Trade Intermediation *

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Abstract

Exporters must decide which markets to sell to and the mode of product delivery. Alongside the conventional option of direct export, this model introduces an additional indirect export channel: intermediation. Intermediation is modeled as a Pissarides (2000) matching market which is then embedded within a standard intraindustry model of trade à la Chaney (2008). Firms determine the exporting channel on the basis of the variety being sold, the destination, and ease of finding a trade intermediary. Firms endogenously select into export channels such that high-productivity firms export directly, moderate-productivity firms export through intermediaries, and low-productivity firms do not export at all. The model is able to generate several stylized facts that have been observed in empirical studies and offers tractable analytic explanations.

Keywords: international trade, intermediaries, export channels, heterogenous firms, search and matching

JEL Classification: F11,F12,F15,F23,F41

1 Introduction

This paper takes the position that trade intermediaries improve the efficiency of cross-border distribution by reducing exporting firms' transaction costs. By serving as cost minimizers, intermediaries help link foreign producers with local consumers. This role both increases firms' potential foreign profits and augments the set of varieties available to consumers. It is impossible, however, to evaluate the role of intermediaries in classical trade models because it is assumed that exporting firms can seamlessly sell to foreign markets. A more realistic assessment incorporates the additional trade frictions and costs required to deliver goods overseas. New trade theories account for these extra distribution costs through iceberg transport costs and a fixed cost of foreign market penetration.[1]

* For helpful comments and discussions, I thank Eric Swanson, Priya Ranjan, Guillaume Rocheteau, Antonio Rodriguez-Lopez, Mario Silva, and participants at the UCI Macro Reading Group and Western Economic Association International 91st Annual Conference. All errors are my own.

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[1] Melitz (2003) supposes that a firm must incur an additional fixed cost f_{ex} to export. Helpman et al (2004) supposes that exporting firms bear an additional fixed cost f_x per foreign market, or f_I if it chooses to establish a

Although these developments endogenize export decisions, they still abstract away from a third party which specializes in distribution. A more general approach allows firms to choose whether to export directly or through a third party based on cost-minimizing criteria. The present paper allows for this option by introducing trade intermediaries who may provide the least cost distribution channel to firms. The model assumes that trade intermediaries act as middlemen, located in the importing country, delivering foreign goods to local consumers. Examples of such intermediaries include export management companies (EMCs), export trading companies (ETCs), and individual merchants.[2] The contribution of this paper is to simultaneously endogenize the mode of export and the cost of intermediation as a function of the destination market, the product variety, and competition among intermediaries.

Conventional trade models largely abstract away from the role that intermediaries play in exports despite empirical evidence that shows intermediation activities account for a nontrivial share of international trade. For example, in the 1990's Japan's nine general trading companies (known as *soga shoshas*) accounted for 40% and 70% of the country's exports and imports respectively (Jones 1998). In the early 1980's only 300 Japanese trading firms accounted for 80% of total Japanese trade and the ten largest of these firms were responsible for 30% of Japan's GNP (Rossman 1998). Statistics like these not only show that trade flows are affected by intermediation activities, but also that trade intermediaries may play a vital role in export-driven growth. Hong Kong and Singapore are examples of such entrepôt economies where trading activities account for a sizable portion of GDP growth. Feenstra (2003) finds that in 1998, total trade was 259% of GDP in Hong Kong and 269% in Singapore. This striking statistic is largely due to the fact that these countries provide a trading hub for much of Asia where trade is intermediated in an open market. The existence of trade intermediation is not limited to East Asian nations. Bernard et al. (2009) estimate that U.S. wholesalers and retailers account for approximately 11% and 24% of exports and imports respectively. Estimates by Bernard et al. (2011) show that over one-quarter of all Italian

foreign subsidiary. Ahn et al (2010) introduces an intermediation technology where a firm pays a fixed cost f_i which is assumed smaller than a bilateral direct export fixed cost f_x^j.

[2]Conventionally, ETCs works as merchants and take title of the goods being exported while EMCs work as agents and do not take title. However, the distinction between EMCs and ETCs has become ambiguous as expressed by the U.S. Department of Commerce: "There is no clear distinction between EMCs and ETCs. Many former EMCs now call themselves ETCs. Both ETCs and EMCs may take title to goods or work on commission." The distinction is not important to the results of this paper as both may be interpreted as directly engaging with the exporting firm and the end consumer.

exporters are intermediaries and that they account for over 10% of total Italian exports. The share of intermediated trade varies not only across countries but also across products. Ahn et al. (2011) show that trade intermediaries tend to focus on particular countries but export a large variety of products, whereas direct exporters serve many countries with a narrow product range. All of this empirical evidence suggests that trade intermediation is an important component of trade flows and varies with country, product, and firm level characteristics.

Trade intermediation is not only interesting on account of its prevalence but also because it is the target of trade policy. One particularly expansive government policy was the 1982 U.S. Export Trading Company Act which sought to "encourage exports by facilitating the formation and operation of export trading companies, export trade associations, and the expansion of export trade services generally." Therfore, understanding the role that intermediaries play in shaping trade flows is important for evaluating policy proposals.

This paper introduces an intermediary sector where firms may search for a trading partner subject to matching frictions. Introducing matching frictions in the intermediary sector distinguishes the present model from existing papers on export mode selection and provides microfoundations for results found in other models. Rather than assuming that the intermediary sector is competitive, I describe an environment where firms and intermediaries meet in bilateral pairs and bargain over the terms of trade.[3] This helps capture the notion that not all goods are equally suited to foreign trade, and therefore firms must spend time to research and locate an appropriate intermediary to deliver their good to foreign markets. Although it may be reasonable to suppose that a very large firm could expend a battery of resources to penetrate foreign markets quickly, smaller firms lack the capacity for such outlays and must spend time to secure a foreign distribution channel. This idea is supported by empirical evidence from Blum et al. (2010) suggesting that exporters face large cross-country matching costs. Additionally, explicitly modeling firm-intermediary exchanges takes more seriously the reality that wholesalers and retailers often exert bargaining power during negotiations; especially if they act as gatekeepers to foreign markets.

This matching market is embedded within a heterogeneous firm model of international trade where firms have access to direct-export technology at a fixed cost. Firms' choice of export mode

[3]Intermediation is often assumed to be a perfectly competitive sector with marginal distribution costs, as in Ahn et al. (2011).

(intermediation versus direct export) will depend on an exogenous direct-export cost and an endogenous indirect-export cost. In this way, goods will be distributed by different channels depending on both the variety being sold and the destination market. Only the most productive firms will choose to export directly while those with intermediate productivity levels will choose to export indirectly. This result is in line with existing theoretical results as well as empirical studies such as Abel-Koch (2011).[4]

Export mode selection garnered interest beginning with Helpman, Melitz, and Yeaple (2004), who examined the firm-level decision to either export or engage in foreign direct investment (FDI). This framework introduced the proximity-concentration tradeoff between high market access costs of FDI versus lower revenues from exporting. High market access costs are a bulwark only the most productive firms can overcome; therefore only highly-productive firms engage in FDI and incure large access costs while less-productive firms save on access costs and suffer lower revenues. This tradeoff between paying fixed costs and generating new revenues is common in the literature. For example, Ahn et al. (2011) posit a model where firms gain access to a global intermediation sector by paying a global fixed cost or direct access to a single foreign market by paying a bilateral fixed cost. In this way, intermediaries are able to pool market access costs across multiple firms and hence minimize trade costs. The drawback for firms using the intermediary sector is higher marginal costs of foreign distribution which raises the price to foreign consumers resulting in lower revenues. Only the most productive firms are able to generate sufficient profits to cover the access costs of direct export while less productive firms choose to use the intermediation sector and sacrifice revenue. Felbermayr and Jung (2011) develop a model where the lack of enforceable cross-border contracts subjects firms who export through an intermediary to a hold-up problem causing firms to restrict output, driving up the price for foreign consumers, and leading to lower revenues. Akerman (2010) features an intermediary sector with economies of scope, where wholesalers are able to spread the fixed cost of export over multiple goods while only having to make one investment in foreign-market penetration. To cover this onetime investment, however, they charge a markup to final consumers thereby reducing revenues from indirect export.

