting through a trade intermediary, but makes exporting through an own wholesale affiliate

[25]This picture is related to Figure 1 in HMY, where the sorting of firms into exporters and firms producing abroad also involves a trade-off between fixed and variable costs, in their case the proximity-concentration trade-off. In the present context, the trade-off is between variable revenue and fixed costs of foreign market access. And, importantly, the slope of the profit functions shown in Figure 1 is endogenously determined as a function of the producers' bargaining power $\bar{\beta}_{ij}$, the technology parameter λ_{ij}, and the elasticity of substitution σ.

less attractive. When the bargaining power of the producer $\bar{\beta}_{ij}$ is higher in some export market or her outside option better, the loss of revenue implied by intermediation is smaller.[26] Hence, Q_{ij}^M shifts to the left. However, an increase in $\bar{\beta}_{ij}$ makes an own wholesale affiliate less attractive, shifting Q_{ij}^F in the opposite direction.[27]

We can now use Figure 1 and state the first proposition of our paper.

Proposition 1 *Intermediaries and wholesale affiliates coexist and are both used by strictly positive non-overlapping masses of producers from country i for their exports to country j if $\tilde{\beta}_{ij}^{1-\sigma} < \phi_{ij}$. Under this condition, producers endogenously select into export modes along their degree of competitive advantage. Firms with low marginal costs, easily tradeable variants, or a strong brand reputation establish own wholesale affiliates. Those with intermediate values of the above characteristics make use of a trade intermediary.*

The existence condition $\tilde{\beta}_{ij}^{1-\sigma} < \phi_{ij}$ is intuitive:[28] Trade intermediation only arises as a viable alternative to wholesale FDI if the distortion associated to it, $\left(\tilde{\beta}_{ij}^{1-\sigma}\right)$, is small enough relative to the cost savings that the avoidance of wholesale FDI implies (ϕ_{ij}). If $\tilde{\beta}_{ij} < 1$, for any finite ϕ_{ij}, there is a positive mass of firms that wish to establish a foreign sales affiliate. Note the role of the elasticity of substitution between different varieties: if σ is very small, even a small (effective) cost disadvantage implied by intermediation reduces export revenue by a large amount, making wholesale FDI comparably attractive.

[26] Technically, this comes from $\partial\tilde{\beta}_{ij}/\partial\bar{\beta}_{ij} > 0$ and $\partial\tilde{\beta}_{ij}/\partial\lambda_{ij} > 0$.

[27] We do not model direct exports (without intermediaries or wholesale FDI) because we do not have the data to accommodate this mode. It would be fairly easy to incorporate this possibility into the model; e.g., by assuming that direct exports require very high variable trade costs but low fixed costs. This would rationalize why that mode is empirically rather unimportant.

[28] The condition does not suffice to make sure that there always exists a positive measure of firms that do not serve the foreign market at all, i.e, that $Q_i^D < Q_{ij}^M$. This inequality holds for some firms if $\frac{w_j}{w_i}\left(\frac{\bar{\tau}_{ij}}{\tilde{\beta}_{ij}}\right)^{\sigma-1} B_i > B_j$, where w_i, w_j, B_i, and B_j are endogenous objects which can be solved using the labor market clearing and balanced trade conditions for all countries. As the focus of the present paper is not on whether firms export but rather on how they do it, we refrain from determining these objects. We can derive our main theoretical results without solving for w_i, w_j, B_i, and B_j.

3.2 The prevalence of export modes

Changes in the prevalence of export modes do not only depend on movements along the extensive margin, but also on changes along the intensive margin. Sales of firm Q in either mode are simple log-linear functions of firms' competitive advantage

$$s_{ij}^{M}(Q) = \sigma \left(\frac{w_i \bar{\tau}_{ij}}{\beta_{ij}}\right)^{1-\sigma} B_j Q \quad \text{and} \quad s_{ij}^{S}(Q) = \sigma \left(w_i \bar{\tau}_{ij}\right)^{1-\sigma} B_j Q \ . \tag{11}$$

Clearly, in each mode, sales are larger the greater is the degree of competitive advantage (Q), the smaller are systematic transportation costs ($\bar{\tau}_{ij}$) and the more income the foreign market has (B_j) . The more severe the frictions caused by the hold-up problem $1/\beta_{ij}$ are, the lower sales per firm channeled through intermediaries, whereas exports per firm via wholesale affiliates is not affected by the lack of enforceable cross-country contracts.[29]

We can compute the value of total export sales of country i to country j that are facilitated by trade intermediaries $S_{ij}^{M} = M_i^E \int_{\Phi_{ij}^M}^{\Phi_{ij}^F} s_{ij}^{M}(\Phi)\, dG(\Phi)$, where M_i^E is the mass of entrants in country i. Similarly, we can derive total exports of i into j through own wholesale affiliates S_{ij}^{F}.

