The Role of Intermediaries in Facilitating Trade*
PRELIMINARY DRAFT

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Abstract

Using a database that records the census of firm-level trade by Chinese firms, we provide systematic evidence that intermediaries play an important role in faciliating trade across borders. Intermediaries account for at least 20% of China's imports and exports in 2005. This implies that a large number of firms are able to engage in international trade without directly exporting or importing products. We modify a heterogenous firm trade model to allow firms to endogenously select their mode of export–either directly or indirectly through an intemediary. The model predicts that intermediaries play a relatively more important role in markets that are more difficult to penetrate. We provide empirical confirmation for this prediction as well as generate new facts regarding the activity of intermediaries.

Keywords: China, Intermediaries, Heterogeneous Firms, Middlemen, Fixed Costs
JEL classification: F1

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1. Introduction

Research using firm-level data has uncovered that only a fraction of firms export products to foreign markets. In the U.S., Bernard, Jensen, and Schott (2008) report that only 35 and 25 percent of firms in mining, agriculture and manufacturing sectors exported or imported at least one product in 2000. This fact, which has emerged across many countries, is now well-grounded in theoretical models featuring firm heterogeneity and fixed export costs (e.g., Melitz (2003) and Bernard, Eaton, Jensen, and Kortum (2003)). These empirical and theoretical findings, however, do not account for the role that intermediaries, wholesalers, distributors, and more generally, "middlemen", play in facilitating international trade. The prominence of intermediaries appears in aggregate trade statistics; in the U.S., wholesale and retail firms account for 21 and 30 percent of non-service related exports and imports (Bernard, Jensen and Schott, 2008).

The use of intermediary firms has been even more pervasive in developing economies, particularly in Asia. In the early 1980s, 300 trading (non-manufacturing) Japanese firms accounted for 80 percent of Japanese trade, and the ten largest of these firms accounted for 30 percent of Japan's GNP (Rossman, 1984). During the early 1950s in China, only six firms engaged in international trade on behalf of domestic firms; by the time China embarked on market reforms in 1978, all international trade flowed through just sixteen trading firms (Lardy, 1993).[1] In China today, the setting of our study, our data indicate that *at least* 22 and 18 percent of total Chinese exports and imports flows through non-manufacturing firms.

The importance of intermediary firms in facilitating Chinese trade across borders indicates that existing models should be augmented to account for the entire portrait of a country's imports and exports. In this paper, we modify the workhorse international trade framework developed by Melitz (2003) to include intermediation. The model features heterogeneous firms that endogenously select whether to directly or indirectly export their product. As in Melitz (2003), the most productive firms are able to directly export their varieties by paying a fixed exporting cost. Less productive firms are unable to cover the fixed export cost; however, they incur a marginal cost to forward their product to an intermediary who exports on their behalf. The presence of intermediary firms therefore provides a mechanism through which less-productive firms are able to access the export market: the most productive firms incur the fixed cost of exporting while less productive firms avoid the fixed cost, but incur higher marginal costs to forward their varieties that the intermediaries export. So while relatively less productive firms are able to access foreign markets resulting in a less efficient allocation of resources relative to a model without intermediation,

[1] Of course, these early Japanese and Chinese statistics reflect government intervention which often prevented domestic firms from directly trading abroad. We discuss this issue and how we circumvent this problem in Section 3.

consumers benefit from a proliferation of varieties. In a special circumstance where firm productivity is distributed Pareto, opening to trade in our model always brings an increase in the total number of varieties irrespective of the size of the fixed cost of exporting.[2]

The model yields several predictions that we verify using a recently constructed database of firm-level Chinese international trade transactions. We classify a firm as an intermediary if the firm has the words "importer" and/or "exporter" in its name. The data reveal many interesting stylized facts about Chinese intermediary firms and consequently, China's overall trade patterns. In 2005, Chinese intermediaries accounted for 22 and 18 percent of total exports and imports. Between 2000 and 2005, the number of intermediaries increased dramatically from about 9,000 to 22,000, suggesting that while the Chinese government relaxed the restrictions on direct trading right during this period (see discussion below), intermediaries still found it profitable to enter the trading market. Intermediary firms are also more likely to engage in both importing and exporting, and their product mix span remarkably broad sectors. Perhaps more interestingly, intermediary firms appear to have a relative "country" focus while firms that engage in direct exporting appear to have a relative "product" focus. That is, intermediary firms send relatively more products per country while direct exporters export to more countries per product. This fact is intuitive; manufacturing firms likely possess a core competent product line (Bernard, Redding and Schott, 2009), while in our model, intermediaries emerge precisely to overcome the fixed costs of market access.

The model predicts that the share of exports handled by intermediary firms increases in both the variable and fixed costs of exporting. The reason is that as trade becomes more costly, firms need to possess high levels of productivity to overcome these costs to directly export. When barriers to trade are larger, a greater fraction of relatively less-productive domestic firms forward their varieties to the intermediary firms to export on their behalf. We therefore expect to observe the share of a total exports to a country facilitated by Chinese intermediaries to be increasing in the degree of difficulty in penetrating the market. The data are consistent with this prediction; more distant, smaller countries, and countries that have more regulatory barriers to trade receive a larger fraction of exports through Chinese intermediaries. Intermediary firms play a relatively smaller role in exporting to countries that have large Chinese-speaking population, which is intuitive if common language represents a measure of fixed exporting costs. Finally, intermediary firms' export share increases with countries that levy higher tariffs on Chinese exports. Our point estimates imply that doubling a country's distance to China would increase the share of exports handled by intermediaries to that country by about 10 percent. Likewise, an increase in tariffs by 10

[2] This finding contrasts with the "anti-variety" result in Baldwin and Forslid (2006). They demonstrate that in a standard heterogeneous firm model, if productivity follows the Pareto distribution and the fixed costs of exporting exceed production, trade will result in a loss of product variety for consumers as foreign exporters displace domestic varieties (there are still overall gains from trade).

percentage points (roughly one standard deviation in our sample) is associated with a 15 percent increase in intermediary export shares.

The model therefore predicts that less-productive firms are able to access foreign markets by relying on intermediary firms. This prediction is consistent with observations from the business literature (e.g., Peng and Ilinitch, 1998) and underpins government policy, such as the 1982 U.S. Export Trading Company Act, which explicitly encourages the formation of intermediary firms to export on behalf of the "tens of thousands" of small- and medium-sized U.S. businesses (Export Trading Company Act of 1982). The model also formalizes the well known observation that intermediary trading companies have long played an important role in global trade. Grief (1993) documents the importance of the Maghribi traders coalition in establish trade across long distances during the 11th century. Other prominent trading companies throughout history include the Dutch East India Trading Company, large-scale Japanese trading firms (*sogo shosha*), and more recently, Li and Fung, the Hong Kong textile and apparel firm.

Our theoretical and empirical findings offer an alternative channel for why intermediaries arise in cross-border trade. Previous work has focused on the role of intermediaries in matching buyers and sellers by either reducing search costs (e.g., Rubinstein and Wolinsky 1987) or adverse selection costs by acting as gauranteers of quality (see Biglaiser (1993) and Spulber (1996)). In a study of Hong Kong's entrepôt trade, consistent with the quality-sorting role of intermediaries, Feenstra and Hanson (2004) find that between 1988-1993, 53 percent of China's exports were shipped through Hong Kong, and the average markup of Hong Kong re-exports of Chinese goods was 24 percent. They find that Hong Kong intermediaries possess an informational advantage and therefore serve as well-placed brokers that aid the matching of Chinese suppliers with foreign buyers. The role of intermediaries in reducing search costs has also been explored by Rauch and Trindade (2002) who find that ethnic Chinese networks have a sizable impact on bilateral trade flows. More recent work by Blum, Claro, and Horstmann (2009) argues in the majority of importer-exporter matches between Colombian and Chilean firms, at least one firm is extremely large due to search costs. Rauch and Watson (2004) and Felbermayr and Jung (2008) focus on holdup problems that may arise between intermediaries and manufacturers. Our theoretical framework is closest to Felbermayr and Jung (2008) who also derive a sorting equilibrium with less productive firms choosing to export via intermediaries. However, their model focuses on potential holdup problems between intermediaries and manufactures and generates the prediction that intermediary shares are independent of market size, distance and variable and fixed export costs. Their predictions are inconsistent with the evidence from the data.