The present model delivers an alternative tradeoff where search frictions and bilateral bargaining

[4]Abel-Koch (2011) use Turkish data from the World Bank Enterprise Survey and show a negative correlation between firm size and the relative importance of intermediated exports. They show that this negative correlation is quite robust to the inclusion of other firm characteristics.

endogenously determine the cost of indirect export. Firms' optimal price is not subject to double marginalization or any per-unit distribution costs so that revenues are identical between direct and indirect exporters. Firms instead face a tradeoff between taking time to search for an intermediary and bargaining over the terms of trade versus suffering high market access costs. Importantly, the cost of intermediation may be larger or smaller than the cost of direct export which is dissimilar from the models mentioned. Nevertheless, export sorting occurs where the relative share of direct to indirect export depends on the efficiency of the intermediation technology and the severity of matching frictions in the export market.

Introducing search and bargaining endogenizes the cost structure facing exporting firms and captures trade frictions in a flexible way. In reality, *trade frictions* refers to a host of impediments to free trade which include protectionist policies, transport costs, red tape, and culture gaps. The conventional method used to account for these frictions is to assume a fixed cost of foreign-market access and iceberg transport costs. However, this approach misleadingly suggests that all firms face exactly the same level of trade frictions and places restrictive assumptions on the cost structure of exporting firms. Helpman, Melitz, and Yeaple (2004) suppose that international distribution requires a fixed cost, implying that exporting is a decreasing cost activity so that only the most productive and largest firms choose to export while smaller firms do not. This is a common result in heterogeneous firm models of intraindustry trade that is difficult to reconcile with empirical evidence. Empirical studies like Eaton, Kortum, and Kramarz (2005) and Blum et al. (2009) show there are many firms exporting small amounts to particular markets. At the same time, it has been well documented by Das, Roberts, and Tybout (2005) that firms self-select into exporting which implies the existence of large up-front costs. Capturing both of these stylized facts has been challenging for models predicated on an exogenous fixed cost of exporting. One solution, proposed by Arkolakis (2007), supposes variable market penetration costs that increase with the number of foreign consumers reached.[5] This cost structure implies that exporting is an increasing cost activity and can generate many firms exporting small amounts in the presence of large fixed costs due to adjustments on the extensive margin. Clearly, the cost structure underlying export decisions, and the implicit distribution technology that accompanies it, are important determinants

[5] Arkolakis suggests a "marketing cost function" which shows that the cost of international distribution is increasing in the population of the foreign market, the productivity of the exporting firm, and the number of foreign consumers actually sold to.

of which firms choose to export and how. Introducing an intermediation sector with search frictions and bilateral bargaining captures a more flexible cost structure. The cost of direct export follows the tradition of exogenous fixed costs used in models similar to Melitz (2003), while the indirect costs are endogenous and akin to the market penetration costs of Arkolakis (2007) in that they vary positively with firm productivity and foreign market size.

Felbermayr and Jung (2010) consider bilateral meetings between firms and intermediaries but focus on the hold-up problem and how this affects the terms of trade. The present model abstracts from the hold-up problem and resolves the terms of trade via a dynamic Nash bargaining process. That is, each firm's disagreement point depends on how much time it will take before they have the opportunity to bargain again. Rather than bargaining over the sharing of revenues, as is done in Felbermayr and Jung (2010), the firm and intermediary divide the total surplus via a linear service fee paid to the intermediary. This ensures that the bargaining outcome is jointly efficient and avoids double marginalization. This bargaining description is natural when one assumes that intermediaries do not take title to the goods but simply act as a distribution middleman. Also, this bargaining program results in identical prices for indirect versus direct export. When there is a holdup problem, if the firm has no bargaining power during negotiations then they will optimally restrict output to zero. Contrarily, in the present model, output is still delivered to foreign consumers even if firms have no bargaining power. In this case, the intermediary simply extracts all foreign profit from the firm.

Also different from existing papers is the focus on *import* intermediaries. Ahn et al. (2011) and Akerman (2010) endow domestic intermediaries with technologies enabling them to pool firms' fixed costs and export to multiple destinations. Instead, the underlying assumption in the present model is that intermediaries are market specific and earn profits by *importing* foreign goods. As a consequence, the costs that intermediaries incur are destination specific rather than product specific. This assumption captures the notion that the costs of maintaining distribution networks depend on the destination market. Although the paper does not consider the underlying reasons for these differences, one could imagine regulatory requirements, geographical differences, quality of infrastructure, etc.

What are the consequences of allowing for an additional distribution channel in the form of intermediation? First, and perhaps obvious, intermediation reduces the costs of international transport.

Contrary to previous models, the costs of intermediation arise endogenously through the search and matching framework and depends on firm and export-market characteristics. Second, intermediaries act as market makers by enlarging the set of goods traded. In this way, intermediaries have a positive welfare effect by allowing greater diversity of goods for consumers than would exist in their absence. Under certain conditions, however, excessive intermediation can occur where the set of goods available to consumers shrinks. Third, intermediation benefits less-productive firms by providing access to foreign markets without paying high fixed costs from direct export. Fourth, intermediation results in a decrease in aggregate productivity among exported goods. It is interesting to note that there exist changes in aggregate productivity despite the absence of free entry and exit among firms as in Melitz (2003). The present model suggests that intermediation is another channel that can affect aggregate productivity. Fifth, intermediation is strictly welfare improving in that it lowers the price index of importing nations and increases national income.

The model is able to generate stylized facts that have been identified across empirical studies. Chief among them is that an increase in country-specific fixed export costs increases the share of trade performed by intermediaries. The model also correctly predicts that smaller countries have a larger share of intermediated trade. Taken together, these results suggest that trade intermediaries may be especially relevant for developing nations who are usually small and costly for firms to penetrate.

2 Demand

There exists a discrete number of countries indexed $i = 1, ..., N$. Each country has a representative consumer with Cobb-Douglas tastes for two types of goods,

$$U = c_0^{1-\eta} C^{\eta}, \quad \eta \in (0, 1) \tag{1}$$

where c_0 is a homogeneous good and C is a constant elasticity of substitution (CES) aggregator over a continuum of horizontally differentiated goods indexed $z \in Z_i$,

$$C = \left(\sum_{i=1}^{N} \int_{Z_i} c_i(z)^{\frac{\sigma-1}{\sigma}} dz \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma \in (1, \infty). \tag{2}$$

The consumer's problem is to maximize (1) subject to the budget constraint,

$$\sum_{i=1}^{N}\left(p_0c_0+\int_{Z_i}p_i(z)c_i(z)dz\right)\leq Y$$

where $c_i(z)$ is the consumption of variety $z\in Z_i$ produced in country $i=1,...,N$ and Y is the income of the domestic country. Consumers are assumed to own the firms and receive lump sum profits of T in addition to wage w. Choosing the homogeneous good to be the numeraire, $p_0=1$, utility maximization yields a demand schedule for individual varieties from a particular country,

$$c_i(z)=\left(\frac{p_i(z)}{P}\right)^{-\sigma}\frac{\eta Y}{P} \tag{3}$$

and for the homogeneous good,

$$c_0=(1-\eta)Y.$$

The demand for a particular variety is log linear in its own price $p_i(z)$ and income $Y=Lw+T$, both deflated by the domestic price index $P=\left(\sum_{i=1}^{N}\int_{Z_i}p_i(z)^{1-\sigma}dz\right)^{\frac{1}{1-\sigma}}$. The elasticity of substitution across varieties $\sigma=1/(1-\rho)>1$ is assumed identical in all countries.[6]

Utility can now be expressed as a function of income and the price index,

$$U=\eta^{\eta}(1-\eta)^{1-\eta}YP^{-\eta}. \tag{4}$$

3 Production

Each variety in the set $\bigcup_{i=1}^{N}Z_i$ is produced by a single firm in a monopolistically competitive market. That is, consumers' unbounded love for variety means that each firm will optimally produce a single unique variety so that the measure of operative firms is equal to the number of produced varieties. It is assumed that the number of varieties is sufficiently large so that firms ignore the effect of their own pricing behavior on aggregate quantities.

Country i is endowed with L_i units of labor. Labor is the only factor of production receiving a wage w, and it is supplied inelastically by the household. Expenditure in the differentiated

[6]The assumption of constant elasticity of substitution abstracts the pro-competitive effects of trade liberalization for the sake of simplicity. The model could be amended to include variable markups.

goods sector and differences in L_i are assumed small enough so that the homogeneous product is produced in every country and wages are equalized across countries. The homogeneous product is produced with one unit of labor per unit output so that the common wage rate is normalized to one. Consumers are assumed to own the firms and are entitled to lump sum profits T. There exist distributable economic profits because there is no free entry by firms.[7] Firm profits are discounted at interest rate r according to the consumer's discount factor $(1+r)^{-1}$.

