

Quality Differentiation and Trade Intermediation*

Heiwai Tang[†]
Tufts University and LdA

Yifan Zhang[‡]
Lingnan University

June 15, 2011

Preliminary and Incomplete.

Abstract

Importers are often concerned about product quality when buying goods from developing countries. An extensive theoretical literature proposes that intermediaries can solve the "quality" problem by effectively verifying product quality for buyers. As such, trade intermediaries are expected to handle a larger share of exports of quality-differentiated products. Using Chinese product-level data and various measures of quality differentiation, we find, on the contrary, that the share of exports handled by intermediaries tends to be lower for more *vertically* differentiated products. Consistent with existing research, we do find that intermediaries handle proportionally more exports of more *horizontally* differentiated products and to more (physically or culturally) distant markets. To rationalize these findings, we develop a model that features heterogeneous product quality and two exporting modes – exporters can choose to export directly or indirectly through an intermediary. An exporter invests in quality verification of its products for foreign buyers under direct exporting, and outsources the verification tasks to an intermediary under indirect exporting. When contracts are incomplete, trade intermediaries underinvest in quality verification, giving rise to a negative correlation between quality differentiation and the prevalence of intermediation in equilibrium. The positive correlation between products' horizontal differentiation and trade intermediation, on the other hand, simply arises from the varying degrees of competition across markets.

Key Words Trade intermediation, vertical differentiation, product differentiation

JEL Classification Numbers: F12, L15

*We thank Jaebin Ahn, Pol Antras, Davin Chor, Yannis Ioannides, Hiau Looi Kee, Amit Khandelwal, Tommy Leung, and participants at the Midwest International Trade Meeting in Notre Dame, the RMET Meeting in Banff, and the Econometric Society Summer Meeting in St Louis for insightful conversation and comments. All errors are my own.

[†]Email: heiwai.tang@tufts.edu

[‡]Email: yifan.zhang@ln.edu.hk

"The idea is that maybe foreigners don't know which factory to go to, so you perform an introductory role, maybe a quality-control role and there it stops," says managing director of Li & Fung's, a multinational trading company that has offices in more than 40 countries.

"I was fed up with middlemen and poorly run factories distorting pricing, failing to control quality and allowing intellectual property (IP) to be knocked off, so I decided to do something about it," says the founder of Passage Maker, a third-party assembly, inspection and packaging company.

1 Introduction

News about recalls of foreign-produced products due to quality issues frequently make headlines.¹ Buyers are generally more concerned about product quality when importing goods from foreign countries than buying them locally. An extensive theoretical literature proposes that intermediaries, such as wholesalers, trading companies, and import-export companies, can solve the "quality" problem by providing effective quality verification for buyers. Given the significance of trade intermediaries in facilitating international trade, a larger share of quality-differentiated products' exports is expected to be handled by trade intermediaries.² Recent literature has examined the factors that shape the pattern of trade intermediation, but the focus has been mainly on destination-country characteristics. To the best of our knowledge, little has been written about a specific role played by trade intermediaries. This paper aims to explore the roles of trade intermediaries. In particular, we focus on the quality verification role and examine both theoretically and empirically how the degrees of vertical and horizontal differentiation of a product are related to the prevalence of trade intermediation.

An extensive theoretical literature proposes that middlemen play several roles in facilitating market exchanges, which include assuring product quality, matching and brokering, and providing liquidity, immediacy and even contract enforcement (see a review by Spulber, 1996). On the role of assuring quality, Biglaiser (1993) explains theoretically how a middleman can help alleviate the "lemon" problem due to her prior investments in inspection technology. Biglaiser and Friedman (1994) highlight the same absolute advantage of middlemen, which arise from incentives to protect reputation as high-quality goods sellers.³ To the extent that buyers (and also sellers) are more vulnerable to information asymmetry in international commerce than in the domestic market,

¹See *Poorly Made in China* (2010) for many first-hand anecdotes about how foreign buyers suffer from quality issues in importing goods from China.