Moreover, the existing empirical work analyzing intermediary firms rely on product or industry-level data in their analysis. One exception is a Blum, Claro, and Horstmann (2009) who can observe matches between importers and exporters but do not identify if either party

within the match are non-manufacturing intermediaries. Their analysis is also restricted to Chilean-Colombian trading partners. Here, we provide the first systematic evidence of the characteristics of intermediary firms and their overall importance in international trade for the third largest exporting economy, China, because we can directly observe the universe of transactions by intermediary and direct exporters. We are therefore able to analyze the sources of variation in intermediary trade across products and markets, and relate these findings to predictions from the model. Furthermore, by embedding intermediation within an otherwise standard heterogenous firm framework, our model is a tractable framework for analyzing the role of intermediary firms in an open economy setting.

The remaining paper is structured as follows. In Section II, we lay out the basic model and the predictions that we will very in the data. Section III describes the data. Section IV presents stylized facts of intermediary firms and verifies the predictions from the model. We conclude in Section IV.

2. A Model of Intermediary Firms

We present a heterogeneous firm model that includes intermediation technology. We focus on the open economy equilibrium because in autarky, there is no role for intermediaries to export. We assume consumers have identical CES preferences for differentiated varieties in two countries, home (H) and foreign (F):

$$U = \left[\int_{\omega\in\Omega} q(\omega)^{\rho} d\omega\right]^{\frac{1}{\rho}},$$

where Ω is the set of total available varieties in the differentiated goods sector. The corresponding price index is given by:

$$P = \left[\int_{\omega\in\Omega} p(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}},$$

where $\sigma = \frac{1}{1-\rho} > 1$ is the constant elasticity of substitution across varieties. Each consumer is assumed to supply one unit of labor inelastically.

The production technology assumes a continuum of firms in a monopolistically competitive market. Each firm manufactures a unit variety with constant marginal cost and a fixed per period overhead cost, f. Following Melitz (2003), firms are heterogeneous in productivity. The amount of labor required to produce q units for a firm with productivity level φ is:

$$l = f + \frac{q}{\varphi}.$$

Firms enter the market by paying an entry cost, f_e, to draw their productivity from the distribution $g(\varphi)$. Conditional on its productivity draw φ, a firm has the option to exit the market. Incumbent firms face an exogenous probability of death, δ, in each period.

Conditional on remaining in the market, the firm must decide its mode of export. We allow firms to export their varieties to the foreign market either *directly* or *indirectly*. Exporting via the direct mode is analogous to Melitz (2003) where firms pay a fixed per period export cost, f_{DX}, to set up firm-specific networks and facilities and incur iceberg trade costs, $\tau > 1$, to export their products. Here, we allow firms to indirectly export their varieties via intermediation technology. The technology enables them to avoid paying the fixed costs of exporting. However, the firm then incurs an iceberg cost, $\gamma > 1$, in addition to the trade costs. The parameter γ is interpreted as a cost of "forwarding" the variety to an intermediary firm. The parameter γ therefore captures the intermediation technology in this model and is the only feature through which our model differs from Melitz (2003). This is the simplest possible way to introduce intermediation technology without explicitly modeling the intermediary firms.[3]

Given consumer preferences and market structure, prices are constant markups over marginal cost. The price of a firm with productivity φ in the domestic market is $p_d^j(\varphi) = \frac{1}{\rho\varphi}$, with $j = \{H, F\}$. Firms that directly export from market j charge $p_{DX}^j(\varphi) = \frac{\tau}{\rho\varphi}$. The price of varieties that are indirectly exported is $p_{IX}^j(\varphi) = \frac{\tau\gamma}{\rho\varphi}$. Notice that indirect export leads to double marginalization. All the varieties produced by active firms are sold in both markets and the revenues the firm obtains depends on its export mode. The revenue expressions for each of the three activities are:

$$r_d^j(\varphi) = R^j \left(\frac{p_d^j(\varphi)}{P^j} \right)^{1-\sigma} \tag{1}$$

$$r_{DX}^j(\varphi) = R^{-j} \left(\frac{p_{DX}^j(\varphi)}{P^{-j}} \right)^{1-\sigma} \tag{2}$$

$$r_{IX}^j(\varphi) = R^{-j} \left(\frac{p_{IX}^j(\varphi)}{P^{-j}} \right)^{1-\sigma}, \tag{3}$$

[3] The qualitative predictions of the model do not change if we explicitly introduce symmetric intermediary firms who equally divide the total indirect export revenue. A free entry condition for the intermediary sector would determine the total number of intermediary firms. The γ parameter would be replaced with intermediary firms' markup over the price such that the indirectly exported varieties would be double marginalized. One could also imagine a model with heterogeneous producers matching with heterogeneous intermediary firms. However, in our data, we only observe direct exporters and intermediary firms in our model; we do not have information on the indirect exporters. We therefore do not complicate the analytical framework by introducing heterogeneous intermediary firms. Finally, note that it is likely that there is additional cost for the match between indirect exporting firms and the intermediaries to occur, thereby giving rise to firms serving purely domestic market. As long as the indirect export cutoff is more or less same across countries, the qualitative predictions of the current model would still hold.

where $-j$ denotes j's trading partner, P^j and R^j is country $j's$ price index and national income (or total expenditure) respectively.

The model yields two cutoff conditions that pin down the firms engaging in indirect exporting and the firms that engage in direct exporting. The first cutoff (φ_d^{*j}) defines an indifference condition where the least productive firm earns operating profits from domestic sales and indirect exporting to exactly cover its fixed costs of production. The second cutoff condition (φ_{DX}^{*j}) is the marginal firm that is just indifferent between directly and indirectly exporting. These cutoffs conditions are given by[4]:

$$\pi^j(\varphi_d^{*j}) = \pi_d^j(\varphi_d^{*j}) + \pi_{IX}^j(\varphi_d^{*j}) = \frac{r_d^j(\varphi_d^{*j}) + r_{IX}^j(\varphi_d^{*j})}{\sigma} - f = 0 \tag{4}$$

and

$$\pi_{DX}^j(\varphi_{DX}^{*j}) = \pi_{IX}^j(\varphi_{DX}^{*j}) \Longleftrightarrow \frac{r_{DX}^j(\varphi_{DX}^{*j})}{\sigma} - f_{DX} = \frac{r_{IX}^j(\varphi_{DX}^{*j})}{\sigma} \tag{5}$$

where $\pi_d^j(\varphi), \pi_{IX}^j(\varphi)$ and $\pi_{DX}^j(\varphi)$ denotes profits from domestic market, indirect exporting, and direct exporting respectively. The free entry condition requires that the present value of expected profit from entry must be equal to the entry cost, f_e:

$$V_j = \frac{[1 - G(\varphi_d^{*j})]}{\delta} \cdot \left[\overline{\pi}_d^j + \chi_{IX}^j \cdot \overline{\pi}_{IX}^j + \chi_{DX}^j \cdot \overline{\pi}_{DX}^j\right] = \left[1 - G(\varphi_d^{*j})\right] \cdot \frac{\overline{\pi}^j}{\delta} = f_e \ , \tag{6}$$

where $\overline{\pi}_d$ is the average profit across firms from domestic market, $\overline{\pi}_{IX}$ is the average profit from indirect exporting, and $\overline{\pi}_{DX}$ is the average profit from direct exporting. χ_{IX} is the probability of indirect exporting, conditional on successful entry, and χ_{DX} is the probability of direct exporting, conditional on successful entry. It then follows that $\frac{\overline{\pi}}{\delta}$ denotes the present value of average expected profit of firms conditional on successful entry, while $1 - G(\varphi_d^*)$ is the probability of successful entry. In equilibrium, the goods market must be cleared in each country, which amounts to the requirement that total expenditure in country j equals the sum of domestic and foreign firms' revenue from market j:

$$\left[M_j \cdot r_d^j(\widetilde{\varphi}_d^{*j}) + M_{-j} \cdot \chi_{IX}^{-j} \cdot r_{IX}^{-j}(\widetilde{\varphi}_{IX}^{*-j}) + M_{-j} \cdot \chi_{DX}^{-j} \cdot r_{DX}^{-j}(\widetilde{\varphi}_{DX}^{*-j})\right] = R_j = L_j \tag{7}$$

[4] We impose parameter restrictions so that more productive firms choose to export directly their varieties,

$$\left(\frac{f_{DX}}{f}\right)^{\frac{1}{\sigma-1}} \left(\frac{\left(1 + (\tau\gamma)^{1-\sigma}\right)}{\left(1 - (\gamma)^{1-\sigma}\right)}\right)^{\frac{1}{\sigma-1}} \tau > 1.$$

This assumption comes from equation (9) below.

where M_j denotes the number of firms in country j, and $\widetilde{\varphi}^*$ is defined as weighted average productivity[5] such that $r(\widetilde{\varphi}^*)$ denotes the average revenue among the firms within a corresponding group.