Firms are heterogeneous with respect to technology where $a(z) \in \mathbb{R}_+$ is the unit labor requirement for variety z. The distribution of productivities is governed by the cumulative probability distribution function $G(a)$. There are no fixed costs of production.

The profit of a firm producing variety z is

$$\pi(z) = q(z)(p(z) - a(z)). \tag{5}$$

A firm earns per unit profits of the mill price, governed by demand schedule (3), less the marginal cost of production $a(z)$. Since all firms face the same unitary wage, a more productive firm with a lower unit labor requirement $a(z)$ will earn higher profits. Maximization of (5), taking the price index as exogenous, shows that a monopolistic firm optimally charges a constant markup over marginal cost,

$$p(z) = \left(\frac{\sigma}{\sigma - 1}\right) a(z). \tag{6}$$

Subjecting this pricing rule to demand schedule (3) shows that the revenues and profits accruing to a firm located in country j serving its domestic market are given by,

$$r_j^D(a) = \frac{a^{1-\sigma} H_j \Lambda}{1-\rho} \tag{7}$$

$$\pi_j^D(a) = a^{1-\sigma} H_j \Lambda \tag{8}$$

where $H_j = \eta Y_j P_j^{\sigma-1}$ and $\Lambda = (1-\rho)\rho^{\sigma-1}$. More productive firms charge lower prices, earning higher domestic revenues and profits scaled by the size of the market. Notice that location subscripts have been included to reflect differences in country size H_j and in anticipation of transport costs

[7] This assumption is similar to that imposed by Chaney (2008) where a global fund collects and redistributes profits to shareholders.

which cause the price level P_j to vary across countries.

Each firm has the option of serving only its domestic market or exporting to foreign markets. If a firm wants to export to market i it has two options: (i) pay a bilateral startup cost f_i to access the foreign market or (ii) search for an intermediary in a matching market and pay a fee $\phi_i(a)$ for its services. An important technical assumption is that the startup cost f_i is a onetime lump sum payment that a firm must incur to access the foreign market, contrary to the flow cost of intermediation ϕ_i. That is, the amortized flow cost of direct export is rf_i, but a firm must pay the entire sum f_i if it decides to export directly. The importance of this assumption will become clear when firms must compare the profitability of different export channels.

Transport costs $\tau_{ij} \geq 1$ associated with export are of the iceberg form, symmetric between country pairs, and normalized so that $\tau_{ii} = 1$. If a firm chooses to export directly, it incurs both iceberg trade costs and a fixed cost. Export revenues and profits are given by,

$$r_{ij}^E(a) = \frac{(a\tau_{ij})^{1-\sigma} H_i \Lambda}{1-\rho} \tag{9}$$

$$\pi_{ij}^E(a) = (a\tau_{ij})^{1-\sigma} H_i \Lambda - rf_i. \tag{10}$$

For a particular country j there exist $N-1$ profit functions associated with each foreign market. It is important to note that an exporting firm does not sacrifice domestic sales; while equation (10) represents *additional* profits from a foreign market, *total* profits include domestic sales as well. When the good is shipped to foreign destinations the marginal cost of a direct exporter is $a\tau_{ij}$. Alternatively, the presence of transport costs can be interpreted as an adjustment to market size so that the effective market size is $\tau_{ij}^{1-\sigma} H_i$. The absence of fixed costs for domestic operations implies that firms always find it profitable to produce. On the contrary, the presence of fixed costs in direct exporting suggests that there is a cutoff level of productivity $(a_{ij}^*)^{1-\sigma} = rf_i/\tau_{ij}^{1-\sigma} H_i \Lambda$ at which a firm in location j is indifferent between exporting or not to a particular market i. This cutoff will depend on market characteristics such as size H_i, the cost of establishing foreign distribution f_i, and transport costs τ_{ij}.

Additionally, CES preferences imply that the relative revenues of firms depend only on their

relative productivities,

$$\frac{r_j^D(a')}{r_j^D(a)} = \frac{r_{ij}^E(a')}{r_{ij}^E(a)} = \left(\frac{a'}{a}\right)^{1-\sigma}$$

where the elasticity of substitution controls the differences in profitability between firms for given relative productivities. For tractability, and in accordance with much of the trade literature, productivities $1/a$ are assumed to be Pareto distributed with shape parameter $k > 2$ and scale parameter $\xi > 0$. In order to guarantee that the size distribution of firms has a finite mean it is assumed $k > \sigma - 1$. [8] It follows that the probability density function for unit labor requirements is $g(a) = k\xi^k a^{k-1}$.

Because the wage is exogenous and there is no free entry or exit, the price index facing a particular country, export revenues, and the cutoff productivity can all be determined immediately. The price index in country i consists of those firms who are above the productivity threshold a_{ij}^*,

$$P_i^{1-\sigma} = \sum_{j=1}^{N} n_j \left[\left(\frac{\sigma}{\sigma-1}\right)\tau_{ij}\right]^{1-\sigma} \int_0^{a_{ij}^*} y^{1-\sigma} dG(y)$$

Using this price index, we obtain the revenues of an exporting firm and the threshold productivities:

$$\begin{cases} P_i = (c_1 c_2)^{-1/k} Y_i^{-\frac{1}{k}-\frac{1}{\sigma-1}} \\ r_{ij}^E(a) = a^{1-\sigma}\sigma\tau_{ij}^{1-\sigma}\Lambda\eta(c_1c_2)^{\frac{-(\sigma-1)}{k}} Y_i^{\frac{\sigma-1}{k}} \\ a_{ij}^* = (rf_i)^{\frac{1}{1-\sigma}}\tau_{ij}^{-1}(\eta\Lambda)^{\frac{1}{\sigma-1}}(c_1c_2)^{\frac{-1}{k}} Y_i^{\frac{1}{k}} \\ c_1 = \sum_{j=1}^{N} n_j \tau_{ij}^{-k}(rf_i)^{-\frac{k}{1-\sigma}-1} \\ c_2 = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \frac{k\xi^k}{k-\sigma+1}(\eta\Lambda)^{-\frac{1}{k}-\frac{1}{\sigma-1}} \end{cases}$$

The method of direct export described above is nearly identical to that considered by Chaney (2008). The novelty here is that firms do not have to export directly. They may instead choose to search for an intermediary. However, this search is costly to firms due to matching and bargaining

[8] A random variable X distributed Pareto with shape parameter k and scale parameter ξ is governed by the probability density function $f(x) = k\xi^k x^{-(k+1)}$. In order to guarantee that the variance of X remains finite, it is enough to restrict $k > 2$.

frictions.

4 Intermediation

Conventional trade models largely assume that exporting firms can sell directly to foreign consumers. In reality, not all firms engage in direct export because it requires dedication of resources toward foreign market research, building a foreign sales and distribution structure, and complying with the rules and regulations of foreign markets. Intermediaries, on the other hand, save firms' time and resources by providing knowledge of foreign market characteristics, well established distribution networks, and expertise in export activities. In this way, indirect export via intermediaries provides immediate access to foreign markets at potentially lower cost.

There are many different ways a firm can choose to export indirectly. Exchange management companies (EMCs), exchange trading companies (ETCs), export merchants, export commission houses, and export brokers are all viable channels. Common to all is the provision of services enabling a firm to sell their product in foreign markets with limited direct involvement. Payment methods vary, but the most common include fee-based contracts, buy-and-sell arrangements, and commission-based contracts. The modeling assumption used here is that all contracts are fee-based. This assumption implies that intermediaries never take title to the goods so consumers do not face double marginalization.

Each intermediary possesses the resources and/or knowledge to access a particular market i and deliver the product from a firm in market j to consumers in market i. However, to maintain access to this market it must pay a flow cost d_i which finances the maintenance of existing distribution infrastructure. An intermediary earns revenue by charging firms a fee $\phi_i(a)$ for the service of connecting them with foreign markets.

Fee-based contracts coupled with market access costs, unrelated to the quantity of production, avoids jointly inefficient outcomes that would disappear with a two-part pricing scheme. Furthermore, the modeling assumptions preclude any wedge between wholesale and retail prices either due to additional per unit costs like in Ahn (2011) or the lack of cross-border enforceable contracts as in Felbermayr and Jung (2010). Without a wedge, the tradeoff that firms face when choosing an export mode is not between low revenues versus low fixed costs, as conventionally done, but rather

between low fixed costs versus the cost of search and bargaining frictions, which are unrelated to firm revenues.