The severity of the hold-up problem $1/\beta_{ij}$ affects intermediated export sales in several ways. First, taking wages and market size as given, for any firm, a lower degree of contractual imperfections increases sales through intermediaries, see (11). Second, contractual imperfections affect the selection of producers into the intermediated distribution mode. As $1/\beta_{ij}$ goes down, more firms find it optimal to export through trade intermediaries and either choose to establish an own wholesale affiliate abroad or stop exporting to market j completely; see (9) and (10). Hence, a reduction of contractual imperfections has a positive effect on total intermediated export sales both on the *intensive* and on the *extensive* margin. Ignoring general equilibrium effects, the derivative of S_{ij}^{M} with respect to β_{ij} is positive.[30]

The risk of expropriation (ϕ_{ij}) only affects the extensive margin. Clearly, a higher risk of expropriation is associated with higher sales through trade intermediaries relative to sales through own wholesale affiliates.

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[29] These observations relate to *direct* effects only; $\sigma, \bar{\tau}_{ij}, \beta_{ij}$ also affect sales through B_j.

[30] This follows immediately from the considerations on the intensive and extensive margin above.

Moreover, we can establish a link between the dispersion of the distribution of the comparative advantage Q and the relative prevalence of export modes. A higher dispersion gives more mass to firms with high values of Q, therefore shifting relative sales in favor of own wholesale affiliates.

With Φ distributed according to the Pareto distribution, as assumed above, aggregate export sales of country i to country j via intermediaries are given by

$$S_{ij}^{M} = \Psi_{ij}\beta_{ij}^{\sigma-1}\left[\tilde{\beta}_{ij}^{k-(\sigma-1)} - \left(\frac{1-\tilde{\beta}_{ij}^{\sigma-1}}{\phi_{ij}-1}\right)^{\bar{k}}\right], \tag{12}$$

where $\bar{k} \equiv \frac{k}{\sigma-1} - 1$ is a constant, and Ψ_{ij} is a shifting factor.[31] Looking at the first order effect only, intermediated exports from i to j increase when both countries involved are larger or systematic trade costs $\bar{\tau}_{ij}$ are smaller. Intermediated exports also fall in f, the fixed costs that any foreign market presence entails.

Similarly, we can derive total exports of i into j through own wholesale affiliates S_{ij}^{F}. Evaluating $S_{ij}^{F} = M_i^E \int_{\Phi_{ij}^F}^{\infty} s_{ij}^{F}(\Phi)\, dG(\Phi)$, we have

$$S_{ij}^{F} = \Psi_{ij}\left(\frac{1-\tilde{\beta}_{ij}^{\sigma-1}}{\phi_{ij}-1}\right)^{\bar{k}}. \tag{13}$$

A rise in $1/\beta_{ij}$ now does not affect sales of each single exporter in the FDI mode directly, see (11). Total sales to affiliates, however, increase as some firms switch from using intermediaries to establishing own affiliates so that the cut-off value Q_{ij}^{F} falls; see (10).

We can can now express the relative prevalence of export modes as a function of exogenous variables only.

Proposition 2 *If the sorting condition holds and if firms' degree of competitive advantage follows the Pareto distribution, the prevalence of export sales via trade intermediaries relative to*

[31] The term Ψ_{ij} is endogenously determined and given by $\Psi_{ij} = \frac{\sigma k}{k-(\sigma-1)} M_i^E B_j^{\frac{k}{\sigma-1}} \left(w_i\bar{\tau}_{ij}\right)^{-k} \left(f w_j\right)^{-\bar{k}}$

sales through affiliates, $\chi_{ij} \equiv S^M_{ij}/S^F_{ij}$*, is*

$$\chi_{ij} = \beta_{ij}^{\sigma-1}\left[\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\bar{k}} - 1\right].$$

This measure increases in the additional costs associated to linguistic, informational, or legal issues ϕ_{ij} *and decreases in the severity of contractual problems* $1/\beta_{ij}$*. It decreases in the degree of dispersion of competitive advantage* $1/k$ *and falls in the elasticity of substitution* σ*. Moreover,* χ_{ij} *decreases in the dispersion of domestic sales, given by* $1/[k-(\sigma-1)]$*. It is independent from the size of the export market as given by* B_j*, the wage rates in either country, and from transportation costs* $\bar{\tau}_{ij.}$

Not surprisingly, when the strength of contractual imperfections increases trade intermediation becomes more expensive relative to the use of an own wholesale affiliate; hence relative prevalence of intermediation (χ_{ij}) falls. On the other hand, sales through intermediaries are more prevalent if the protection of property against expropriation is low (i.e., ϕ_{ij} is high).

More interestingly, χ_{ij} does not depend on the systematic component of transportation costs ($\bar{\tau}_{ij}$). This is due to the fact that sales in both distribution modes are affected by systematic transportation costs in the same way. Approximating $\bar{\tau}_{ij}$ with bilateral geographical distance, it follows that the relative prevalence of intermediation does not depend on geographical distance. This is a prediction of our framework that is testable given adequate data. Also, relative prevalence χ_{ij} increases as firms become more homogeneous ($\bar{k} \to \infty$). In the extreme case, the distribution of Q has a mass point at the lower bound of its support (here: normalized to unity). If the condition in Proposition 2 is met, most firms cluster in the neighborhood of the lower bound of the support and therefore export through intermediaries. As $\bar{k}$ falls, more firms find it optimal to establish own subsidiaries and χ_{ij} falls.