When countries are symmetric (relaxed below) in every dimension, cutoff productivity conditions in equations (4) and (5) can be solved for each cutoff productivity as:

$$\varphi_d^* = \frac{(\sigma f)^{\frac{1}{\sigma-1}}}{(1+(\tau\gamma)^{1-\sigma})^{\frac{1}{\sigma-1}}\,\rho P R^{\frac{1}{\sigma-1}}} \tag{8}$$

$$\varphi_{DX}^* = \left(\frac{f_{DX}}{f}\right)^{\frac{1}{\sigma-1}} \left(\frac{\left(1+(\tau\gamma)^{1-\sigma}\right)}{(1-(\gamma)^{1-\sigma})}\right)^{\frac{1}{\sigma-1}} \tau\varphi_d^*. \tag{9}$$

As $\gamma \to \infty$, indirectly exported goods become prohibitively expensive such that no product would be sold via intermediaries; in this case, the model collapses to Melitz (2003). Our extension therefore provides a general framework for understanding the role of intermediaries in facilitating trade. Firms with productivities that lie in the interval $[\varphi_d^*, \varphi_{DX}^*]$ endogenously choose intermediation to access the foreign market. They avoid the fixed cost of exporting by incurring the additional cost γ. Intermediaries reduce transaction costs and exploit increasing returns to scale in a given market. The set of the most productive firms $\varphi > \varphi_{DX}^*$ are productive enough to pay the direct export fixed cost and avoid the double marginalization due to intermediary technology.

We define our welfare measure to be the country's real wage. When the nominal wage level is equalized across countries and normalized to one, the inverse of the price level is equivalent to real wage. The welfare level is then written from equation (8) as :

$$W = P^{-1} = \left[\left(\frac{R}{\sigma f}\right)^{\frac{1}{1-\sigma}} \frac{1}{\rho}\frac{1}{\varphi_d^*}\left(1+(\tau\gamma)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}\right]^{-1} \tag{10}$$

For given parameter values, it is clear that the welfare of the economy depends not only on the domestic cutoff level, φ_d^*, but also on the term $\left(1+(\tau\gamma)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ which captures the role of intermediaries. Intermediaries generate a tradeoff between efficiency loss in resource reallocation and variety gains; they enable less productive firms to access foreign markets but this leads to a less effecient allocation of resources across manufacturers. However, the presence of intermediaries results in a proliferation of varieties to consumers. In Melitz (2003),

[5] Specifically, we define the weighted average productivities as $\widetilde{\varphi}_d^{*j} = \left[\frac{1}{1-G(\varphi_d^{*j})}\int_{\varphi_d^{*j}}^{\infty} \varphi^{\sigma-1}\cdot g(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}$ for all domestic varieties, $\widetilde{\varphi}_{IX}^{*j} = \left[\frac{1}{G(\varphi_{DX}^{*j})-G(\varphi_d^{*j})}\int_{\varphi_d^{*j}}^{\varphi_{DX}^{*j}} \varphi^{\sigma-1}\cdot g(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}$ for indirectly exported varieties, and $\widetilde{\varphi}_{DX}^{*j} = \left[\frac{1}{1-G(\varphi_{DX}^{*j})}\int_{\varphi_{DX}^{*j}}^{\infty} \varphi^{\sigma-1}\cdot g(\varphi)d\varphi\right]^{\frac{1}{\sigma-1}}$ for directly exported varieties.

while there are always aggregate gains from trade, the net contribution of each channel will depend on parametric assumptions. For instance, Baldwin and Forslid (2006) have shown that in the standard heterogeneous firm model, if productivity follows the Pareto distribution and the fixed costs of exporting exceed production, trade will result in a loss of product variety for consumers as foreign exporters displace domestic varieties. Nevertheless, there are of course gains from trade because the productivity channel outweighs the decline in variety. Introducing intermediaries in this framework implies that if productivity is Pareto, opening to trade always brings an increase in the total number of varieties irrespective of the size of the fixed cost of exporting (see Appendix A3). Thus, in this special case, our model emphasizes gains from trade occuring through the variety channel in a manner that is similar to the symmetric firm model of Krugman (1980). However, we note that this result is sensitive to our assumption that the fixed costs of indirect exporting are zero when in practice they may not be.

By defining the ratio of indirect exports to direct exports, υ, as:

$$\upsilon = \frac{\text{tot indirect exports}}{\text{tot direct exports}} = \frac{\int_{\varphi_d^*}^{\varphi_{DX}^*} R\left(\frac{p_{IX}(\varphi)}{P}\right)^{1-\sigma} g(\varphi)d\varphi}{\int_{\varphi_{DX}^*}^{\infty} R\left(\frac{p_{DX}(\varphi)}{P}\right)^{1-\sigma} g(\varphi)d\varphi} = \left(\frac{Z(\varphi_d^*)}{Z(\varphi_{DX}^*)} - 1\right)\gamma^{1-\sigma} \quad (11)$$

where $Z(\varphi^*) = \int_{\varphi^*}^{\infty} \varphi^{\sigma-1} g(\varphi)d\varphi$ with $Z'(\varphi^*) < 0$, we can analyze how this ratio would respond to trade liberalization.

Proposition 1 *Declines in the variable costs of trade, τ, and declines in the fixed costs of exporting, f_{DX}, both lead to a decrease in the export cutoff and an increase in the domestic cutoff. This reduces the ratio of indirect to direct exports in both cases. That is, lowering the variable and fixed costs of exporting reduces the fraction of exports that indirectly passes through intermediaries.*

Proof. See Appendix. ■

As is the case in Melitz (2003), trade liberalization leads to resource reallocation toward more productive firms and makes it easier for manufacturers to participate in direct exporting. As a result, the share of exports handled by intermediary firms declines. Conversely, as the difficulty of accessing markets through larger fixed and/or variable trade costs increases, intermediation plays a larger role in aggregate trade flows. Thus, this model captures the intuition behind models that explain why intermediaries arise in equilibrium.

Furthermore, we can establish the comparative statics in the indirect export ratio regarding the changes in γ. As intermediary technology improves (decrease in γ), less productive firms can now benefit from indirect exporting and it results in a lower domestic cutoff. At the same time, marginal firms that found indifferent between indirect exporting and direct exporting earlier would switch to indirect exporting due to higher profitability of indirect

exporting with lower γ. As a result, the indirect export ratio to direct export would increase. This is summarized in the following proposition.

Proposition 2 *Improvement in intermediary technology implied by a decrease in γ results in an increase in the ratio of indirect to direct exporting.*

Proof. See Appendix ■

In order to take the predictions of the model to the data, we derive a multiple-country version of the model which allows for asymmetric countries. Countries will vary in their fixed costs of exporting (f_{DXj}) and their trade costs (τ_j), as well as country size in terms of expenditure (R_j). For the home country, there is now one common domestic cutoff condition which states that the sum of operating profits from home market and indirect exports to all partner j countries exactly covers the fixed costs of production:

$$R^H(\rho\varphi_d^* P^H)^{\sigma-1} + \sum\nolimits_{j\neq H} R^j(\frac{\rho\varphi_d^*}{\tau_j\gamma}P^j)^{\sigma-1} = \sigma f$$

The cutoff for exporting directly to country j (φ^*_{DXj}) is given by indifference condition between direct exporting and indirect exporting to that country:

$$\pi_{DXj}(\varphi^*_{DXj}) = \pi_{IXj}(\varphi^*_{DXj}) \Longleftrightarrow \frac{r_{DXj}(\varphi^*_{DXj})}{\sigma} - f_{DXj} = \frac{r_{IXj}(\varphi^*_{DXj})}{\sigma}$$

Accordingly, the cutoff level to export directly to any given country j is determined by country-specific fixed and variable trade costs as well as market size:

$$\varphi^*_{DXj} = \frac{\tau_j}{\rho P^j}\left[\frac{\sigma f_{DXj}}{R^j\,(1-\gamma^{1-\sigma})}\right]^{\frac{1}{\sigma-1}} \tag{12}$$

Analogous to equation (11), we can define the ratio of indirect to direct exports to destination country j as :

$$\upsilon_j = \frac{\text{total indirect exports to country } j}{\text{total direct exports to country } j} = \left(\frac{Z(\varphi_d^*)}{Z(\varphi^*_{DXj})} - 1\right)\cdot\gamma^{1-\sigma} \tag{13}$$

Proposition 3 *Other things being equal, the share of exports via the intermediation technology will be larger in countries with (i) smaller market size, (ii) higher variable trade costs, or (iii) higher fixed costs of exporting.*