Firms meet intermediaries subject to search frictions, captured by the matching function $m(u_F, u_I)$ where u_F denotes the measure of unmatched firms and u_I the measure of unmatched intermediaries. The matching function is assumed to be increasing, concave, and homogeneous of degree one. The rate at which firms meet intermediaries is $m(1, \theta) = \mu(\theta)$ and the rate at which intermediaries meet firms is $m(1/\theta, 1) = \mu(\theta)/\theta$ where $\theta = u_I/u_F$ is a measure of export market tightness. Additionally, it is assumed that $\mu(0) = 0$, $\mu'(0) = 1$, and $\mu(\infty) = 1$. Matches dissolve at an exogenous rate λ. Matches occur bilaterally between pairs of countries: the thickness of each market depends on the number of firms and intermediaries present between countries i and j. This assumes that there is a measure of intermediaries looking to facilitate trade with a particular country and that there are no externalities or congestion effects between different export markets. With this in mind, it is appropriate to denote market tightness as θ_{ij} to reflect the fact that the global export market has been segmented into $N(N-1)$ local export markets. For the remainder of the paper I will omit these subscripts, but it should be understood that θ is a market tightness specific to a country pair.

Both firms and intermediaries maximize expected lifetime discounted profits. If a firm is matched with an intermediary then it pays a fee $\phi_i(a)$ (which is allowed to vary with the type of firm) for the intermediary's service and stands to earn total variable profits of $\hat{\pi}_{ij}(a) = \pi^D_{ij}(a) + \pi^I_{ij}(a)$. If a firm is unmatched then it earns domestic profits of $\pi^D_{ij}(a)$. A matched intermediary stands to earn the fee $\phi_i(a)$ while an unmatched intermediary earns nothing. Regardless, the intermediary must pay a market access cost d_i.

Since firms are heterogeneous with respect to productivity, intermediaries face ex ante uncertainty over what type of firm they will be matched with. Once a match is formed, however, the intermediary learns the type of firm they have met and there is no ex post uncertainty. As a result, there is no asymmetric information during negotiations over the fee. An intermediary's decision to enter the export market depends on the expected surplus of a match which depends on the type of firm that it is matched with.

Let $E(a)$ and $D(a)$ denote the value functions of a matched and unmatched firm respectively and let $T(a)$ and U denote the value functions of a matched and unmatched intermediary respectively. Suppressing the location subscripts for notational convenience, the value functions of a firm and

intermediary must satisfy the following Bellman equations,

$$rD(a) = \pi^D(a) + \mu(\theta)[E(a) - D(a)] \tag{11}$$

$$rE(a) = \hat{\pi}(a) - \phi(a) + \lambda[D(a) - E(a)] \tag{12}$$

$$rT(a) = \phi(a) + \lambda[U - T(a)] - d \tag{13}$$

$$rU = \frac{\mu(\theta)}{\theta} \int_0^{\phi^{-1}(d)} [T(a) - U] dG_T(a) - d. \tag{14}$$

Equation (11) shows that the discounted value of an unmatched firm equals instantaneous profits from the domestic market plus the expected surplus of finding a match. Equation (12) shows that a matched (exporting) firm earns instantaneous profits from exporting $\hat{\pi}(a)$, pays an intermediation fee $\phi(a)$, and incurs an expected loss from exogenous separation. A matched firm earns domestic profits plus additional export profits from the foreign market which are determined by profit function (5) subject to foreign demand (3),[9]

$$\pi_{ij}^I(a) = (a\tau_{ij})^{1-\sigma} H_i \Lambda. \tag{15}$$

Comparison to expression (10) shows that the fee associated with indirect export is analogous to the amortized fixed cost associated with direct export. However, the cost of indirect export $\phi_i(a)$ will be an endogenous outcome of the search and matching environment, whereas rf_i is exogenous. This is different from the existing literature which treats all fixed costs as exogenous.[10] As was the case for direct export, note that expression (15) shows *additional* variable profits from indirect export. Total variable profits from indirect export are given by,

$$\hat{\pi}_{ij}(a) = a^{1-\sigma} \Lambda (H_j + \tau_{ij}^{1-\sigma} H_i). \tag{16}$$

Equation (13) shows that a matched intermediary earns revenue $\phi(a)$, has an expected loss from exogenous separation, and must pay a cost d to maintain access to its market. Using this Bellman

[9]Note that foreign *variable* profits are not equivalent to *ex post* foreign profits $\pi_{ij}^I(a) - \phi(a)$. The distinction is important since it will be variable profits that are part of the surplus that firms and intermediaries bargain over. The outcome of the bargaining will then yield ex post foreign profits.

[10]Note that revenues from indirect and direct export are identical which is in sharp contrast to much of the existing literature. This means that firms will weigh the amortized fixed cost of direct export against the fixed cost of indirect export when determining which export mode is optimal. This feature is different from existing papers where an intermediary sector forces additional per unit costs upon firms thereby lowering revenues.

equation, we can write an expression for an intermediary's surplus from a match,

$$T(a) - U = \frac{\phi(a) - d - rU}{r + \lambda}.$$

Intermediaries face ex ante uncertainty and must form beliefs about the type of firm they meet given the productivity distribution $G(a)$. Upon meeting a firm, it must decide whether a match is acceptable or wait to be matched with a more desirable type in the future. The intermediary will only accept a match if its value outweighs that of continuing to search for a potentially better firm,

$$T(a) \geq U \Leftrightarrow \phi(a) - d \geq rU.$$

Because this surplus increases linearly with respect to the service fee, there exists some cutoff fee $\underline{\phi}(a)$ at which the firm is indifferent between searching and accepting a match. Allowing for free entry among intermediaries guarantees that the value of being unmatched is driven to zero in equilibrium $U = 0$. There is thus a simple relationship that must be satisfied for the intermediary to cooperate with the matched firm,

$$\phi(a) \geq d.$$

That is to say, the revenue earned by the intermediary must at least cover the flow cost of maintaining access to its distribution network. Equation (14) reflects the intermediary's expected surplus of finding an acceptable match while paying a cost d to maintain access to its market. Note that higher a corresponds to a lower productivity firm and therefore the fee ϕ is decreasing in a. Hence, a lower cutoff $\underline{\phi}$ corresponds to an upper cutoff $\bar{a}$. This is why $\phi^{-1}(d)$ is the upper integrating limit in expression (14).

5 Nash Bargaining

When a firm and an intermediary meet, they negotiate over the fee. Resolution of this negotiation is described by an asymmetric Nash bargaining game. Giving the intermediary primitive bargaining

power β, the Nash program is

$$\max_{\phi(a)}(T(a)-U)^{\beta}(E(a)-D(a))^{1-\beta} \tag{17}$$

which results in the usual proportional sharing rule,

$$T(a)-U=\frac{\beta}{1-\beta}(E(a)-D(a)). \tag{18}$$

Notice that the threat point in (17) suggests that a firm chooses to continue searching for an intermediary if negotiations fail. This will always be preferable direct export because the startup cost f_i is a onetime lump sum cost. If bargaining breaks down, no firm will find it profitable to pay a lump sum cost relative to the flow cost of continued search. [11]

From (12) and (13), expressions for the value of the surpluses are obtained,

$$E(a)-D(a)=\frac{\hat{\pi}(a)-\phi(a)-rD(a)}{r+\lambda} \tag{19}$$

$$T(a)-U=\frac{\phi(a)-d-rU}{r+\lambda}. \tag{20}$$

So long as profits exist from entering the export sector, intermediaries will continue to do so until the value of being unmatched is equal to zero. This provides a free entry condition for intermediaries,

$$U=0. \tag{21}$$

Substituting (19) and (20) into the outcome of the Nash bargaining (18) and invoking the free entry condition (21) yields an explicit expression for the negotiated fee,

$$\phi(a)=\beta(\hat{\pi}(a)-rD(a)-d)+d. \tag{22}$$

[11] Felbermayr and Jung (2010) consider bilateral meetings between firms and intermediaries but focus on the holdup problem and how this affects the terms of trade. Their bargaining problem is static where the disagreement point of the firm is the amount of the numeraire input that a firm can recover if bargaining fails and for the intermediary is set to zero. The resulting transaction price is subject to double marginalization reflecting the severity of the distortion caused by the holdup problem. The approach taken here ensures that the bargaining outcome is jointly efficient and avoids double marginalization.