4 Empirical evidence

In this section we present empirical evidence that is consistent with our Proposition 2. Since we do not have firm-level data, we cannot directly verify the correlation between firm characteristics and the choice of export mode (Proposition 1). Akerman (2010) uses Swedish data and shows (among other things) that our sorting result Proposition 1 holds.[32]

4.1 Data

In official data, exports to wholesale affiliates for the purpose of selling to foreign consumers appear as within-firm trade. Hence, we use data on related-party and non-related party exports, as collected by the U.S. Census.[33] The data are based on export declarations and are publicly available at 6-digit NAICS level. A "related party" is associated to an ownership share of at least 10 percent. Trade between U.S parents and foreign affiliates is not distinguished from trade between foreign production units in the U.S. and foreign parents.

While in the theoretical part of the paper we focus on trade in final goods, exports to affiliates not only include final output goods but also intermediate inputs. This problem is common to the literature. For example, the empirical analysis in HMY relies on export data from Feenstra (1997) that do not distinguish final goods from imports either. However, as we have pointed out in footnote 8, our setting is flexible enough to nest also trade in inputs without altering the testable implications of the model.[34]

Using data on related and non-related party imports, Bernard et al. (2010b) analyze the sourcing of *imported* inputs rather than the choice of *export* mode. While sales dispersion is expected to determine both sourcing of inputs and choice of export mode, the set of other controls differs substantially. In particular, our theoretical model stresses the risk that a wholesale affiliate is confiscated by the foreign government. In order to test this hypothesis, we have to allow for variation in destination country characteristics. We thus focus on U.S. exports rather than U.S. imports.

[32] Akerman (2010) does not observe the export mode, but identifies intermediation by studying exports of Swedish wholesalers. Using product and destination fixed effects, he finds that those wholesalers' sales are approximately half those of manufactures who directly export. Abel-Koch (2010) more directly tests our theoretical sorting prediction using Turkish survey data. She cannot, however, control for country characteristics which may bias her results.

[33] Strictly speaking, non-related party trade also comprises exports directly to the consumer. Survey evidence from different countries suggests that this mode is unimportant quantitatively (see, e.g., Trabold, 2002).

[34] Data provided by the Bureau of Economic analysis (BEA) show that about 35% of sales to foreign affiliates are "goods for resale without further processing". A comparable statistic on final good trade of unrelated parties is not available. Moreover, the BEA data do not provide extensive product detail.

The U.S. Census data do not contain zero trade flows but several missing values. We aggregate the data from the 6-digit NAICS level to match the BEA 3-digit industry classification in order to make our dependent variable comparable to the available covariates. Table 1 reports the summary statistics. It shows that our measure of relative prevalence (the log thereof) exhibits substantial variation across sectors and countries.

Our sales dispersion measure across industries comes from HMY.[35] Their measure relates to the mid of 1990s. Our analysis thus focuses on the first year the trade data are publicly available, namely 2000. The sales dispersion measure is expected to negatively affect the relative prevalence of trade intermediation.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min	Max
ln(Relative prevalence)	2.016	1.617	−6.063	8.194
Dispersion	1.748	0.300	1.240	2.560
Specificity	−0.132	0.192	−0.910	−0.003
ln(Freight)	4.674	0.071	4.605	5.676
Risk of confiscation	36.287	20.938	10	90
Common language	0.239	0.427	0	1
ln(Distance)	8.825	0.579	6.307	9.692
NAFTA	0.029	0.168	0	1
ln(Population)	16.505	1.654	12.428	20.956

N=3,461 country-and-industry pairs.

Our model predicts that the relative prevalence of trade intermediation is affected by the *effective* bargaining power of the exporter which presumably depends on the specificity of her product. If the product is specifically tailored to a foreign market, the hold-up problem becomes more severe which lowers effective bargaining power. We re-interpret the measure of contract intensity developed by Nunn (2007) as a measure of product specificity. He uses input-output tables for 1997/98 to measure the proportion of inputs that are exchange-traded, reference priced, or differentiated. We aggregate the value of incorporated inputs data from the 6-digit IO-industry classification level to match the BEA 3-digit industry classification. Then, we compute the product specificity as a share of incorporated inputs that are not exchange-traded for each BEA industry. Our model predicts a negative relationship between product specificity

[35] They construct measures on the basis of different data sources for the US and Europe for 52 BEA 3-digit manufacturing industries.

and the relative prevalence of trade intermediation.

Our measure for the risk of expropriation of physical assets by governments comes from the Heritage Foundation. Higher levels of expropriation risk are expected to increase the relative prevalence of intermediation. We also include a dummy for common language to account for linguistic, cultural or more general informational problems that may be related to the setting up of an own wholesale affiliate and hence drive up ϕ_{ij}. Then, we expect a negative relationship between the dummy and the relative prevalence of trade intermediation.