²For instance, wholesalers and retailers accounted for 21 (31) percents of non-service exports (imports) in the U.S. (Bernard et al., 2010b). In Germany, 28% of exports in 1993 went through intermediaries. In Japan, Sogo Shosha (general trading companies) intermediated over 40% exports and over 70% imports in the 90s. The largest 10 trading companies accounted for 30% of Japan's GDP in the 80s. See Yoshihahra and Lifson (1986) for a classic description of Sogo Shoshas in Japan. Aiming to promote export-led growth, many developing countries since the 1980s followed the successful example of Japan and implemented policies to encourage the development of trading companies. In South Korea and Turkey for example, 51% and 38% of exports respectively were intermediated by middlemen (Peng and Ilinitch, 1998). Hong Kong intermediated 50% of the exports from mainland China (Feenstra et al. (2003)).

³In a similar vein, Li (1998) shows theoretically that intermediaries optimally choose to trade goods of higher quality than producers.

intermediaries will play a more important role as a quality assurer in international trade. A common hypothesis of these studies, which we refer to as the "quality-verification view", proposes a positive correlation between a product's quality differentiation and the prevalence of intermediation in exports. Despite the extensive literature, empirical literature is relatively scant. The few exceptions that we are aware of are Feenstra and Hanson (2004) and Feenstra et al. (2004). They find that Chinese entrepot exports through Hong Kong account for a larger share of more differentiated-product exports; and that the estimated welfare gains of foreign buyers are higher for differentiated products than homogeneous products. Their rationale is that trading companies in Hong Kong can provide better quality verification, according to the various reasons proposed in the literature aforementioned.

However, business practitioners and scholars do not always agree with the quality-verification view. They argue that when costly investments are needed for quality verification, trading companies' misaligned investment incentives may undermine their ability to verify product quality. In particular, when complete and self-enforcing contracts are unavailable in practice to specify the terms of investments and contingencies, trading companies may underinvest in quality verification technology and capital from the perspective of the producer, which are partially firm- and product-specific.⁴ In a seminal book on this topic, Yoshino and Lifson (1986) provide many anecdotes showing that intermediation is more prevalent in homogeneous or less sophisticated goods in Japan. Other studies also find confirming evidence (e.g., Trabold, 2002 and Peng et al., 2006). The common hypothesis of these studies, which we refer to as the "underinvestment view," would predict a negative correlation between product quality and the prevalence of trade intermediation.

In sum, whether trade intermediaries help facilitate exports of quality-differentiated products remains an unresolved empirical question.

We use Chinese transaction-level data for both export intermediaries (trading companies) and direct-exporting producers to answer this question.⁵ Our data set covers the universe of direct and indirect exports from China in 2005. Besides the extensive coverage, the choice of the country fits the purpose of the study as there have been rising concerns about the quality of Chinese exported products. We correlate the share of intermediated trade in total exports of a product to a country with measures of quality and horizontal differentiation. Following recent empirical literature on quality and trade, we use different measures for quality differentiation, including our own constructed measure of quality dispersion, R&D intensity, advertising intensity (Verhoogen, 2008), and quality ladder (Khandelwal, 2009). Regarding the measures of horizontal differentiation, we use Rauch's (1999) classification of differentiated goods and Broda and Weinstein's (2006) estimates of elasticity of substitution between varieties within each product. Our regression results show a *negative* and significant relation between the prevalence of intermediated trade and the

⁴Peng and Ilinitch (1998) point out that middlemen need to undertake costly investments in specialized physical and human capital to intermediate exports, especially for exports of highly differentiated products. Peng and York (2001) emphasize the agency costs involved in trade intermediation, and discuss the misaligned incentives between the producer and the export intermediary.