The intermediary receives its reservation fee d and a fraction β of the total surplus created by a match. The value of an unmatched firm is obtained from Bellman equations (11) and (12),

$$rD(a) = s(\theta)(\hat{\pi}(a) - \phi(a)) + (1 - s(\theta))\pi^D(a) \tag{23}$$

where $s(\theta) = \mu(\theta)/(r + \lambda + \mu(\theta))$. This is then used to derive an expression for the negotiated fee.

Proposition 1: *An intermediary's fee reflects the state of the export market, bargaining power, country specific costs, and the profitability of the matched firm. The cost of intermediation thus captures both market-specific and firm-specific characteristics.*

$$\phi(a) = \frac{\beta(r + \lambda)(\pi^I(a) - d)}{r + \lambda + (1 - \beta)\mu(\theta)} + d \tag{24}$$

If the intermediary has all the bargaining power, $\beta = 1$, then the intermediary extracts all foreign variable profits $\phi(a) = \pi^I(a)$. If the firm has all the bargaining power, $\beta = 0$, then the intermediary simply recovers the flow cost of maintaining access to its market $\phi(a) = d$. Any division of bargaining power leads to a fee which is a linear combination of foreign profits and market access costs weighted by export market characteristics. The fixed cost of indirect export is a function of effective market size ($\tau_{ij}\Lambda H_j$) and the elasticity of substitution (σ) through the profit function. Notice that, unlike in Melitz (2003), export costs vary with characteristics of the export market and country specific costs d_i. Quite dissimilar from existing models is the fact that it is possible for the cost of indirect export to exceed the amortized cost of direct export. Usually, in order to get well behaved export sorting, an exogenous ranking must be established between market access costs. Here however, the indirect cost of market access is determined endogenously and allowed to be greater or less than the direct cost. Nevertheless, there still exists well behaved, non-overlapping export sorting as will be apparent in the next section.

If the separation rate is high, firms do not expect to be in a match for very long and therefore value being matched more. That is, the effective bargaining power of a firm is reduced when the likelihood of staying in a match decreases so the intermediary can demand a larger fee. If the level of tightness is high, then firms can expect to find a match quickly which increases the value of its outside option and effectively increases its bargaining power so the firm can demand a lower fee. If

market access costs increase then the intermediary's reservation fee increases and so too does the fee.

Another perspective on the negotiated fee is that it represents the wedge between the firm's dock price and the retail price; where the dock price is simply the unit price that an intermediary pays a firm for its product. Defining the wedge to be the difference between $p(a)$ and $(p(a)q(a)-\phi(a))/q(a)$ we immediately have that it is equal to $\phi(a)/q(a)$. Thus, the fee (24) identifies how frictions in the export market and the bargaining power of intermediaries contributes to the wedge.

6 Export Mode Selection

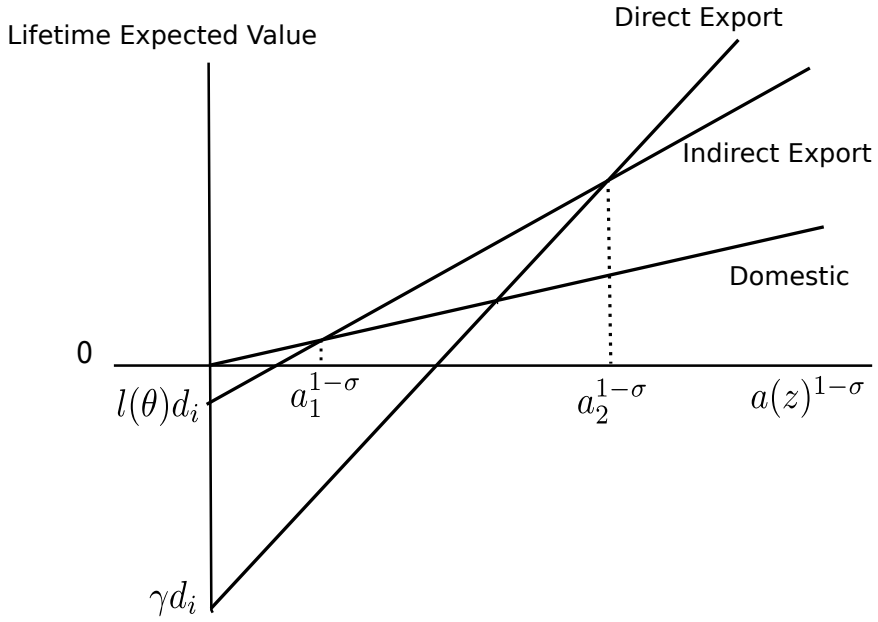
Firms choose the mode of export which maximizes discounted lifetime profits. This decision depends on their production technology and foreign market characteristics which influences search and bargaining costs. As previously mentioned, a firm always finds it profitable to produce domestically since there are no fixed costs of production. The relevant decision for a firm is thus which form of export yields greater profits over only serving the domestic market. The expected lifetime profits accruing to a firm which exports directly are given by,

$$\int_0^\infty e^{-rt}[\pi_{ij}^E(a)+\pi_{ij}^D(a)]dt = \frac{\pi_{ij}^E(a)+\pi_{ij}^D(a)}{r}. \tag{25}$$

In order to glean analytic insight, a normalization is helpful. It is assumed that $rf_i = \gamma d_i$ where $\gamma \geq 1$. This assumes that the flow cost of a firm establishing a sales and distribution network from scratch is at least as expensive as for an intermediary to maintain existing networks. This is not, however, imposing an exogenous restriction on the cost of indirect versus direct export. As was seen in the previous section, the cost of indirect export $\phi(a)$ is allowed to be greater or less than the flow cost of market access d_i so there is no a priori ranking over direct and indirect costs. Note that γ indexes the efficiency of intermediation. A large γ implies that intermediaries have substantially lower access costs to foreign markets than firms. As a result, there are greater potential savings from indirect export over direct export. It will be shown that the set of firms using intermediaries is strictly increasing in γ. Using the profit functions we have that

$$\pi_{ij}^E(a)+\pi_{ij}^D(a) = a^{1-\sigma}\Lambda(H_j+\tau_{ij}^{1-\sigma}H_i)-\gamma d_i. \tag{26}$$

Figure 1: Export Mode Sorting



The expected lifetime profits accruing to a firm which exports indirectly are given by expression (23) which shows that a producer expects to earn foreign profits $\hat{\pi}_{ij}(a) - \phi_i(a)$ and pay the intermediary its fee for an average duration of $s(\theta)$ while always earning domestic profits. Using the profit functions, the lifetime profits of an indirect exporter are given by,

$$rD(a) = a^{1-\sigma}\Lambda(H_j + l(\theta)\tau_{ij}^{1-\sigma}H_i) - l(\theta)d \tag{27}$$

where $l(\theta) = \mu(\theta)(1-\beta)/(r+\lambda+(1-\beta)\mu(\theta))$.

Figure 1 plots the expected lifetime value of domestic sales (8), direct exports (26), and indirect exports (27) as a function of productivity $a^{1-\sigma}$. The horizontal intercepts are the zero profit cutoffs: productivity at which a firm breaks even for a given mode of export. The vertical intercept for indirect export will always lie above that of direct export since $l(\theta) < 1 \leq \gamma$ and the slope of the direct profit line is steeper than the indirect export profit line.

Firms will choose to export indirectly only if $rD(a) \geq \pi_{ij}^D(a)$. The productivity level at which

firms begin to export indirectly is given by,

$$a_1^{1-\sigma} = \frac{d_i}{\tau_{ij}^{1-\sigma} H_i \Lambda}. \tag{28}$$

Firms will choose to export directly only if $\pi_{ij}^E(a) + \pi_{ij}^D(a) \geq rD(a)$. The productivity level at which firms begin to export directly is given by,

$$a_2^{1-\sigma} = \frac{(\gamma - l(\theta))d_i}{\Lambda \tau_{ij}^{1-\sigma} H_i (1 - l(\theta))}. \tag{29}$$

Figure 1 shows that firms always find it profitable to sell to its domestic market. However, it may not always be profitable to export—only more productive firms will choose to export . The most productive firms find it profitable to export directly while firms with intermediate productivity find it profitable to search for an intermediary.