As an additional covariate, we include freight rates provided by Feenstra et al. (2002) at a very disaggregate level. This data features both country and industry variation and needs to be aggregated up to our level of sectoral detail. In our model the relative prevalence of trade intermediation does not depend on trade costs. This is the case because trade costs affect total sales through trade intermediaries and through own wholesale affiliates equiproportionally. Hence, we do not expect a significant relationship between trade costs and the relative prevalence of export modes. We also use geographical distance as an additional proxy for trade costs.[36] Furthermore, we include a NAFTA dummy. NAFTA not only addresses tariffs, but also fosters business relationships. The net effect on the relative prevalence of export modes is therefore *a priori* ambiguous. In our regressions, we also consider country size measured by population.[37] Whereas our model contains no predictions about country size, population is a common control in the related literature.

4.2 Estimation strategy and results

We use a battery of regressions to address the theoretical predictions outlined in Proposition 2 on the relative prevalence of trade intermediation and its determinants.[38] We exploit both the country and the industry dimension of our data. Our dataset contains information for 3461 country-and-industry pairs.

Our empirical strategy is related to HMY. However, we discuss a different issue (the choice

[36]Distance and common language come from the CEPII.

[37]Population data are taken from the World Development Indicators.

[38]The working paper version of this article contains some additional results.

of export mode versus the choice of location of production) and stress a different mechanism (contractual imperfections versus concentration-proximity). While HMY study sales *of* foreign affiliates versus export sales, our dependent variable relates export sales to intermediaries versus those *to* foreign affiliates. Hence, our exercise is not subject to the criticism, that it is essentially unknown where (and by whom) products sold by foreign affiliates have been produced.

Naive regressions. First, we run 'naive' regressions without controls for *unobserved* industry or country characteristics. In order to address the endogeneity of the measure of firm size dispersion to the relative prevalence of export modes, we instrument the US dispersion measure by the similar measure for Western European firms. This strategy has been first proposed by HMY.[39]

Table 2 presents the results. In column (1), we regress sector specific variables on relative prevalence of trade intermediation, using the standard OLS estimator. We find that product specificity is negatively correlated to prevalence, as predicted by our theory. The measure of industry productivity dispersion, however, turns out insignificant, while – contrary to our theoretical exercise – the freight rate is statistically (albeit marginally so) significant. As discussed above, the dispersion measure is prone to endogeneity and needs to be instrumented. In the absence of instrumentation, all parameter estimates are biased. In particular, to the extent that higher prevalence of intermediation increases the observed dispersion (by compressing the sales distribution), OLS must overestimate the effect of dispersion. Column (2) shows that this intuition bears out: when dispersion is instrumented, the effect falls strongly and becomes statistically significant, fully in line with our theory.[40] Moreover, the variable freight looses statistical significance; this is also in line with theory.

We now focus specifically on country-specific variables. As long as dispersion is not used as an explanatory variable, there is no need to use IV estimation. Column (3) shows the risk

[39] Unlike HMY we do not instrument the US dispersion measure by all four available European measures to avoid overidentification problems. Our strategy passes a number of crucial econometric tests. However, the exact choice of instruments is not important for our empirical results.

[40] Robust score test and Wooldridge regression test jointly signal that exogeneity of US dispersion has to be rejected. Moreover, the first-stage F-statistic, the first-stage R^2, and the first-stage partial R^2 indicate validity of the instrumentation strategy.

Table 2: Relative prevalence of export modes. 'Naive' regressions.

Dependent variable: Relative prevalence of trade intermediation						
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	IV	OLS	OLS	IV	IV
Dispersion	0.078	-0.850^a		0.049	-0.917^a	-0.895^a
	(0.098)	(0.192)		(0.096)	(0.189)	(0.189)
Specificity	-0.421^a	-0.489^a		-0.515^a	-0.589^a	-0.561^a
	(0.162)	(0.166)		(0.163)	(0.167)	(0.167)
ln(Freight)	1.260^b	0.623	0.762	0.571	−0.124	−0.048
	(0.526)	(0.542)	(0.530)	(0.533)	(0.555)	(0.547)
Risk of confiscation			0.008^a	0.008^a	0.009^a	0.007^a
			(0.001)	(0.001)	(0.001)	(0.001)
Common language			-0.294^a	-0.297^a	-0.289^a	-0.251^a
			(0.063)	(0.063)	(0.064)	(0.063)
ln(Distance)			0.026	0.031	0.036	−0.087
			(0.055)	(0.054)	(0.056)	(0.050)
NAFTA			-1.106^a	-1.111^a	-1.127^a	-1.467^a
			(0.160)	(0.156)	(0.161)	(0.142)
ln(Population)			-0.083^a	-0.086^a	-0.089^a	
			(0.019)	(0.019)	(0.020)	
RMSE	1.613	1.635	1.582	1.579	1.603	1.607
R^2	0.006	n.a.	0.045	0.048	n.a.	n.a.
First stage partial R^2		0.245			0.245	0.245

N=3,461 country-and-industry pairs. Robust standard errors in parentheses. *a* and *b* indicate significance, respectively, at 1% and 5%. All regressions include a constant (not shown). In IV regressions, US dispersion is instrumented by European dispersion. Robust Wooldridge score test and regression-based test reject the hypothesis that US dispersion is exogenous. R^2 from IV estimation omitted; see Wooldridge (2009, p. 516) for details.

of expropriation is statistically significantly positively correlated with the relative prevalence of trade intermediaries. The dummy variable common language as proxy for linguistic problems in setting up an own wholesale affiliate is statistically significantly negatively related to the relative prevalence of trade intermediaries. Both results are in line with our theoretical predictions.