⁵In this paper, we focus primarily on export intermediaries located in China, and abstract from the discussion on exports to import intermediaries located in foreign countries.

degree of quality differentiation, contrasting the quality-verification view. The empirical results are robust to the use of different measures of quality differentiation, as well as controlling for other determinants of the prevalence of intermediated exports, including search costs. Figure 1 highlights the main message of the empirical results. As is shown, there is a negative and significant association between the share of intermediated exports (to the rest of the world) and (log) R&D plus advertising intensity across industries (HS2).

Consistent with existing literature, we do find a positive correlation between product differentiation (an inverse of the elasticity of substitution between varieties) and the share of intermediated exports. We also find a higher share of intermediated exports to more distant (culturally and physically) markets. The distance effects are weaker for more vertically differentiated products. Horizontal differentiation (lower elasticity of substitution between varieties), on the other hand, strengthens the distance effects.

To rationalize the findings that appear to contrast with the quality-verification view, we construct a heterogeneous-firm model with varying degrees of vertical and horizontal differentiation across products. In the model, firms draw vertical attributes before entering into an export market. Firms need to pay fixed costs to export as in Melitz (2003) and Chaney (2008). The horizontal aspect of the variety is product-specific, which depends on the elasticity of substitution between varieties of the product. Firms can produce and organize exports by themselves or outsource the exporting tasks to an export intermediary, who controls the goods when they cross international border.⁶ Export intermediaries incur a lower fixed export cost, which can potentially arise from economies of scale, having access to pre-established networks with foreign buyers, or better inventory management. In addition to the difference in fixed trade costs, the producer has to undertake in-house investment in quality verification for the foreign buyers under direct exporting. Under indirect exporting, the producer simply outsources the quality-verification tasks to an intermediary.

Crucially, our model assumes that under indirect exporting, firms cannot write contracts *ex ante* to specify the division of surplus between the producer and the intermediary. The rationale we have in mind is that the quality of services provided by the intermediary is difficult to verify *ex post*. Without complete contracts, the exporter and the intermediary undertake investments non-cooperatively, expecting *ex-post* Nash bargaining. When bargaining fails, the intermediary can only recoup part of the sunk costs for investments in quality verification by working with other producers outside the relationship. Thus, in addition to a lower fixed export cost, trade intermediaries have an endogenous cost advantage in quality verification due to positive outside options. Since both the intermediary and the exporter anticipate only a fraction of the joint surplus from investments, the intermediary will underinvest in quality verification, while the producer will underinvest in production (i.e., quantity exported), relative to the first best under direct exporting. Product quality perceived by the buyers is thus lower under indirect exporting.

Despite the cost advantage of intermediaries in verifying product quality, the hold-up effects

⁶In the theoretical framework, we assume that intermediaries do not take possession of the goods. They simply represent the producers to sell the goods in a foreign market. The case that involves selling the goods directly to intermediaries is considered by Rauch and Watson (2004).

always dominate, driving the variable trade cost of indirect exporting above that of direct exporting. As is postulated by recent theoretical work, a combination of lower fixed costs and higher variable costs under indirect exporting renders a productivity sorting of firms into different trading modes – exporters with the highest product quality (or productivity) export directly, while those with lower quality (or productivity) export through intermediaries.

Importantly, this paper complements the existing literature by providing evidence on the sectoral pattern of intermediated trade. Since for more vertically differentiated products, sales are more sensitive to quality verification, underinvestment in quality verification by the intermediary is more detrimental to sales for these products. As such, a salient prediction of the model is that the share of intermediated exports is negatively correlated with the degree of vertical differentiation across products.

While this theoretical prediction appears to contrast the existing quality-verification view of trade intermediation, our model predicts a *positive* relation between the share of intermediated exports and horizontal differentiation, consistent with the existing literature (e.g. Feenstra and Hanson, 2004). In our model, when horizontal differentiation increases, varieties become less substitutable, permitting less productive exporters to capture a larger market share. Since these less productive exporters are more likely to export via intermediaries that are associated with a lower fixed trade cost, our model predicts a larger share of intermediated trade in more horizontally-differentiated product markets.