Proof. Differentiating equation (12), we get (i) $\partial\varphi^*_{DXj}/\partial R^j < 0$, (ii) $\partial\varphi^*_{DXj}/\partial\tau_j > 0$, and (iii) $\partial\varphi^*_{DXj}/\partial f_{DXj} > 0$. Since $Z^{'}(\varphi^*) < 0$, $\partial\upsilon_j/\partial\varphi^*_{DXj} > 0$ for fixed φ_d^*, and thus we conclude that (i) $\partial\upsilon_j/\partial R^j < 0$, (ii) $\partial\upsilon_j/\partial\tau_j > 0$, and (iii) $\partial\upsilon_j/\partial f_{DXj} > 0$. ■

That is, equation (13) coupled with equation (12) yields a prediction that the share of intermediary exports to a country j will depend on its country size, variable trade costs and

the fixed costs of exporting. the share of exports via the intermediation technology will be larger in (i) smaller countries, (ii) countries that are geographically farther away from Home country or have higher tariffs, or (iii) countries that have higher fixed costs of exporting. Below, we use detailed firm-level export data from China to verify these predictions.[6]

3. Data

Our data analysis uses Chinese data that record the census of firm-level import and export transactions across products and countries.[7] Products are classified at the eight-digit HS level. We observe values and quantities for each firm-product-market transaction. The data do not contain information about domestic production or characteristics of the firms and so we cannot assign a primary industry to identify if the firm is a manufacturer or a wholesaler, distributer and/or intermediary. We therefore identify the set of intermediary firms based on Chinese characters that have the English-equivalent meaning of "importer", "exporter", and/or "trading" in the firm's name.[8] This assignment is of course imperfect, but we believe that we will underestimate the importance of intermediaries in operating in China for two reasons. First, intermediaries could have names that do not have the phrases "importer/exporter" or "trading" in their names. Second, the direct exporters may rely on foreign intermediary partners in their transactions (e.g., see Feenstra and Hanson (2004)) who we cannot observe.

One issue that complicates our analysis is that the Chinese government directly controlled the set of firms with direct trading rights prior to China's entry into the WTO in December 2001. The WTO mandated that China liberalize the scope and availability of licenses so that within three years after accession, *all* enterprises would have the right to import and export all goods. At the time of the WTO entry, only wholly Chinese-invested firms with registered capital exceeding RMB 5 million could obtain direct trading rights. In the second year after accession, the minimum capital requirement required for direct trading

[6] On the contrary, Felbermayr and Jung (2008) predicts that the share of indirect exports relative to direct exports is uncorrelated with any gravity type country characteristics. The difference comes from the fact that our model considers (implicitly) domestic intermediaries operating in multiple countries while their model takes intermediaries as importer country specific. As a result, in Felbermayr and Jung (2008), indirect export cutoff moves along the gravity type country characteristics in the same direction as direct export cutoff, offsetting any effect on the indirect exports ratio to direct exports. When domestic intermediaries operate in multiple markets (as emphasized in empirical findings in section 4), however, the lower bound productivity level of indirectly exported goods will be invariant across countries as long as the marginal cost of introducing additional variety is nil, with only the upper bound (hence, direct export cutoff) varying across countries, thereby yielding gravity type predictions in the current model.

[7] Similar data has been used by Manova and Zhang (2009). One concern that inevitably arises with Chinese data is its quality. We checked the aggregate import and export values against those reported in the Comtrade data. The two datasets match remarkably well. Total exports in 2005 within the transactions data are $771.53 billion compared to $761.95 billion in Comtrade and at the HS2 level, the databases report similar values as well.

[8] Specifically, we search for Chinese characters that mean "trading" and "import/export". In pingyin (romanized Chinese), these phrases are: "jin4chu1kou3", "jing1mao4", "mao4yi4", "ke1mao4" and "wai4jing1".

was RMB 3 million, and this fell to RMB 1 million by 2004. By 2005, any firm that wished to directly trade with foreign partners was free to do so. As a result of this complication, our analysis uses a single cross-section of the data in 2005 when direct trading licenses had been effectively removed.

4. Empirical Results

4.1. Stylized Facts

We document a series of facts comparing the activity of intermediary and direct exporting firms. Table 1 reports the overall import and export values by firm type from 2000 to 2005. The figures illustrate China's phenomenal import and export growth during this period. Total exports originating from China grew 211 percent, while imports grew an equally remarkable 193 percent between 2000 and 2005. The share of intermediaries in imports and exports fell during this period, which is consistent with the model, but could also reflect in part the liberalization of import and export licenses discussed above. Nevertheless, intermediaries accounted for 22 and 18 percent of total Chinese exports and imports in 2005. Moreover, it is likely that our estimates understate the importance of intermediaries. Moreover, intermediaries play an important role in virtually all two-digit HS sectors: the share of intermediaries in the average HS2 sector is 30% with a 14% standard deviation. The overall numbers in Table 1 are therefore not driven by certain sectors. These figures in the aggregate data alone highlight the importance of intermediary firms.

Table 2 reports the total number of firms that import and export. This table also illustrates large increases in the number of globally engaged Chinese firms during this period. Total exporting firms more than doubled from approximately 63,000 firms in 2000 to 144,000 by 2005. Interestingly, the growth in the number of intermediary firms over this period *exceeded* the entry of direct exporters. This is suggestive evidence that despite the liberalization of direct trading rights, intermediary firms found it profitably to enter the market.[9]

Direct and intermediary firms differ along several notable and important dimensions. Intermediaries are more likely to engage in both importing and exporting relative to their counterparts that directly trade (table not shown). Table 3 reports overall firm-level summary statistics in 2005 in panel one, and statistics by firm type in panels two and three. Again, we choose this year because direct trading licenses had been abolished by this year. As is well known in transactions data, a small number of exceptionally large firms dominate trade statistics, so we focus on the median statistics. Panel two shows that the median di-

[9] Table 2 reports that the share of exports by intermediaries declines over time. This is consistent with the model's prediction: trade liberalization results in an increase share of direct exporters. However, as discussed in Section 3, we are unable to test formally this time-series propostion because of the importing license requirements prior to 2005.

rect firm exports 3 products to 3 destination markets. In contrast, the median intermediary exports 11 products to 6 countries. In row 4, we classify HS codes into one of 16 unrelated sectors.[10] The idea is to identify a firm's *core* activity (e.g., animal products, wood products, textiles, etc.). Not surprisingly, the median direct firm only exports products in one of these sectors. This is consistent with theoretical work in multiple-product firm models (e.g., Eckel and Neary (2009), Nocke and Yeaple (2006), or Bernard, Redding and Schott (2008)) who introduce core competencies in a model of multiple-product firms. Intermediary firms, however, handle products that span entirely unrelated sectors. The median intermediary exports products in 4 sectors.[11]

These statistics are broadly suggestive that intermediaries have a relative "country" focus–compared to direct firms, they export more products per country. However, the final row of Table 3 reports that the average intermediary is larger than its direct exporting counterpart. It is therefore not surprising that the summary statistics indicate that traders export more products and to more destination markets. In order to verify if trading firms have a relative country focus, we need to condition on firm size. Column 1 of Table 4 report the average export varieties per country (column 1) by direct and intermediary firms, conditional on a flexible quadratic polynomial in firm size (proxied by total export revenue).[12] The table shows that intermediary firms average 10.5 varieties per country compared to direct firms that export 8.3 varieties per country. In column 2, we include additional controls for ownership types and the results continue to hold–intermediary firms export more varieties per country than direct firms. These results are intuitive. Manufacturing firms are likely to possess a core competent product, while the model suggests that the role of intermediaries is to facilitate access to markets. Thus, intermediaries appear to be relative "specialists" of countries rather than products.

What types of products require intermediation? Figure 1 plots a histogram of the share of intermediary exports across the 5,034 HS6 codes. The histogram shows that virtually that intermediaries export virtually all products. The average intermediary share is 32.8% and only 6 percent of the HS6, or 302 codes, report intermediary shares of less than 1%. The two-digit HS sectors with the largest share of intermediary exports are: tobacco (HS 24, 99%), cereal (HS 10, 65%), ores (HS 26, 64%), live animals (HS 1, 63%) and explosives (HS 36, 56%). The five smallest are railway locomotives (HS 86, 3%), nickel (HS 75, 4%), nuclear reactors (HS 84, 9%) electrical machinery (HS 85, 9%) and semi-precious

[10] HS 01-05 "Animal and Animal Products"; HS 06-15 "Vegetable Products"; HS 16-24 "Foodstuffs"; HS 25-27 "Mineral Products"; HS 28-38 "Plastics/Rubbers"; HS 41-43 "Raw Hides, Skins, Leathers & Furs"; HS 44-49 "Wood and Wood Products"; HS 50-63 "Textile"; HS 64-67 "Footwear/Headgear"; HS 68-71 "Stone/Glass"; HS 72-83 "Metals"; HS 84-85 "Machinery/Electrical"; HS 86-89 "Transportation"; HS 90-97 "Miscellaneous"; HS 98-99 "Service".