Additionally, we include a control for freight rate as a proxy for trade costs.[41] As expected, freight rate does not enter significantly. Similarly, the distance coefficient turns out to be insignificant. This result allows to distinguish our model from the proximity-concentration trade-off analyzed by HMY. The NAFTA dummy is negatively correlated with the relative prevalence of trade intermediaries. This reveals that NAFTA does not only affect trade costs but

[41] Recall that this variable features country-and-industry variation.

also enhances the business environment. Country size measured by population enters negatively. While this result is not in line with our theory, it is common in the related empirical literature.[42]

Robustness checks. We check robustness of the results by controlling for unobserved country and industry characteristics. We show results for fixed-effect estimation only, knowing that the estimates are always consistent.[43] Table 3 adds country fixed effects to regression (2) in Table 2; results turn out similar. However, it is noteworthy that both the estimated size and the precision of the estimates increase quite substantially, while freight remains insignificant. These findings support our theory. Moreover, they imply that unobserved country characteristics may bias the results in Table 2 upwards; a finding that was already suggested by a comparison of columns (2) and (5) in Table 2.

Similarly, controlling for unobserved industry characteristics (columns (3) and (4) in Table 3) leaves the results reported in Table 2 unchanged. All coefficients are of the same size and level of statistical significance. Again, this feature does not depend on whether industry effects are modeled as fixed or random.

Finally, we run a regression where we include both country and industry fixed effects. Given the dimensionality of our data, we can only address the relationship between the relative prevalence of trade intermediaries and the freight rate. As expected, there is no statistically significant correlation.

Summarizing, our empirical results are in line the key predictions of our model. They support the view that the choice of export mode reflects a trade-off between the costs associated to contractual frictions in the case of intermediation and to the cost of FDI in the case of internalization.

[42] Bernard et al. (2010b) find a positive effect of population size on intra-firm imports; see their Table 7.

[43] In the working paper version of this article, we also use random-effects models, which may be more efficient. Results are similar.

Table 3: Relative prevalence of export modes. Controlling for unobserved characteristics.

Dependent variable: Relative prevalence of trade intermediation					
	(1) OLS	(2) IV	(3) OLS	(4) OLS	(5) OLS
Dispersion	0.057	-0.976^a			
	(0.092)	(0.178)			
Specificity	-0.567^a	-0.648^a			
	(0.155)	(0.158)			
ln(Freight)	0.059	−0.728	0.087	0.234	−0.481
	(0.506)	(0.524)	(0.573)	(0.566)	(0.549)
Risk of confiscation			0.009^a	0.007^a	
			(0.001)	(0.001)	
Common language			-0.288^a	-0.249^a	
			(0.061)	(0.060)	
ln(Distance)			0.044	−0.091	
			(0.053)	(0.047)	
NAFTA			-1.106^a	-1.471^a	
			(0.159)	(0.140)	
ln(Population)			-0.098^a		
			(0.019)		
Country fixed effects	YES	YES			YES
Industry fixed effects			YES	YES	YES
RMSE	1.461	1.464	1.519	1.525	1.385
R^2	0.215	n.a.	0.132	0.124	0.305
First stage partial R^2		0.244			

N=3,461 country-and-industry pairs. Robust standard errors in parentheses. *a* indicates significance at 1%. All regressions include a constant (not shown). In IV regressions, US dispersion is instrumented by European dispersion. Robust Wooldridge score test and regression-based test reject the hypothesis that US dispersion is exogenous. R^2 from IV estimation omitted; see Wooldridge (2009, p. 516) for details.

5 Conclusions

In this paper, we have discussed the choice between two different modes of exporting to a foreign market: a producer can either use a foreign trade intermediary, who enjoys a fixed cost advantage but – due to the lack of enforceable cross-country contracts – exposes the producer to a hold-up problem, or they can establish an own wholesale affiliate, avoiding the threat of hold-up at the cost of increased investment. This trade-off produces an interesting sorting pattern of producers into the two export modes. Firms with high perceived quality of their products, low variable production costs, and strong marketability of goods prefer to establish affiliates; firms with low realizations of those characteristics prefer to use trade intermediaries. The reason is that contractual frictions reduce variable revenues proportionally, while the fixed-cost disadvantage of affiliates does not depend on sales. Hence, firms with high sales opt for wholesale subsidiaries in the foreign country.

Importantly, in our model, variable trade costs are endogenously determined in the game between the producer and the intermediary. However, the contractual frictions are not isomorphic to the usual iceberg-type trade costs, since they do not lead to a loss of output. Rather, they imply an additional restriction of production by monopolistically competitive firms, so that the markup goes up. Hence, our model warns against modeling differences across modes as exogenous differences in iceberg-type variable trade costs.

Under the assumption of the Pareto distribution, we show that the relative prevalence of intermediation does not depend on transportation costs between the source and the destination country, on market size or on wage rates. It increases with the risk of expropriation of physical assets and in the degree of heterogeneity of producers. It falls with the severity of contractual problems.