If search frictions are extreme ($\mu(\theta) = 0$) or firms hold no bargaining power ($\beta = 1$), then the intermediation sector shuts down and the indirect value line coincides with the domestic value line. In this case, a smaller subset of firms export with the cutoff productivity given by $\gamma a_1^{1-\sigma}$. If there are no cost savings from intermediation ($\gamma = 1$), then the direct export cutoff coincides with the indirect export cutoff and no firm chooses to search for an intermediary. The ratio of (28) and (29) provides an expression for measuring the extent to which firms choose to search for an intermediary.

Proposition 2: *The degree of export-mode sorting can be summarized by the following expression,*

$$\left(\frac{a_2}{a_1}\right)^{1-\sigma} = \frac{\gamma - l(\theta)}{1 - l(\theta)} \tag{30}$$

The size of the intermediary sector depends on the efficiency of intermediation γ and the state of the export market $l(\theta)$.

Expression (30) shows a positive relationship between competition among intermediaries and the measure of firms choosing to search for an intermediary. As the level of tightness in an export market grows, firms benefit from both lower fees and a higher probability of finding a match. As the efficiency of intermediation grows, a larger set of firms will choose to export indirectly for a given level of tightness. Additionally, assigning the intermediary less bargaining power results in a larger set of firms searching for an intermediary for a given level of tightness.

We can also observe the partial effects on export mode selection from changes to the state of export market summarized by $l(\theta) = \mu(\theta)(1-\beta)/(r+\lambda)(1-\beta)\mu(\theta))$. For given level of tightness, a positive shock to the separation rate ($\uparrow \lambda$) decreases the direct export productivity threshold thereby shrinking the set of the firms that use intermediaries. A higher separation rate induces a higher fee charged by intermediaries and reduces the profitability of indirect export. The same argument applies to a negative financial shock ($\uparrow r$) or a negative shock to the firms bargaining power ($\uparrow \beta$).

7 Equilibrium

Equilibrium is defined in terms of export market tightness, service fee, and resulting export cutoffs: $(\theta^*, \phi^*, a_1, a_2)$. Equilibrium in the export market is determined by the behavior of intermediaries of which there is an unbounded pool of prospective entrants. Each intermediary acts so that in equilibrium expected search costs equal the expected value of a match. From Bellman equations (13), (14) for an intermediary and the free entry condition (21) we have two equilibrium conditions governing export market tightness:

$$\int_{a_2}^{a_1} T(a) g_T(a) da = d\frac{\theta}{\mu(\theta)} \quad \text{and} \quad T(a) = \frac{\phi(a) - d}{r + \lambda}.$$

Notice that the expected value of a match is computed using the truncated distribution that emerges from firms' endogenous export decision.[12] As is shown in (14), an intermediary never cooperates with a firm whose unit labor requirements exceed $\phi^{-1}(d) = a_1$. Now, however, intermediaries know they will never encounter an especially productive firm with unit labor requirements below a_2 because these firms endogenously select to export directly. Equating the above two expressions gives and relation between the negotiated fee and market tightness taking into account

[12] When forming expectations, intermediaries truncate the distribution $g(a)$ to account for firms endogenous selection into export modes. The relevant probability distribution function for firms in the export market is now,

$$g_T(a) = \frac{g(a)}{G(a_1) - G(a_2)}$$

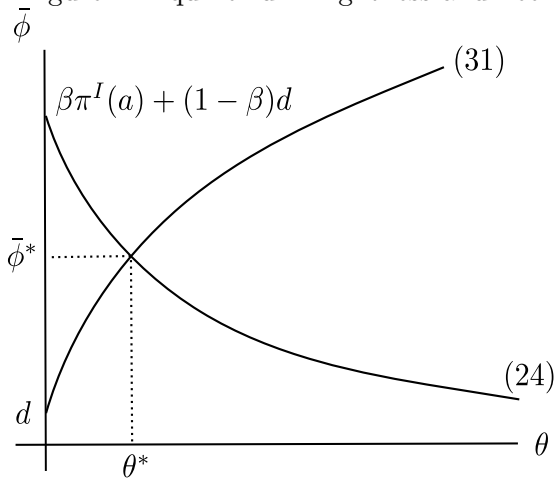
where G the cumulative probability distribution function of productivity levels and a_1, a_2 are the upper and lower cut off productivity levels which define which firms will search for intermediaries. Note that higher productivity $a(z)^{1-\sigma}$ corresponds to lower unit labor requirements. Hence the "lower" productivity cutoff corresponds to the higher a. Endogenous export sorting then suggests that $a_1 > a_2$.

the endogenous decision of firms to search for intermediaries,

$$\int_{a_2}^{a_1} \frac{\phi(a) - d}{r + \lambda} g_T(a) da = d \frac{\theta}{\mu(\theta)}. \tag{31}$$

Equations (24) and (31) provide a unique equilibrium level of intermediation and fee $(\phi^*(a), \theta_{ij}^*)$ as represented in Figure 2.

Figure 2: Equilibrium Tightness and Fee



In equilibrium, there exists an average fee $\bar{\phi}^*$ and tightness θ_{ij}^* for a particular $i - j$ market. There exists, nevertheless, a continuum of differentiated fees for each matched firm based on its type. A necessary condition for an equilibrium to exist is that there is the possibility of a mutually beneficial match between firms and intermediaries. It must be that, on average, a firm's additional profits from exporting outweigh the cost to an intermediary of maintaining its distribution network,

$$\pi^I(\bar{a}) = (\bar{a}\tau_{ij})^{1-\sigma} \Lambda H_i \geq d_i.$$

Since the lefthand side is decreasing in average productivity $\bar{a}(z)$ there exists an upper threshold above which no equilibrium exists.

The equilibrium level of tightness is completely defined by condition (31) using the negotiated fee (24) and the cutoff productivities a_1, a_2 defined in (28) and (29). Focusing exclusively on steady state, it must be that for a given interval of time the number of firms who find intermediaries equals the number of firms who become unmatched, $\lambda(1 - u_F) = \mu(\theta) u_F$, which describes the equilibrium

proportion of searching firms who are successful indirect exporters,

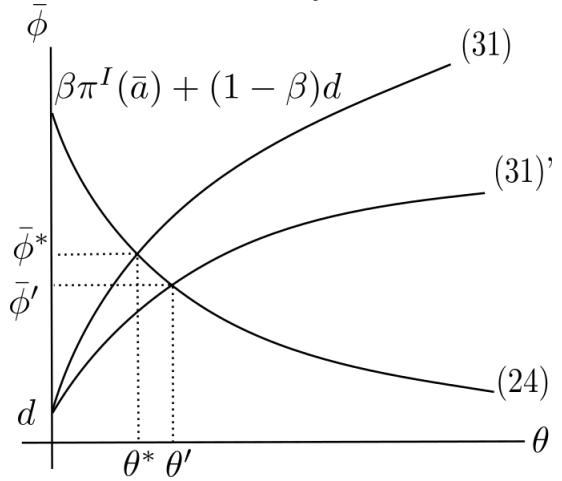
$$1 - u_F = \frac{\mu(\theta)}{\lambda + \mu(\theta)}. \tag{32}$$

Observing equations (28) and (29), assuming transport costs are identical across countries ($\tau_{ij} = \tau$), the cutoff productivity levels depend only on the characteristics of the destination country, not the source country.[13] Therefore, the ceteris paribus effect of being a larger country is that you attract more goods.

Proposition 3: *An increase in the efficiency of intermedation results in lower intermediation fees for firms and a tighter export market. Export destinations with lower trade costs have higher intermediation fees and may have tighter or looser export markets. An increase in the interest rate or separation rate results in higher intermediation fees and a tighter export market.*

Qualitatively, an increase in γ causes the cutoff productivity of direct exporters to increase ($a_2 \downarrow$). In Figure 3, equation (31) rotates toward the horizontal axis resulting in a higher level of tightness and a lower fee. Intuitively, greater efficiency of intermediation results in more firms searching for intermediaries which increases the expected surplus of intermediaries. Increased entry by intermediaries decreases their effective bargaining power resulting in lower fees.