Our findings shed light on economic policies in emerging economies. Historically, fast economic growth episodes were often found in countries that were able to gradually specialize in skill- and capital-intensive production (e.g. South Korea in the 90s), as well as moving up the quality ladder within an industry (e.g. automobile and electronic products industries in Japan in the 70s-80s). If intermediaries play an important role in promoting exports of high-quality products, this paper provides policy implications for developing countries' governments that consider liberalizing the entry of trading companies. Specifically, our results support the idea of using intermediaries to promote exports to distant markets, but reveal the limited role of intermediaries in upgrading a country's overall product quality.

Our paper relates to a small but growing literature on trade intermediation using firm-level data. Ahn et al. (2011) extend the Melitz (2003) model by incorporating the option to export via intermediaries. Under the assumption that different exporting modes are associated with different fixed export costs, their model predicts that the most productive firms export directly, while the less productive firms export through intermediaries. Using the same data as ours, they find that intermediated exports are more prevalent for markets that are harder to penetrate. Building on another extension of Melitz (2003), Akerman (2010) studies how economies of scale together with double marginalization shape the pattern of intermediated trade. Using Swedish firm-level data, he finds a positive correlation between the share of intermediated exports and various proxies for fixed export costs. Supporting these findings, Bernard et al. (2010a) also find evidence that the prevalence of intermediated exports is positively correlated with country-specific fixed trade costs,

but not variable trade costs.

Bernard et al. (2010b) study the varying degree of prevalence of wholesalers and retailers across markets and products using U.S. firm-level data. They find a disproportionate dominance of wholesalers in agriculture-related trade, and a greater penetration into smaller markets. Blum et al. (2010) use matched importer-exporter data on trade between Chile and Colombia and find that within a trade relationship, at least one of the firms is large. They reconcile their findings with a model that features search costs and an option to use trade intermediaries. Our work is distinct from all these existing research on trade intermediaries as we focus primarily on vertical differentiation and its impact on the sectoral pattern of intermediated exports. We provide additional results to confirm the existing findings, and show how vertical and horizontal differentiation affect the cross-country pattern of intermediated trade.

Earlier theoretical work includes Rauch and Watson (2004) and Petropoulou (2010) who model the emergence of trade intermediaries as an outcome of search frictions and network in international trade. Recent theoretical work include Antras and Costinot (2010) and Dasgupta and Mondria (2011). Antras and Costinot introduces matching between producers and intermediaries into an otherwise standard Ricardian trade model. They highlight the welfare impact of trade liberalization represented by a decline in search frictions with the presence of intermediaries. Dasgupta and Mondria (2011) focus on reputation concerns of the exporters and how intermediaries in the destination countries handle exports of intermediate range of quality. Of note, our paper is closely related to Felbermayr and Jung (2009), who also adopt a Nash bargaining framework to study the effects of hold-up in trade intermediation. Mark-ups arise endogenously due to bargaining in their model, and are also increasing in the de facto bargaining power of intermediaries. However, our paper is different from theirs in at least two respects. First, we focus on quality differentiation and verification, while they emphasize the relationship specificity of the products. Second, we study hold-up by the intermediaries located in the exporting country, instead of the destination country as in their study.

The paper is organized as follows. Section 2 describes our data source and construction of the variables of interest. Section 3 presents the empirical results. Section 4 develops the theoretical framework to rationalize our empirical findings. The last section concludes.

2 Model

2.1 Preferences

We develop a multi-sector model of Melitz (2003), similar to Chaney (2008). We model quality differentiation in the fashion similar to Mandel (2009), Crozet et al. (2010), Johnson (2010), and Hallak and Schott (2011), among others. We draw ideas from Antras and Helpman (2004) to introduce Nash bargaining between the producer and the trade intermediary under indirect exporting.