Our paper is related to HMY. While we discuss a different issue (the choice of export mode versus the choice of location of production) and stress a different mechanism (contractual imperfections versus concentration-proximity), we can use a related empirical strategy on US census data to assess the predictions of the model. We find that most predictions of our theory are in line with the data.

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A Proofs and detailed derivations

Proof of Lemma 1 (pricing behavior). The producer maximizes her expected profits from exporting via a trade intermediary subject to the demand function to choose her optimal quantity to supply in the match. Using optimal demand to substitute out the c.i.f price and inserting (5) the solves

$$\begin{aligned} & \max_{x_{ij}^M(\omega)} \bar{\beta}_{ij} J_{ij}(\omega) + \tilde{\pi}_{ij}^P(\omega) - x_{ij}^M(\omega)\tau_{ij}(\omega) a(\omega) w_i \\ = & \max_{x_{ij}^M(\omega)} \bar{\beta}_{ij} p_{ij}^M(\omega) x_{ij}^M(\omega) + \left[\left(1-\bar{\beta}_{ij}\right)\lambda_{ij} - 1\right] x_{ij}^M(\omega)\tau_{ij}(\omega) a(\omega) w_i \\ = & \max_{x_{ij}^M(\omega)} \bar{\beta}_{ij} (H_j)^{1/\sigma} \zeta(\omega)^{(\sigma-1)/\sigma} \left[x_{ij}^M(\omega)\right]^{(\sigma-1)/\sigma} + \left[\left(1-\bar{\beta}_{ij}\right)\lambda_{ij} - 1\right] x_{ij}^M(\omega)\tau_{ij}(\omega) a(\omega) w_i \end{aligned}$$

The first order condition is

$$\rho\bar{\beta}_{ij} (H_j)^{\frac{1}{\sigma}} \zeta(\omega)^{\frac{\sigma-1}{\sigma}} \left[x_{ij}^M(\omega)\right]^{-\frac{1}{\sigma}} = \left[\left(1-\bar{\beta}_{ij}\right)\lambda_{ij} - 1\right]\tau_{ij}(\omega) a(\omega) w_i.$$

Substituting $x_{ij}^M(\omega)$ yields the pricing rule stated in Lemma 1

$$p_{ij}^M(\omega) = \frac{\tau_{ij}(\omega) a(\omega) w_i}{\beta_{ij}\rho},$$

where $\beta_{ij} = \beta_{ij}\left(\bar{\beta}_{ij}, \lambda_{ij}\right) = \bar{\beta}_{ij} / \left[1 - \lambda_{ij}\left(1-\bar{\beta}_{ij}\right)\right] \geq \bar{\beta}_{ij}$.

Comparative statics related to Lemma 1. The additional markup is inverse proportional to the degree of contractual imperfections β_{ij}. $\beta_{ij}\left(\bar{\beta}_{ij}, \lambda_{ij}\right)$ is increasing in the bargaining power $\bar{\beta}_{ij}$ and the recycling rate λ_{ij}

$$\begin{aligned} \frac{\partial \beta_{ij}\left(\bar{\beta}_{ij}, \lambda_{ij}\right)}{\partial \bar{\beta}_{ij}} &= \frac{1-\lambda_{ij}}{\left(1-\lambda_{ij}\left(1-\bar{\beta}_{ij}\right)\right)^2} > 0, \\ \frac{\partial \beta_{ij}\left(\bar{\beta}_{ij}, \lambda_{ij}\right)}{\partial \lambda_{ij}} &= \frac{\left(1-\bar{\beta}_{ij}\right)\bar{\beta}_{ij}}{\left(1-\lambda_{ij}\left(1-\bar{\beta}_{ij}\right)\right)^2} > 0. \end{aligned}$$

The term $\tilde{\beta}_{ij} = \tilde{\beta}_{ij}(\beta_{ij}, \sigma) \equiv \left[\beta_{ij} + (1-\beta_{ij})\sigma\right]^{\frac{1}{\sigma-1}} \beta_{ij} \geq \beta_{ij}$ is closely related to our measure of contractual imperfections β_{ij}. We have $\tilde{\beta}_{ij}(0, \sigma) = 0$ and $\tilde{\beta}_{ij}(1, \sigma) = 1\tilde{\beta}_{ij}$ is strictly increasing in β_{ij} for $\beta_{ij} \in (0,1)$

$$\frac{\partial \tilde{\beta}_{ij}(\beta_{ij}, \sigma)}{\partial \beta_{ij}} = \frac{\tilde{\beta}_{ij}}{\beta}\left(1 - \frac{\beta_{ij}}{\beta_{ij} + (1-\beta_{ij})\sigma}\right) > 0,$$

since $\beta_{ij} / \left[\beta_{ij} + (1-\beta_{ij})\sigma\right] < 1$.