Figure 3: Increase in Efficiency of Intermediation ($\uparrow \gamma$)

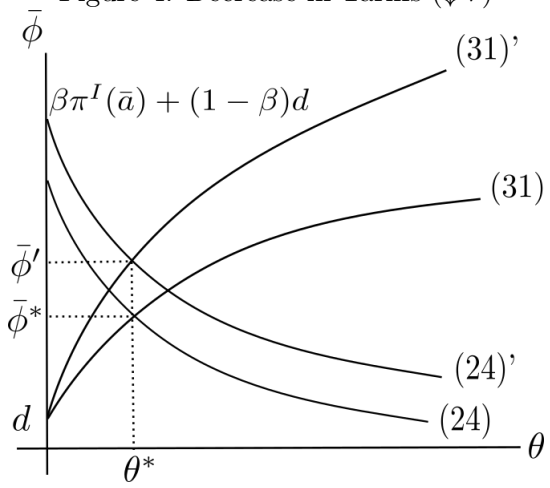


Qualitative analysis can also shed light on the effects of trade liberalization ($\tau \downarrow$). A decrease

[13] This is an attribute of export sorting that exists in Chaney (2008). It is a consequence of exogenous wages and the lack of free entry.

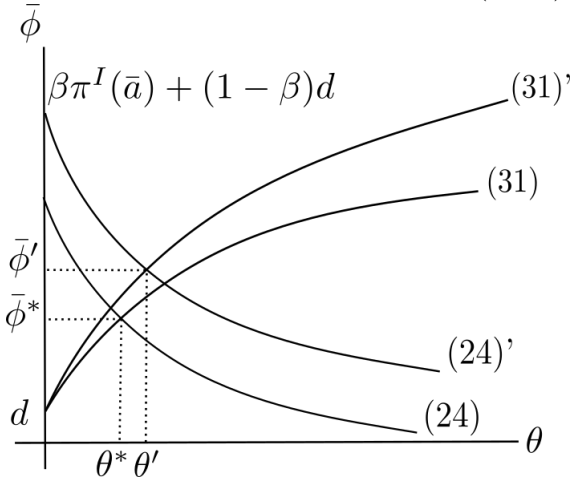
in tariffs raises the average fee that intermediaries can charge because it increases the joint surplus from exporting, as seen in equation (24). Intermediaries will begin entering the export market anticipating higher fees thus rotating (31) upward as shown in Figure 4. The effect on market tightness is ambiguous and depends on the distribution of firm productivity. This means that the contact rate and the proportion of trade intermediated may either increase or decrease following a shock to trade costs. This highlights a problem that policy makers may face when observing the effect on intermediated trade following trade liberalization. Although trade liberalization has a positive effect on welfare, firms will realize higher fees charged by intermediaries and may simultaneously realize lower contact rates. Predicting the effect on contact rates relies on an accurate accounting of firm productivities. This implies, however, that trade liberalization can have different effects on market tightness across countries and across industries, as there is no reason to assume identical productivity distributions.

Figure 4: Decrease in Tariffs ($\downarrow \tau$)



Finally, I consider the effect of a negative financial shock ($\uparrow r$) or, equivalently, a negative separation shock ($\uparrow \lambda$). Both types of shocks increase the rate at which intermediaries discount the value of being in a match, rotating equation (31) toward the vertical axis. For any given level of market tightness, a higher discount rate implies intermediaries must be compensated by a higher average fee. Firms also realize a higher discount rate which means time spent unmatched is more costly. Thus, firms are willing to pay a higher intermediation fee to be in a match, shifting equation (24) rightward. The resulting equilibrium is one with higher fees and a tighter export market.

Figure 5: Increase in Discount Rate ($\uparrow r, \lambda$)



To derive closed form equilibrium equations, I assume Pareto distributed productivity so that the truncated distribution is given by $g_T(a) = ka^{k-1}/(a_1^k - a_2^k)$. Substituting the negotiated fee (24) and the truncated density into equilibrium condition (31) obtains,

$$\int_{a_2}^{a_1} \frac{\beta(\pi^I(a) - d)}{r + \lambda + (1-\beta)\mu(\theta)} \frac{ka^{k-1}}{a_1^k - a_2^k} da = d\frac{\theta}{\mu(\theta)}.$$

Substituting the expressions for foreign variable profits (15) and cutoff productivities (28), (29) into the above yields the condition for equilibrium in the export market.

Proposition 4: *Under Pareto distributed productivity, equilibrium export market tightness is given by,*

$$\frac{\beta}{r + \lambda + (1-\beta)\mu(\theta)} \left[\frac{k}{k - \sigma + 1} \left(\frac{1 - M(\theta)^{\frac{k-\sigma+1}{1-\sigma}}}{1 - M(\theta)^{\frac{k}{1-\sigma}}} \right) - 1 \right] = \frac{\theta}{\mu(\theta)} \tag{33}$$

where $M(\theta) = (\gamma - l(\theta))/(1 - l(\theta))$. As an artifact of the Pareto distribution, the level of intermediation is determined independently of effective market size $\tau_{ij}^{1-\sigma} H_i$. It is completely determined by export market characteristics $(\gamma, \lambda, r, \beta)$, the elasticity of substitution σ, and the dispersion of firm productivities dictated by scale parameter k. This implies that equilibrium tightness will be identical in all export markets. However, the threshold productivities will still be country specific due to differences in effective country size and therefore market demand. [14]

[14]Note that the independence of export market tightness on effective market size in an artifact of the Pareto distribution. More generally, market size will have an effect on tightness as shown in Figure 5. With Pareto distributed productivities, the negative effect on tightness through free entry and the positive effect on tightness from the Nash bargained fee cancel out.

With market tightness determined by (35), equilibrium values for productivity thresholds, firms' revenue, and the price index are as follows:

$$\begin{cases} P_i = c_1 c_2 \gamma^{\frac{k-\sigma+1}{k(1-\sigma)}} \Gamma(\theta)^{\frac{-1}{k}} Y_i^{\frac{k-\sigma+1}{k(1-\sigma)}} \\ r_{ij}^E(a) = r_{ij}^I(a) = \eta \rho^{\sigma-1} (a\tau_{ij})^{1-\sigma} Y_i^{\frac{\sigma-1}{k}} (c_1 c_2)^{\sigma-1} \gamma^{\frac{\sigma-k-1}{k}} \Gamma(\theta)^{\frac{1-\sigma}{k}} \\ a_1^{ij} = (rf_i)^{\frac{1}{1-\sigma}} \tau_{ij}^{-1} (\eta\Lambda)^{\frac{1}{\sigma-1}} (c_1 c_2) \gamma^{1/k} \Gamma(\theta)^{-1/k} Y_i^{1/k} \\ a_2^{ij} = M(\theta)^{\frac{1}{1-\sigma}} a_1^{ij} \\ \Gamma(\theta) = M(\theta)^{\frac{k-\sigma+1}{1-\sigma}} + \left(\dfrac{\mu(\theta)}{\lambda + \mu(\theta)} \right) (1 - M(\theta)^{\frac{k-\sigma+1}{1-\sigma}}) \\ c_1 = \displaystyle\sum_{j=1}^{N} \left(\frac{Y_j}{Y} \right)^{-1/k} \tau_{ij} \left(\frac{d_i}{\eta\Lambda} \right)^{\frac{k-\sigma+1}{k(\sigma-1)}} \\ c_2 = \left(\dfrac{\sigma}{\sigma-1} \right)^{\frac{\sigma-1}{k}} \left(\dfrac{k\xi^k}{k-\sigma+1} \right)^{-1/k} \left(\dfrac{Y}{1+\pi} \right)^{-1/k} \end{cases}$$

Intermediation affects the the price index of the economy by $\gamma^{\frac{k-\sigma+1}{k(1-\sigma)}} \Gamma(\theta)^{-1/k}$ capturing both the effect of cheaper foreign market access and the size of the intermediary sector. Large cost savings from intermediation ($\uparrow \gamma$) and a large number of actively searching intermediaries ($\uparrow \theta$) puts downward pressure on price index. Also, the welfare gains generated by intermediaries are inversely related to the dispersion of firm productivity and positively related to the elasticity of substitution among product varieties.

Consider two limiting cases to highlight how intermediation affects welfare. First, suppose that there are no efficiency gains from intermediation, $\gamma = 1$. In this case, the productivity thresholds are identical for direct and indirect exporters to that $\Gamma(\theta) \to 1$ and therefore the price index is exactly equal to an economy without intermediation. Second, suppose that export market frictions vanish, $\theta \to \infty$, so that firms instantaneously find intermediaries. In this case, $\Gamma(\theta) \to 1$ and the welfare gains come entirely from $\gamma > 1$.