[11] The patterns of these statistics are very similar if we focus attention only on direct and intermediary firms that are privately owned (i.e., excluding state-owned or foreign firms). The import statistics also appear very similar and are reported in the Appendix tables.

[12] The regression excludes the constant.

stones (HS 71, 11%). In Table 5, we correlate HS6 shares of intermediary exports with measures of product differentiation. Column 1 reports the correlation with the coefficient of price variation. The result shows that products that are more homogenous tend to have larger intermediary shares. In column 2, we report the correlation with the quality ladders proposed by Khandelwal (2009), and while the result is not statistically significant, the correlation is consistent with column 1. Both measures suggest that intermediaries are more likely to handle relatively more homogenous, or "commoditized" products. The magnitudes impy that a product with a coefficient of variation one standard deviation larger than the mean has only a 2 percentage points smaller intermediary share, or about a 6 percent (.02/.328) decline.

Within products, exports by intermediaries are more expensive than direct exporters. This is seen in Table 6 which compares unit values between firm types. In this table, we regress (log) unit values on an intermediary dummy and country-HS8 product-ownership pair fixed effects. We include ownership type in the fixed effect because of evidence that foreign firms charge higher prices relative to domestic firms (Wang and Wei, 2008). Column 1 indicates that exports by intermediaries are about 4.5 percent higher than direct exporters, and controlling for firm size in column 2 lowers the coefficient to 2.5 percent. There are two possible interpretations of this finding. The literal interpretation of the model would suggest this is consistent with the prediction of double marginalization for products forwarded by intermediaries. While the coefficient on the intermediary dummy does not have the structural interpretation of the γ parameter , the results are consistent with this interpretation.[13] Alternatively, if unit values proxy for quality, Table 6 is consistent with the quality-sorting role of intermediary firms. For instance, Feenstra and Hanson (2004) have shown that re-exports of Chinese products by Hong Kong intermediaries have higher markups. That is, intermediaries mitigate adverse selection problems by acting as gauranteers of quality.

4.2. Facilitating Trade

In Table 7, we examine the main predictions of the model: the share of intermediary exports are increasing in the fixed and variable costs of exporting to markets. We construct the share of intermediary exports in country-HS6 observations and correlate the sahres with gravity-type proxies for trade costs. We use the following regression model

$$s_{ch} = \alpha + X'_{ch}\beta + \varepsilon_{ch} \tag{14}$$

where s_{ch} is the share of intermediary exports from China to country c in HS6 code h and the X's contain proxies for trade costs. In column 1, we regress country-HS6 intermediary

[13] In the model, γ is the difference between the weighted average prices of direct and indirect exporters, rather than a comparison of simple averages across firm types.

share of exports on the distance to the country and the country's GDP. The coefficient on distance is positive, a variable cost, and the coefficient on GDP, a measure of market size, is negative. This is intuitive and accords with the model's predictions. Countries that are smaller and more distant rely relatively more on intermediaries for their imports from China. The results imply that doubling distance to China increases intermediary shares by 3.2 percentage points. Doubling market size results in a 2.2 percentage point decline in intermediary export shares. To get a sense of the magnitudes, the average HS6-level intermediary share is about 30 percent; thus, doubling distance to China increases intermediary shares to that country by about 10 percent. In column 2, we include the fraction of ethnic Chinese population with the country and find that intermediaries export relatively more to countries with fewer ethnic Chinese populations, although the coefficient is not significant at conventional levels.[14] This finding is also intuitive: Chinese firms will find it easier to export directly to countries with larger Chinese populations. This finding is related to Rauch and Trindade (2004) who show that bilateral trade flows are larger among countries with larger ethnic Chinese populations. Here, the results indicate that the share of exports through intermediaries is smaller in these countries. Presumably trade costs, which also encompass information barriers, are smaller between China and countries with a large number Chinese emigrants.

In column 3, we proxy for the fixed costs of exporting using the number of documents required by the country's customs authorities (obtained from the World Bank's Doing Business Report) in 2005. While admittedly crude, this variable, also used by Helpman, Melitz and Rubinstein (2008), potentially captures the fixed costs of exporting to a market. The coefficient on this variable is positive and statistically significant suggesting that more difficult to export markets are handled by relatively larger shares of intermediaries. The coefficients on market size and distance are also robust.

In column 4, we add the country's HS6-level MFN tariff rates as an additional variable cost proxy. According to the model, higher trade costs reduce the likelihood that less productive firms can cover the fixed costs of exporting and therefore will indirectly export products. The correlation between intermediary shares and tariffs is positive indicating that intermediaries are more important in country-product pairs with higher tariffs. The magnitudes indicate that an 10 percentage point increase in tariffs (roughly one standard deviation in our sample), holding other variables constant, would increase intermediary shares by .46 percent. This implies that raising tariffs by 10 percentage points would increase a product's intermediary export share would increase by about 15 percent (0.046/0.30).

Our baseline results in Table 7 are consistent with the predictions from the model. We now assess the sensitivity of the results through a series of robustness checks. In column 5, we

[14] Shares of ethnic Chinese populations are obtained from Ohio University's Shao Center Distribution of the Ethnic Chinese Population Around the World (http://cicdatabank.library.ohiou.edu/opac/population.php)

include country fixed effects in the baseline regression. This specification therefore identifies the parameters using only cross-product variation within a country. The coefficient on tariffs remains positive and significant, although not suprisingly, the magnitude attenuates. This is an extremely flexible regression which provides strong evidence that when Chinese firms face higher tariffs, a larger fraction of exports are sent via intermediaries.

In column 6, we remove shipments that are classified as processing and/or assembly trade since the fixed and variable trade costs for these shipments are likely to differ from ordinary exports. We see that the coefficients attenuate somewhat but remain statistically significant.

Fisman, Moustakerski and Wei (2008) present evidence that intermediaries who import from China into Hong Kong are sometimes used to evade tariffs, and that tariff evasion increases with tariff rates. Another concern with Hong Kong's trade is that a large fraction of China's exports to Hong Kong are re-exported to foreign markets (often by Hong Kong intermediaries, see Feenstra and Hanson (2004)). In column 7, we therefore exclude exports to Hong Kong; the results continue to hold.

Finally, in column 8 we exclude exports by state-owned enterprises. We exclude SOEs because the objective function of these firms may not be consistent with the model's assumptions. The magnitude on distance attenuates somewhat but the qualitative estimates remain similar to the previou columns. Thus, these sensitivity checks are consistent with the view that intermediaries handle a relatively larger share of exports in more "difficult-to-access" markets.

Overall, the results identify stylized facts of intermediaries. First, although intermediaries span wide variety of products, conditional on size, intermediaries appear to adopt a relative country focus by having exports concentrated relatively within countries than within products. Second, intermediaries export varieties with higher unit values which is suggestive of the quality-sorting role of intermediaries. Finally, the aggregate shares indicate that intermediaries are more likely to export to "tougher" to access markets, where toughness is captured by measures fixed and variable costs. These results are consistent with the transaction costs role of intermediaries developed in the model.

5. Conclusion

This paper presents the first evidence of the role of intermediary firms in facilitating trade across the full spectrum of exporting firms in China. We find that non-manufacturing mediate a substantial fraction of firm trade; in 2005, they mediated about 20% of China's aggregate trade. Intermediaries appear to adopt a relative country focus by having exports concentrated relatively within countries than within products. This "country" specialization is reflected in aggregate statistics which suggest that intermediaries are more likely to export to "tougher" to access markets.

This paper demonstrates that further research on intermediary exporting and importing firms is warranted for several reasons. First, the recent literature on firm heterogeneity within international trade has largely ignored the role of intermediaries. From a welfare perspective, the introduction of intermediaries within heterogenous firm models can potentially alter the compositions of the gains from trade by placing a larger emphasis on varieties. Moreover, our model predicts that small firms endogenously choose to export via intermediaries; this implies that small firms can, and do, access foreign markets even though they are unable to cover the fixed costs of direct exporting. Thus, one implication of the model is that firms can benefit from importing products even if they do not directly import products. The presence of intermediaries implies that analyzing firm-level imports may understate the benefits from importing that arise at the sector-level because of intermediaries (see Goldberg, Khandelwal, Pavcnik and Topalova (2009)).

Intermediaries could therefore serve as vehicles for small firms to learn their potential in foreign markets, either by learning about their own productivity, or about foreign demand. In subsequent periods, this may enable them to select directly in to the export market. Thus, the matching of firms to intermediaries may be important for understanding the growth of the extensive margins of trade. It could also explain why countries enact policies to encourage the formation of intermediaries (e.g., Japan and the U.S.). We believe that the model presented in this paper, as well as the new stylized facts, could be a launching point for future research on intermediaries.