The derivative with respect to σ is given by

$$\begin{aligned}
\frac{\partial \tilde{\beta}_{ij}}{\partial \sigma} &= \tilde{\beta}_{ij}\left(-\frac{\ln\left[\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right]}{\left(\sigma-1\right)^2}+\frac{1-\beta_{ij}}{\left[\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right]}\right)\\
\frac{\partial \tilde{\beta}_{ij}}{\partial \sigma} &= \frac{\tilde{\beta}_{ij}}{\sigma-1}\frac{\beta_{ij}+\left(1-\beta_{ij}\right)\sigma-1-\left[\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right]\ln\left[\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right]}{\left(\sigma-1\right)\left[\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right]}<0.
\end{aligned}$$

$\tilde{\beta}_{ij}$ is strictly decreasing in σ, since $\frac{x-1}{x}<\ln x$, where $x=\beta_{ij}+\left(1-\beta_{ij}\right)\sigma$.

Moreover, $\tilde{\beta}_{ij}$ is well behaved in the limiting cases

$$\begin{aligned}
\lim_{\sigma\to 1}\tilde{\beta}_{ij}\left(\beta_{ij},\sigma\right) &= \beta_{ij}\exp\left[\lim_{\sigma\to 1}\left(\frac{\ln\left(\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right)}{\sigma-1}\right)\right]\\
&= \beta_{ij}\exp\left[\lim_{\sigma\to 1}\left(\frac{1-\beta_{ij}}{\beta_{ij}+\left(1-\beta_{ij}\right)\sigma}\right)\right]\\
&= \beta_{ij}e^{1-\beta_{ij}},\\
\lim_{\sigma\to \infty}\tilde{\beta}_{ij}\left(\beta_{ij},\sigma\right) &= \beta_{ij}\exp\left[\lim_{\sigma\to \infty}\left(\frac{\ln\left(\beta_{ij}+\left(1-\beta_{ij}\right)\sigma\right)}{\sigma-1}\right)\right]\\
&= \beta_{ij}\exp\left[\lim_{\sigma\to 1}\left(\frac{1-\beta_{ij}}{\beta_{ij}+\left(1-\beta_{ij}\right)\sigma}\right)\right]\\
&= \beta_{ij}.
\end{aligned}$$

Proof of Proposition 1 (Sorting). The cutoff Q_{ij}^M immediately follows from rearranging (8)

$$Q_{ij}^M=\left(\frac{w_i\bar{\tau}_{ij}}{\tilde{\beta}_{ij}}\right)^{\sigma-1}f_jB_j^{-1}.$$

Q_{ij}^F is determined by solving $\pi_{ij}^M\left(Q_{ij}^F\right)=\pi_{ij}^F\left(Q_{ij}^F\right)$ for Q_{ij}^F

$$\begin{aligned}
\left(w_i\bar{\tau}_{ij}\right)^{1-\sigma}B_jQ_{ij}^F-\phi_{ij}f_j &= \left(\frac{w_i\bar{\tau}_{ij}}{\tilde{\beta}_{ij}}\right)^{1-\sigma}B_jQ_{ij}^F-f_j\\
Q_{ij}^F &= \left(w_i\bar{\tau}_{ij}\right)^{\sigma-1}\left(\frac{\phi_{ij}-1}{1-\tilde{\beta}_{ij}^{\sigma-1}}\right)f_jB_j^{-1}\\
&= Q_{ij}^M\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)
\end{aligned}$$

Sorting exists, if Q_{ij}^F is strictly larger than Q_{ij}^M :

$$\begin{aligned}
\left(w_i\bar{\tau}_{ij}\right)^{\sigma-1}\left(\frac{\phi_{ij}-1}{1-\tilde{\beta}_{ij}^{\sigma-1}}\right)f_jB_j^{-1} &> \left(\frac{w_i\bar{\tau}_{ij}}{\tilde{\beta}_{ij}}\right)^{\sigma-1}f_jB_j^{-1}\\
\phi_{ij}-1 &> \tilde{\beta}_{ij}^{1-\sigma}\left(1-\tilde{\beta}_{ij}^{\sigma-1}\right)\\
\phi_{ij} &> \tilde{\beta}_{ij}^{1-\sigma}.
\end{aligned}$$

Derivations of equations (12) **and** (13) **(Export sales per mode).** Sales per firm from exporting via a trade intermediary are given by

$$\begin{aligned} s_{ij}^{M}(\omega) &= p_{ij}^{M}(\omega)\,x_{ij}^{M}\left[p_{ij}^{M}(\omega)\right] \\ &= H_j\left[\frac{p_{ij}^{M}(\omega)}{\zeta(\omega)}\right]^{1-\sigma} \\ s_{ij}^{M}(Q) &= \sigma\left(\frac{w_i\bar{\tau}_{ij}}{\beta_{ij}}\right)^{1-\sigma} QB_j. \end{aligned}$$