Consider a global economy with J countries. Each country has a mass of L_j consumers who

supply labor inelastically. Consumers in each country have quasi-linear preferences as follows:

$$U = Q_0 + \frac{1}{\mu} \sum_{j=1}^J Q_j^{\frac{\mu}{\alpha_j}},$$

where Q_0 is the consumption of the homogeneous good, which is the numeraire traded freely across countries. Q_j is the consumption index of product j , which takes the following constant elasticity of substitution aggregate over varieties

$$Q_j = \int_{\omega \in \Omega_j} (a_j(\omega) q(\omega))^{\alpha_j} d\omega,$$

where ω is a variety within product j . Consumers value product quality. The demand shifter $a_j(\omega)$ captures quality of variety ω *perceived* by consumers, while $q(\omega)$ is its quantity consumed.⁷ Bernard et al. (2010c) and Crozet et al. (2010) also add a demand shifter to the sub-utility function in a multi-product extension of Melitz (2003). Notice that a subscript j in $a_j(\omega)$ implies that the degree of quality differentiation can vary across product categories. For example, if consumers value product quality more for wine than for wine glasses, $a_j(\omega)$ for wine is higher, all else equal.

$\alpha_j = (\sigma_j - 1) / \sigma_j$, where $\sigma_j > 1$ is the elasticity of substitution between varieties of product j .⁸ In addition to differences in vertical differentiation (a_j), products differ in the degree of horizontal differentiation (σ_j). μ is a parameter capturing the elasticity of substitution between products, which is assumed to be smaller than α_j and identical for all products.

We consider single-product firms producing only one variety within product j . Varieties are differentiated vertically across firms (brands).⁹ To simplify notation, product index j is suppressed until later.

Denote the consumer (trade-cost-included) price of brand ω to country c by $p_c(\omega)$.¹⁰ The inverse demand function in country c facing firm ω is¹¹

$$p_c(\omega) = q_c(\omega)^{-\frac{1}{\sigma}} a(\omega)^{1-\frac{1}{\sigma}} D_c$$

where $D_c = P_c^{1-\frac{1}{\sigma}} (y_c L_c)^{\frac{1}{\sigma}}$. y_c is the consumer's labor income plus dividend income, similar to Chaney (2008) and Arkolakis (2009). $P_c = \left[\int_{\omega \in \Omega_j} \left(\frac{p_c(\omega)}{a_j(\omega)} \right)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$ is the ideal price index in

⁷Product quality is just an obvious example of many other subjective characteristics that can influence consumers' valuation of a product. For example, Felbermayr and Jung (2009) call this term brand reputation. Bernard et al. (2010) call it "consumer taste."

⁸For example, one can think of product categories as sports utility vehicles (SUVs) and brands as different classes of SUVs produced by different automobile companies.

⁹Readers are referred to Bernard, Jensen and Schott (2010) for a multi-product firm set up.

¹⁰One can consider $p^p(\theta)$ as the producer price (factory-gate, quality-unadjusted price) equal to $p_j(\theta) / \tau_j = p^p(\theta)$.

¹¹The inverse demand function is $q_j(\omega) = (p_j(\omega))^{-\sigma} a(\omega)^{\sigma-1} D_j^\sigma$. Quality adjusted demand function: $\tilde{q}_j(\omega) = D_j^\sigma \tilde{p}_j(\omega)^{-\sigma}$.

country c . Export value to country c (including trade costs) is¹²

$$x_c(\omega) = p_c(\omega) q_c(\omega) = [a(\omega) q_c(\omega)]^\alpha D_c,$$

In this paper, we consider two aspects of product quality – objective quality and subjective quality perceived by consumers. The objective quality is an exogenous attribute of the firm, similar to Crozet et al. (2010). To simplify analysis, firm-specific objective quality and labor productivity are both represented by the same productivity draw, denoted by ρ . Endogenizing the choice of quality as in Hallak and Sivadasan (2009) and Johnson (2009) will deliver quality as a power function of ρ . Importantly, our theoretical results are robust to this extension.