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A. Appendix

A.1 Proof of Proposition 1

The proof exploits cutoff condition and free entry condition. Before proceeding, we lay out two lemmas that provide a useful transformation of free entry condition.

Lemma 4 *A sum of revenue from domestic sales and indirect exporting, for a given productivity level, is a function of relative productivity level to the domestic cutoff productivity level. Similarly, a (hypothetical) difference between the revenue from indirect exporting and direct exporting, for a given productivity level, is a function of relative productivity level to the cutoff productivity level for direct exporting .*

Proof. The total revenue from domestic sales and indirect exporting for a firm with productivity φ is

$$r_d(\varphi) + r_{IX}(\varphi) = R(P\varphi\rho)^{\sigma-1}\left(1 + (\tau\gamma)^{1-\sigma}\right).$$

The ratio of total exporting revenues for two firms with different productivities can be expressed as:

$$\frac{r_d(\varphi) + r_{IX}(\varphi)}{r_d(\varphi') + r_{IX}(\varphi')} = \frac{R(P\varphi\rho)^{\sigma-1}\left(1 + (\tau\gamma)^{1-\sigma}\right)}{R(P\varphi'\rho)^{\sigma-1}\left(1 + (\tau\gamma)^{1-\sigma}\right)} = \left(\frac{\varphi}{\varphi'}\right)^{\sigma-1}.$$

In particular, when φ' is the domestic level φ_d^*, the above expression simplies to

$$r_d(\varphi) + r_{IX}(\varphi) = \sigma f \left(\frac{\varphi}{\varphi_d^*}\right)^{\sigma-1}.$$

because $r_d(\varphi_d^*) + r_{IX}(\varphi_d^*) = \sigma f$ from the cutoff condition in (4).

Similarly, we can write a difference between the indirect exporting revenue and direct exporting revenue for a firm with productivity φ as:

$$r_{DX}(\varphi) - r_{IX}(\varphi) = R(P\varphi\rho)^{\sigma-1}\left(1-\gamma^{1-\sigma}\right)\tau^{1-\sigma}$$

Therefore, the ratio of the difference in direct and indirect exporting revenues for different productivity levels can be expressed as :

$$\frac{r_{DX}(\varphi) - r_{IX}(\varphi)}{r_{DX}(\varphi') - r_{IX}(\varphi')} = \frac{R(P\varphi\rho)^{\sigma-1}\left(1-\gamma^{1-\sigma}\right)\tau^{1-\sigma}}{R(P\varphi'\rho)^{\sigma-1}\left(1-\gamma^{1-\sigma}\right)\tau^{1-\sigma}} = \left(\frac{\varphi}{\varphi'}\right)^{\sigma-1}$$

In particular, when φ' is the direct exporting cutoff level φ_{DX}^*, the above expression reduces to

$$r_{DX}(\varphi) - r_{IX}(\varphi) = \sigma f_{DX}\left(\frac{\varphi}{\varphi_{DX}^*}\right)^{\sigma-1}$$

because $r_{DX}(\varphi_{DX}^*) - r_{IX}(\varphi_{DX}^*) = \sigma f_{DX}$ from the cutoff condition (5). ■

Lemma 5 *The free entry condition is a function of the two cutoff productivity levels, or* $f_e = \frac{f}{\delta}K(\varphi_d^*) + \frac{f_{DX}}{\delta}K(\varphi_{DX}^*)$, *where* $K(\varphi) = \int_{\varphi}^{\infty}\left[\left(\frac{\theta}{\varphi}\right)^{\sigma-1} - 1\right]g(\theta)d\theta$.

Proof. By definition, average profit is expressed as:

$$\overline{\pi} = \frac{1}{M}\left[\begin{array}{c} \frac{M}{1-G(\varphi_d^*)}\int_{\varphi_d^*}^{\infty}\pi_d(\varphi)\,g(\varphi)d\varphi + \frac{M}{1-G(\varphi_d^*)}\int_{\varphi_d^*}^{\varphi_{DX}^*}\pi_{IX}(\varphi)\,g(\varphi)d\varphi \\ +\frac{M}{1-G(\varphi_d^*)}\int_{\varphi_{DX}^*}^{\infty}\pi_{DX}(\varphi)\,g(\varphi)d\varphi \end{array}\right],$$

where M is total number of active firms. The above expression can be rewritten as :

$$\begin{aligned}\overline{\pi} &= \left[\begin{array}{c} \frac{1}{1-G(\varphi_d^*)}\int_{\varphi_d^*}^{\infty}\left[\pi_d(\varphi)+\pi_{IX}(\varphi)\right]g(\varphi)d\varphi \\ +\frac{1}{1-G(\varphi_d^*)}\int_{\varphi_{DX}^*}^{\infty}\left[\pi_{DX}(\varphi)-\pi_{IX}(\varphi)\right]g(\varphi)d\varphi \end{array}\right] \\ &= \left[\begin{array}{c} \frac{1}{1-G(\varphi_d^*)}\int_{\varphi_d^*}^{\infty}\left[\frac{r_d(\varphi)+r_{IX}(\varphi)}{\sigma} - f\right]g(\varphi)d\varphi \\ +\frac{1}{1-G(\varphi_d^*)}\int_{\varphi_{DX}^*}^{\infty}\left[\frac{r_{DX}(\varphi)-r_{IX}(\varphi)}{\sigma} - f_{DX}\right]g(\varphi)d\varphi \end{array}\right]\end{aligned}$$

The last equality holds from the cutoff conditions (4) and (5). Using the result from the Lemma 2, we can re-write the free entry conditions in equation (6) as:

$$f_e = \frac{f}{\delta}K(\varphi_d^*) + \frac{f_{DX}}{\delta}K(\varphi_{DX}^*), \tag{15}$$

where $K(\varphi) = \int_{\varphi}^{\infty}\left[\left(\frac{\theta}{\varphi}\right)^{\sigma-1} - 1\right]g(\theta)d\theta$ is a decreasing function in φ. ■

Remaining proofs are direct applications of the ones found in Appendix E in Melitz (2003).

A.1.1 Changes in the fixed exporting cost, f_{DX}

Differentiating the cutoff condition in (9) with respect to f_{DX}, we get $\partial\varphi^*_{DX}/\partial f_{DX} = (\varphi^*_{DX}/\varphi^*_d)\,\partial\varphi^*_d/\partial f_{DX} + [1/(\sigma-1)]\,\varphi^*_{DX}/f_{DX}$. Plugging this result into free entry condition in equation (15) after differentiating it with respect to f_{DX}, we obtain that $\partial\varphi^*_d/\partial f_{DX} < 0$ and $\partial\varphi^*_{DX}/\partial f_{DX} > 0$.

A.1.2 Changes in variable trade cost, τ

Differentiating the cutoff condition in (9) with respect to τ, we get $\partial\varphi^*_{DX}/\partial\tau = (\varphi^*_{DX}/\varphi^*_d)\,\partial\varphi^*_d/\partial\tau + \left[1/(1+(\tau\gamma)^{1-\sigma})\right]\varphi^*_{DX}/\tau$. Plugging this result into free entry condition in equation (15) after differentiating it with respect to τ, we obtain that $\partial\varphi^*_d/\partial\tau < 0$ and $\partial\varphi^*_{DX}/\partial\tau > 0$.

In both cases, declines in trade costs – either a fall in τ or f_{DX} – leads to an increase in domestic cutoff level and a decrease in direct exporting cutoff level. Since $Z'(\varphi^*) < 0$ in equation (11), indirect export ratio declines following trade liberalization.

A.2 Proof of Proposition 2

We are interested in the sign of the derivative of equation (11) with respect to γ, $\partial\upsilon/\partial\gamma = (1-\sigma)\left(\frac{Z(\varphi^*_d)}{Z(\varphi^*_{DX})}-1\right)\cdot\gamma^{-\sigma} + \partial\frac{Z(\varphi^*_d)}{Z(\varphi^*_{DX})}/\partial\gamma\cdot\gamma^{1-\sigma}$. To sign this derivative we need to check how domestic and direct export cutoff change as γ varies. Differentiating the cutoff condition in (9) with respect to γ, we get $\partial\varphi^*_{DX}/\partial\gamma = (\varphi^*_{DX}/\varphi^*_d)\,\partial\varphi^*_d/\partial\gamma - \left[\gamma^{-\sigma}/(1-\gamma^{1-\sigma})\right]\varphi^*_{DX}$. Plugging this result into free entry condition in equation (15) after differentiating it with respect to γ, we conclude that $\partial\varphi^*_d/\partial\gamma > 0$ and $\partial\varphi^*_{DX}/\partial\gamma < 0$. Since $Z'(\varphi^*) < 0$ in equation (11), $\partial\frac{Z(\varphi^*_d)}{Z(\varphi^*_{DX})}/\partial\gamma < 0$, and thus $\partial\upsilon/\partial\gamma < 0$.