Using $Q = \Phi^(1-\sigma)$ and the Pareto distribution, total exports via intermediaries can be calculated as

$$\begin{aligned} S_{ij}^{M} &= M_i^E\sigma\left(w_i\frac{\bar{\tau}_{ij}}{\beta_{ij}}\right)^{1-\sigma} B_j k\int_{\Phi_{ij}^M}^{\Phi_{ij}^F}\Phi^{\sigma-k-2}d\Phi \\ &= M_i^E\left(w_i\frac{\bar{\tau}_{ij}}{\beta_{ij}}\right)^{1-\sigma} B_j\frac{\sigma k}{k-(\sigma-1)}\left[\left(\Phi_{ij}^M\right)^{\sigma-k-1}-\left(\Phi_{ij}^F\right)^{\sigma-k-1}\right] \\ &= M_i^E\sigma\left(w_i\frac{\bar{\tau}_{ij}}{\beta_{ij}}\right)^{1-\sigma} B_j\frac{\sigma k}{k-(\sigma-1)}\left(\Phi_{ij}^F\right)^{\sigma-k-1}\left[\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\frac{k-(\sigma-1)}{\sigma-1}}-1\right] \\ &= M_i^E\left(w_i\bar{\tau}_{ij}\right)^{-k} B_j^{\frac{k}{\sigma-1}} f_j^{-\bar{k}}\frac{\sigma k}{k-(\sigma-1)}\beta_{ij}^{\sigma-1}\left(\frac{\phi_{ij}-1}{1-\tilde{\beta}_{ij}^{\sigma-1}}\right)^{\frac{\sigma-k-1}{\sigma-1}}\left[\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\frac{k-(\sigma-1)}{\sigma-1}}-1\right] \\ &= \Psi_{ij}\beta_{ij}^{\sigma-1}\left[\tilde{\beta}_{ij}^{k-(\sigma-1)}-\left(\frac{1-\tilde{\beta}_{ij}^{\sigma-1}}{\phi_{ij}-1}\right)^{\bar{k}}\right]. \end{aligned}$$

The last expression is equivalent to (12) in the text. Analogously, sales per firm from exporting via a wholesale affiliate take the form

$$\begin{aligned} s_{ij}^{F}(\omega) &= p_{ij}(\omega)\,x_{ij}\left[p_{ij}(\omega)\right] \\ s_{ij}^{F}(Q) &= \sigma\left(w_i\bar{\tau}_{ij}\right)^{1-\sigma} QB_j, \end{aligned}$$

and

$$\begin{aligned} S_{ij}^{F} &= M_i^E\sigma\left(w_i\bar{\tau}_{ij}\right)^{1-\sigma} B_j k\int_{\Phi_{ij}^F}^{\Phi_{ij}^\infty}\Phi^{\sigma-k-2}d\Phi \\ &= M_i^E\left(w_i\bar{\tau}_{ij}\right)^{1-\sigma} B_j\frac{\sigma k}{k-(\sigma-1)}\left(\Phi_{ij}^F\right)^{\sigma-k-1} \\ &= \Psi_{ij}\left(\frac{1-\tilde{\beta}_{ij}^{\sigma-1}}{\phi_{ij}-1}\right)^{\bar{k}}. \end{aligned}$$

which corresponds to (13) in the text. Note that

$$\bar{k} = \frac{k}{\sigma-1}-1.$$

Proof of Proposition 2 (Relative prevalence). The relative prevalence of export modes $\chi_{ij} \equiv S_{ij}^M / S_{ij}^F$ follows immediatly from (12) and (13)

$$\begin{aligned}
\chi_{ij} &= \frac{\beta_{ij}^{\sigma-1}\left[\tilde{\beta}_{ij}^{k-(\sigma-1)} - \left(\frac{1-\tilde{\beta}_{ij}^{\sigma-1}}{\phi_{ij}-1}\right)^{\bar{k}}\right]}{\left(\frac{1-\tilde{\beta}_{ij}^{\sigma-1}}{\phi_{ij}-1}\right)^{\bar{k}}} \\
&= \beta_{ij}^{\sigma-1}\left[\tilde{\beta}_{ij}^{k-(\sigma-1)}\left(\frac{\phi_{ij}-1}{1-\tilde{\beta}_{ij}^{\sigma-1}}\right)^{-\bar{k}} - 1\right] \\
&= \beta_{ij}^{\sigma-1}\left[\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\bar{k}} - 1\right].
\end{aligned}$$

Comparative statics results are derived as follows:

$$\frac{d\chi_{ij}}{d\phi_{ij}}\frac{\phi_{ij}}{\chi_{ij}} = \bar{k}\frac{\phi_{ij}}{\phi_{ij}-1}\frac{\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\bar{k}}}{\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\bar{k}} - 1} > 0$$

$$\frac{d\chi_{ij}}{d\beta_{ij}}\frac{\beta_{ij}}{\chi_{ij}} = (\sigma-1)\left[1 + \frac{\frac{\tilde{\beta}_{ij}^{1-\sigma}}{\tilde{\beta}_{ij}^{1-\sigma}-1}}{\left(\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1}\right)^{\bar{k}} - 1}\bar{k}\frac{d\tilde{\beta}_{ij}}{d\beta_{ij}}\frac{\beta_{ij}}{d\tilde{\beta}_{ij}}\right] > 0,$$

since $\frac{d\tilde{\beta}_{ij}}{d\beta_{ij}}\frac{\beta_{ij}}{d\tilde{\beta}_{ij}} > 0$ and $\frac{\phi_{ij}-1}{\tilde{\beta}_{ij}^{1-\sigma}-1} > 1$ (Lemma 2).

$$\frac{d\chi_{ij}}{d\bar{\tau}_{ij}}\frac{\bar{\tau}_{ij}}{\chi_{ij}} = 0$$

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