Firm revenues look identical because of the assumption that intermediaries are paid with a lump sum transfer. Nevertheless, there exist distinct export choice thresholds for a destination country i, determined by fixed costs of export, bilateral trade costs, and market size. These market specific variables interact with equilibrium tightness in the intermediary sector to determine the productivity difference between the marginal direct exporting firm and the marginal indirect

exporting firm. That is, equilibrium market tightness determines the share of total export revenue accruing the direct export sector and the indirect export sector as is made explicit in the following proposition.

Proposition 5: *Total exports (R_{ij}) from country j to country i are given by*

$$R_{ij} = \eta \left(\frac{\tau_{ij}}{\sum_{j=1}^{N} (Y_j/Y)^{-1/k} \tau_{ij}} \right)^{-k} \left(\frac{Y_i Y_j}{Y} \right) \gamma^{\frac{k-\sigma+1}{1-\sigma}}. \tag{34}$$

Total exports are a function of country sizes (Y_i and Y_j), bilateral trade costs (τ_{ij}), the efficiency gains from intermediation (γ), and a measure of country i's remoteness from the rest of the world ($\sum_{j=1}^{N} (Y_j/Y)^{-1/k} \tau_{ij}$). Direct exports ($R_{ij}^E$) and indirect exports ($R_{ij}^I$) from country j to country i are given by

$$R_{ij}^E = R_{ij} \Gamma(\theta)^{-1} M(\theta)^{\frac{k-\sigma+1}{1-\sigma}} \tag{35}$$

$$R_{ij}^I = R_{ij} \Gamma(\theta)^{-1} (1 - M(\theta)^{\frac{k-\sigma+1}{1-\sigma}}) \left(\frac{\mu(\theta)}{\lambda + \mu(\theta)} \right). \tag{36}$$

The share of exports that are intermediated (R_{ij}^I/R_{ij}) is determined by the level of export market tightness (θ), which is itself a function of ($\gamma, \lambda, r, \beta, \sigma, k$).

Total exports are determined by a gravity relationship indicating more trade between countries of larger sizes, close proximity, and efficient intermediary sectors. Export revenues are then divided between the indirect export sector and the direct export sector according to equilibrium market tightness affecting firms along two margins: (i) an intensive margin where market tightness effects the revenue differential between the marginal indirect exporter and the marginal direct exporter and (ii) an extensive margin where market tightness affects the fraction of firms that successful contact an intermediary. The intensive margin is captured by equation (30) which summarizes the determination of export mode selection, while the extensive margin is formally shown in Proposition 6.

One robust finding across many empirical studies (Bernard et al. (2011) Ahn et al. (2011) Schroder et al. (2003) Akerman (2010)) is that an increase in country specific fixed export costs increases the share of trade performed by intermediaries. An increase in the share of intermediation following an increase in γ would be consistent with the empirical findings. The qualitative analysis

in Figure 4 shows that export market tightness unambiguously increases in response to higher efficiency of intermediation ($\partial\theta/\partial\gamma > 0$). Proposition 5 then shows that the share of intermediation rises which is consistent with empirical findings.

Another empirical fact to check is the effect on the share of intermediation relative to market size. Market size H_j does not affect the level of tightness (due to Pareto distributed productivity), and therefore has no effect on the share of intermediation (despite the fact that it does affect both export cutoffs negatively). Although this result is consistent with theoretical papers like Akerman (2010), it is inconsistent with empirical findings by Bernard et al. (2011) and Schroder et al. (2003). To reconcile the model's predictions with empirical findings, one option would be to use a different distribution of productivity. Alternatively, we could assume that the effiency of the matching function is proportional to market size H_i so that larger and wealthier countries better matching technology.

To compute the number of firms who are engaged in search, we acknowledge that only those firms with intermediate levels of productivity choose indirect export. Letting $n_j = \mathcal{M}(Z_j)$ denote the Lebesgue measure of the set of firms in country j, the measure of firms who are searching to export with country i is $[G(a_1^{ij}) - G(a_2^{ij})]n_j$ where the cutoff values are specific to a particular export market (country pair). Only a proportion of those who are searching are successful in finding a match. This proportion is provided by equation (34). Hence, the number of varieties available to country i is the sum of its domestic varieties, those it imports indirectly, and those it imports directly:

$$n_i = \sum_{s=1}^{N} G(a_1^{is})(1 - u_F^{is})n_s + \sum_{s=1}^{N} G(a_2^{is})u_F^{is}n_s.$$

Proposition 6: *With Pareto distributed productivity, all countries have the same level of export market tightness and therefore the number of varieties available to country i is given by* [15]

$$n_i = \left[u_F(\theta) + (1 - u_F(\theta))M(\theta)^{k/(1-\sigma)}\right] c_2 c_3 \gamma^{\frac{k+2(1-\sigma)}{k(1-\sigma)}} \Gamma(\theta)^{-1/k} Y_i^{1/k} \tag{37}$$

The relationship between export market tightness and the number of available varieties in non-monotone. There exists a level of export market tightness $\tilde{\theta}$ such that for all $\theta < \tilde{\theta}$ the number

[15] $c_3 = \xi^k (rf_i)^{-1/k} (\eta\Lambda)^{1/k} \left(\frac{Y}{1+\pi}\right) \sum_{s=1}^{N} \sum_{j=1}^{N} \frac{Y_s}{Y} \left(\frac{Y_j}{Y}\right)^{-1/k} \left(\frac{\tau_j}{\tau_s}\right)$

available varieties is increasing in tightness and for all $\theta > \tilde{\theta}$ the number of available varieties is decreasing in tightness.

The intuition for this result is as follows: If an increase in export market tightness causes fewer unmatched firms (via the elasticity of the matching function) relative to the number of firms who switch to the indirect export mode, then the number of varieties increases. Conversely, if more firms become unmatched than those who decide to begin exporting indirectly then the number of varieties decreases.

For example, suppose that there is an increase in the efficiency of intermediation ($\uparrow \gamma$). Export market tightness increases as more intermediaries enter anticipating higher fees. Simultaneously, some firms who were exporting directly endogenously switch their mode of transport and begin searching for intermediaries as seen from equation (30). These firms now run the risk that they do not successfully find an intermediary and are unable to export their goods. Nonetheless, with a tighter export market their chances of finding an intermediary has improved so that a larger proportion of searching firms are successful in finding match as seen from equation (32). The first effect, where direct export firms switch to indirect export, means that fewer firms in aggregate are successful in exporting. The second effect, however, increases the rate at which firms find matches and so increases the aggregate number of firms exporting. These two counterveiling forces explain why there exists a level of intermediation where the positive marginal effect on aggregate export volume from an increase in the level of intermediation is just equal to the negative marginal effect.

For the same reasons mentioned above, there may be a negative impact on aggregate productivity following an increase in the level of intermediation. Higher productivity firms who were exporting, now decide to export indirectly wherein a fraction are unsuccessful in exporting. Hence, higher productivity firms vanish. At the same time, lower productivity firms who were exporting indirectly are successful more often. Hence, lower productivity firms become more prominent. [16]

We can also observe that the partial elasticity of available varieties to the efficiency of intermediation is $d\ln n_i/d\ln\gamma = (k+2(1-\sigma))/(k(1-\sigma))$. Interestingly, for reasonable estimates of heterogeneity (Eaton, Kortum and Kramarz (2007) $k/(\sigma-1) \approx 1.5$ or Chaney (2008) $k/(\sigma-1) \approx 2$) this partial effect is practically nil. This suggests that most of the quantitative impact to changes

[16] Although interesting, these results are certainly a feature of a stylized environment where direct exporters find consumers with certainty while indirect exporters do not. If frictions within direct export were included, it is unclear what the effect on aggregate productivity would be.

in the number of varieties operates through export market tightness which alters both the set of firms trying to export indirectly and the rate at which they are successful.

8 Conclusion

Trade intermediaries allow firms, who would not otherwise export, access to foreign markets. Embedding a matching market within a standard heterogeneous firm model of trade generates a flexible cost structure where indirect export costs are endogenously determined, are increasing in the profitability of foreign markets, and depend on characteristics of a export market. Firms choose export modes (indirect or direct) contingent on their productivity draws. Higher productivity firms always choose to export directly while intermediate productivity firms export indirectly. The presence of frictions within the indirect export sector may act as a mechanism to shift aggregate productivity even in the absence of entry and exit by firms. The share of intermediated trade is strictly increasing in the efficiency of intermediation. Trade intermediation unambiguously increases welfare by allowing more firms to access foreign market and thus providing greater variety of goods to foreign consumers.

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