A.3 Solving the Model Under Pareto Distribution

In this section, we solve the model under the assumption that productivity is distributed Pareto, $G(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^k$, where $k > \sigma - 1$, and the density function is given by $g(\varphi) = kb^k\varphi^{-k-1}$. Under this assumption, the equilibrium domestic cutoff level is obtained from free entry condition in (equation (15)) and the cutoff condition (equation (9)) :

$$\varphi^*_d = D\cdot\left[1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\cdot\tau^{-k}\cdot z(\gamma)^{-k}\right]^{\frac{1}{k}}, \tag{16}$$

where $z(\gamma) = \left(\frac{1+(\tau\gamma)^{1-\sigma}}{1-\gamma^{1-\sigma}}\right)^{\frac{1}{\sigma-1}} > 1$ and $D = \left[\frac{(\sigma-1)b^k}{k-\sigma+1}\cdot\frac{f}{\delta}\cdot\frac{1}{f_e}\right]^{\frac{1}{k}}$. Substituting equation (16) into equation (10) gives the equilibrium price level of :

$$P^* = D'\cdot\left[1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\cdot\tau^{-k}\cdot z(\gamma)^{-k}\right]^{\frac{-1}{k}}\left(1+(\tau\gamma)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}. \tag{17}$$

where $D' = D^{-1}\left(\frac{R}{\sigma f}\right)^{\frac{1}{1-\sigma}}\frac{1}{\rho}$. Since we assumed that countries are symmetric, the number of firms in each country is identical and can be solved by substituting equation (16) into equation (7)[15] :

$$M_H^* = M_F^* = \frac{R}{\sigma f}\cdot\frac{k+1-\sigma}{k}\left(1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\tau^{-k}z(\gamma)^{-k}\right)^{-1} \tag{18}$$

The total number of varieties available to consumers in each market is therefore $M_{tot}^* = 2M_H^*$: the total number of varieties available in each country will be two times the number of firms in the country because every firm has access to the foreign market. The total number of varieties in the open economy will exceed the autarky level, irrespective of the fixed export cost :

$$M_{autarky} = \frac{R}{\sigma f}\cdot\frac{k+1-\sigma}{k} < M_{tot}^*$$

because $(1+(\frac{f_{DX}}{f})^{\frac{-k+\sigma-1}{\sigma-1}}\tau^{-k}z(\gamma)^{-k}) < 2$ from the assumption $(\frac{f_{DX}}{f})^{\frac{1}{\sigma-1}}z(\gamma)\tau > 1$ (see footnote 4). This contrasts with Baldwin and Forslid (2006) who show that under the Pareto assumption, the Melitz (2003) model could result in a decline in total varieties available for consumers following opening trade if $f_{DX} > f$.

How does this model compare to the Melitz (2003)? As shown in Baldwin and Forslid (2006), Melitz model under the Pareto distribution yields following cutoff level and price index equations :

$$\varphi_d^{**} = D\cdot\left[1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\cdot\tau^{-k}\right]^{\frac{1}{k}} \tag{19}$$

$$P^{**} = D'\cdot\left[1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\cdot\tau^{-k}\right]^{\frac{-1}{k}}. \tag{20}$$

and the total number of firms in each country and total number of varieties available to consumers in each market are :

$$M_H^{**} = M_F^{**} = \frac{R}{\sigma f}\cdot\frac{k+1-\sigma}{k}\left(1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\tau^{-k}\right)^{-1} \tag{21}$$

$$M_{tot}^{**} = M_H^{**} + \chi_{DX}M_F^{**} = \frac{R}{\sigma f}\cdot\frac{k+1-\sigma}{k}\left(\frac{1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k}{\sigma-1}}\tau^{-k}}{1+\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}}\tau^{-k}}\right) \tag{22}$$

[15] Detailed steps for the derivation of equation (18) are omitted here but available on request.

It is easily confirmed by comparing equations (16) and (19) that the current model with intermediaries yields lower domestic cutoff productivity level for given parameter values because even less productive firms can survive due to indirect exporting. On the other hand, the current model features a larger number of firms in each country than the standard model without intermediaries (see (18) and (21)) as well as larger number of total available varieties. The overall welfare comparison between two models then depends on whether or not the variety gains outweigh the potential loss of efficiency. This comparison in welfare between our model and Melitz (2003) reduces to comparing $(P^*)^{-1} \gtrless (P^{**})^{-1}$, or :

$$\overbrace{\left[1+(\tau\gamma)^{1-\sigma}\right]^{\frac{k}{\sigma-1}}-1}^{LHS} \gtrless \overbrace{\left(\frac{f_{DX}}{f}\right)^{\frac{-k+\sigma-1}{\sigma-1}} \cdot \tau^{-k} \cdot \left[1-(1-\gamma^{1-\sigma})^{\frac{k}{\sigma-1}}\right]}^{RHS} \tag{23}$$

It is not possible to sign this inequality without knowing parameter values. To get a feel for the results, we present a numerical similuation by assuming parameter values of $\tau = 1.3$, $\sigma = 3.5$, and $k = 3$. The trade cost parameter is an upper bound of cif-fob price ratio reported in Bernard, Jensen, and Schott (2006). The elasticity of substitution is the median value obtained from Broda and Weinstein (2004), and k is chosen to satisfy the regularity condition for Pareto distiribution that ensures the finite value of total revenues. Figure 2 presents the numerical results of the welfare gains from intermediaries. In general, LHS is bigger than RHS, implying that the presence of intermediaries brings welfare improvement to the economy: variety gain dominates efficiency loss. This is more so as γ decreases, reflecting the improvement in intermediation technology. Also, larger fixed cost for exporting amplifies the welfare gains because there is much more room for intermediaries to serve the economy via indirect exporting.

Tables

Aggregate Export and Import Values

Year	Total Value ($ million)	Direct Firms	Intermediary Firms	Intermediary Share
	(1)	(2)	(3)	(9)
Export Data				
2000	249,234	163,047	86,187	35%
2001	290,606	198,003	92,603	32%
2002	325,632	230,740	94,892	29%
2003	438,473	323,541	114,931	26%
2004	593,647	450,813	142,835	24%
2005	776,739	608,926	167,813	22%
Import Data				
2000	225,087	166,830	58,256	26%
2001	266,074	197,387	68,687	26%
2002	295,155	225,009	70,146	24%
2003	413,096	323,112	89,983	22%
2004	560,811	447,010	113,802	20%
2005	661,059	539,184	121,875	18%

Notes: Table reports summary statistics from China's transactions data. All values are in millions of U.S. dollars. See text for definition of intermediary firms. Source: Authors' calculations from the China's transactions data.

Table 1: Total Chinese Export and Import Values, by Firm Type, 2000-2005

Exporting and Importing Firms

Year	Total Firms	Direct Firms	Intermediary Firms
	(1)	(2)	(5)
Export Data			
2000	62,768	53,759	9,009
2001	68,487	58,672	9,815
2002	78,612	67,750	10,862
2003	95,688	81,724	13,964
2004	120,590	100,172	20,418
2005	144,027	121,928	22,099
Import Data			
2000	62,786	54,420	8,366
2001	67,588	58,530	9,058
2002	77,303	66,990	10,313
2003	87,934	75,425	12,509
2004	102,242	86,062	16,180
2005	113,454	96,255	17,199

Notes: Table reports the number of firms in China's transactions. See text for definition of intermediary firms. Source: Authors' calculations from the China's transactions data.

Table 2: Total Exporting and Importing Firms, by Firm Type, 2000-2005

Firm-Level Summary Statistics

Export Data

	All Firms (1)		Direct Firms (2)		Intermediary Firms (3)	
	Mean	Median	Mean	Median	Mean	Median
Firms	144,027		121,928		22,099	
Products	15.9	4	10.6	3	45.3	11
Countries	8.0	3	6.9	3	14.3	6
Sectors[a]	2.51	1	2.07	1	4.88	4
Value per Shipment	306,741	58,153	329,613	62,659	180,549	42,978

Notes: Table reports export statistics for 2005. [a]Sectors are classified as follows: HS 01-05 "Animal and Animal Products"; HS 06-15 "Vegetable Products"; HS 16-24 "Foodstuffs"; HS 25-27 "Mineral Products"; HS 28-38 "Plastics/Rubbers"; HS 41-43 "Raw Hides, Skins, Leathers & Furs"; HS 44-49 "Wood and Wood Products"; HS 50-63 "Textile"; HS 64-67 "Footwear/Headgear"; HS 68-71 "Stone/Glass"; HS 72-83 "Metals"; HS 84-85 "Machinery/Electrical"; HS 86-89 "Transportation"; HS 90-97 "Miscellaneous"; HS 98-99 "Service". Source: Authors' calculations from Chinese transactions data.

Table 3: Firm-Level Summary Statistics for Exporting Firms, 2005

Margins, by Firm Type

Firm Type	Varieties per Country	Varieties per Country	Product Herfindahl	Product Herfindahl
Direct Firms	8.34	10.03	0.48	0.44
Intermediary Firms	10.56	11.98	0.28	0.27
Non-parametric firm-size controls	yes	yes	yes	yes
Ownership FEs	no	yes	no	yes
Adjusted R-squared	0.24	0.24	0.73	0.73
Observations	144,027	144,027	144,027	144,027

Notes: Column 1 regresses the firm-level products per country on firm type and a quartic polynomial of firm-size controls. Column 2 includes ownership dummies. The dependent variable in Column 3 and 4 regress firm's herfindahl index computed over products. All coefficients are statistically significant at the 1 percent level and so standard errors have been supressed.

Table 4: Margins, by Firm Type

Intermediary Share of Exports and Product Characteristics

	Intermediary Share of Exports	Intermediary Share of Exports
Coefficient of Price Variation	-0.003 ***	
	0.001	
Quality Ladder from Khandelwal (2009)		-0.006
		0.004
Observations	5,034	3,254

Notes: Table regresses intermediary share of exports at the HS6 level on the HS6 coefficient of price variation (column 1) and the HS6-level quality ladder (column 2) taken from Khandelwal (2009). The loss of observations in column 2 is due to the fact that the quality ladder is not available for all HS6 codes.

Table 5: Intermediary Share of Exports and Product Characteristics

Unit Value Differentials

	Log Export Unit Value	
Intermediary Dummy	0.045 ***	0.025 ***
	0.006	0.005
Non-parametric firm-size controls	yes	yes
Country-HS8 Product-Ownership FEs	yes	yes
Adjusted R-squared	0.73	0.73
Observations	5,073,705	5,073,705

Notes: Table regresses unit values on intermediary dummy and controls in 2005. All regressions include country-HS product-ownership fixed effects. Standard errors are clustered by product. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 6: Unit Value Differentials

Intermediary Export Share and Country Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Distance	0.032 ***	0.022 ***	0.024 ***	0.020 ***		0.026 ***	0.028 ***	0.017 *
	0.008	0.007	0.007	0.008		0.007	0.008	0.009
Log GDP	-0.022 ***	-0.022 ***	-0.021 ***	-0.020 ***		-0.017 ***	-0.022 ***	-0.027 ***
	0.002	0.002	0.003	0.003		0.001	0.002	0.002
Log Chinese Population		-0.002	-0.002	-0.003 **				
		0.001	0.001	0.001				
# of Importing Procs			0.003 **	0.003 ***				
			0.001	0.001				
MFN Tariff				0.046 **	0.024 **			
				0.019	0.010			
HS6 FEs	yes	yes	yes	yes	yes	yes	yes	yes
Country FEs	no	no	no	no	yes	no	no	no
Adjusted R-squared	0.13	0.14	0.15	0.15	0.15	0.11	0.13	0.14
Observations	267,201	217,008	203,229	181,612	223,282	260,799	262,836	228,558

Notes: The dependent variable in each regression is the share of intermediary exports of total country-HS6 exports. Column 1 includes distance and market size as covariates. Column 2 adds the share of ethnic Chinese population, taken from Ohio University Shao Center's Distribution of the Ethnic Chinese Population Around the World. Column 3 includes the World Bank's Doing Business Report measure of the number of procedures required for importing a container. Column 4 includes the country's HS6 MFN tariff on Chinese products, obtained from WITS. Column 5 includes both HS6 and country fixed effects. Column 6 re-reruns column (1) by excluding exports classified as processing and/or assembly trade. Column 7 excludes exports to Hong Kong in the analysis. Column 8 excludes exports by state-owned enterprises. All standard errors clustered at the country level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

Table 7: Intermediary Shares and Country Characteristics

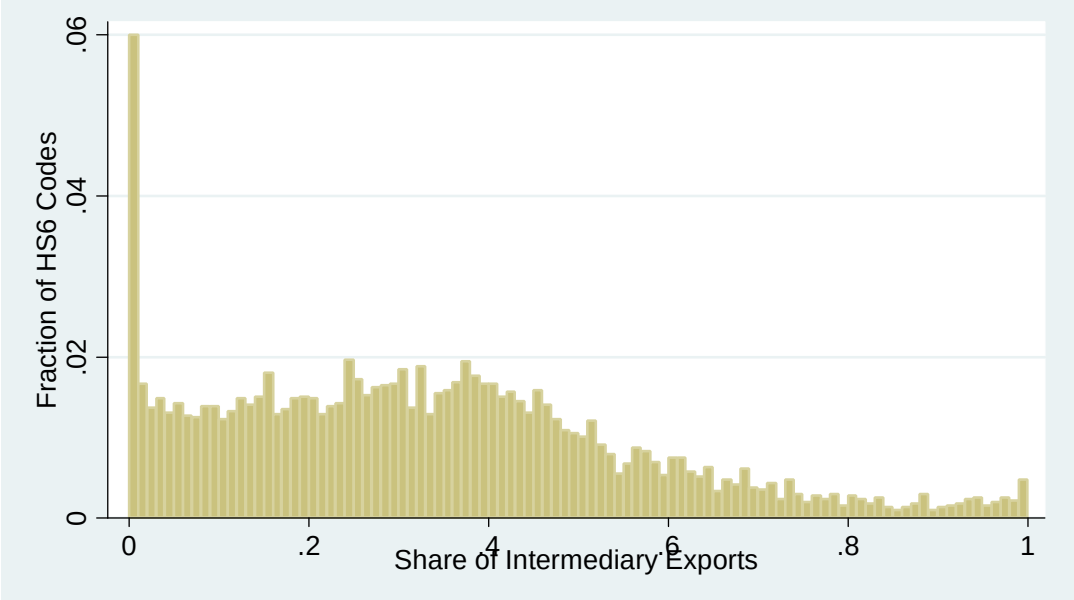


Figure 1: Distribution of Intermediary Export Shares, HS6 level

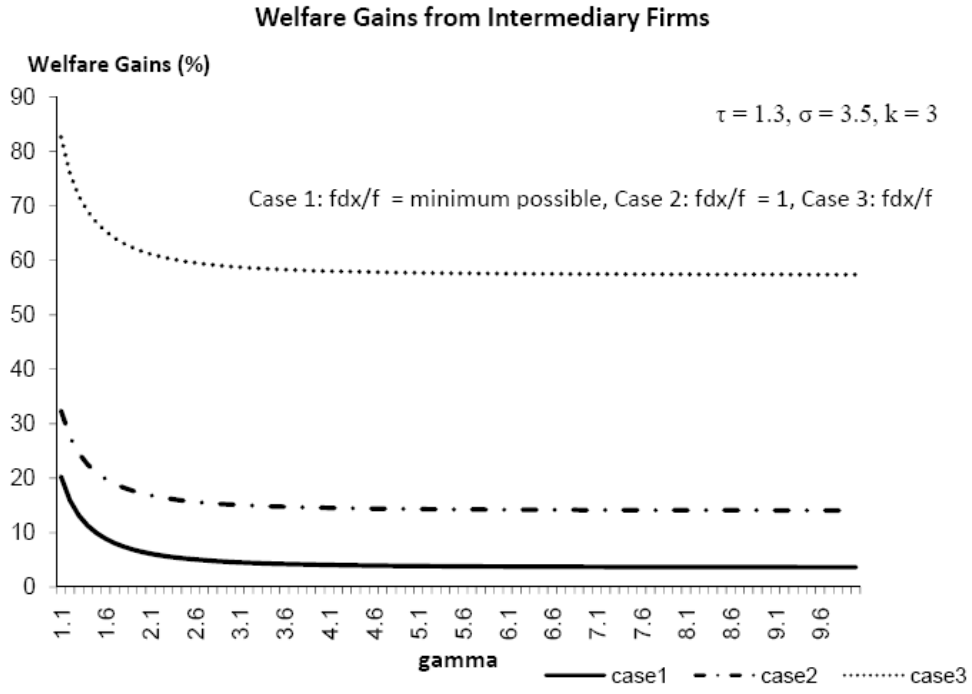


Figure 2: Welfare Gains from Intermediary Firms, Appendix Figure