In addition to objective quality, firms engage in marketing, advertisement, quality assurance, and quality verification activities to "spin" the perception of product quality. To fix ideas, we refer to all these activities collectively as quality verification, albeit abstract, with the understanding that the types of tasks involved can vary widely across firms and sectors. For expositional purposes, perceived quality of a product a takes the following form:

$$a_j = (\lambda\rho)^{\beta(j)} \tag{1}$$

where λ captures quality-verification activities undertaken by the producer or the intermediary (depending on the exporting mode). Following Hallak (2006) and Crozet et al. (2010), we use the product-specific parameter $\beta(j)$ to capture the degree of consumers' desire for quality, where $\beta'(j) > 0$.

Firms differ in labor productivity and thus product quality in our set up. Firm productivity (quality) ρ is exogenously determined by a random draw from a Pareto distribution $G(\rho)$, as in Melitz (2003) and Chaney (2008).

Improving the perceived quality of the product through either actual production of quality or verification is costly. Specifically, the unit labor requirement to produce products with quality ρ is ρ^ϕ , where $\phi > 0$. The cost of quality verification is assumed to be linear, with unit labor requirement for each unit of quality verification equal to 1.

We will now derive firm-level equilibrium under direct exporting. The corresponding firm values for indirect exporting will be solved in the next section. We will then sum up firm values to derive the share of intermediated exports in each product category.

2.2 Production and Quality Verification under Direct Exporting

Let us now focus on a firm exporting a good directly to a foreign country. To simplify notation, we suppress firm, product, and foreign country subscripts. Upon choosing direct exporting, the exporter chooses quantity and the level of quality verification (based on its exogenous productivity) to maximize profits as follows:

¹² $x_j(\omega) = p_j(\omega)^{-(\sigma-1)} a(\omega)^{\sigma-1} D_j^\sigma$

$$\max_{q,\lambda} \left\{ (a(\lambda)q)^\alpha D - w\tau\rho^{\phi-1}q - w\lambda - wf_D \right\} \quad (2)$$

where q stands for quantity supplied; f_D is the fixed export cost incurred by the exporter under direct exporting, measured in terms of labor; τ is the standard iceberg trade cost. Solving this problem yields (quality-unadjusted) price, quantity exported, and quality verification as

$$\begin{aligned} q &= \left(\frac{\alpha D \rho}{w\tau} \right)^{\frac{1}{1-\alpha}} \\ R &= \left(\frac{\alpha \rho}{w\tau} \right)^{\frac{\alpha}{1-\alpha}} D^{\frac{1}{1-\alpha}} \end{aligned}$$

$$\begin{aligned} p &= \frac{\tau w}{\alpha \rho^{1-\phi}}; \\ q &= \left[\left(\frac{\alpha D}{w} \right) \frac{\beta^{\alpha\beta}}{\tau^{1-\alpha\beta}} \rho^{1-(1-\alpha\beta)\phi} \right]^{\frac{1}{1-\alpha(\beta+1)}}; \\ \lambda &= \left[\left(\frac{\alpha D}{w} \right) \frac{\beta^{1-\alpha}}{\tau^\alpha} \rho^{(1+\beta-\phi)\alpha} \right]^{\frac{1}{1-\alpha(\beta+1)}}. \end{aligned}$$

Notice that the quality-unadjusted price is increasing (decreasing) in firm productivity parameter if $\phi > (<) 1$.¹³ In other words, if the marginal cost of quality production is increasing in ρ , a draw of high productivity (thus quality) actually implies a higher marginal cost and thus a higher price.¹⁴

We can then derive the firm's revenue $x(\rho) = p(\rho)q(\rho)$ from exports as (see appendix for derivation)

$$x(\rho) = \left[\Lambda \beta^{\alpha\beta} \left(\frac{\alpha}{w} \right)^{\alpha(\beta+1)} \right]^{\frac{1}{1-\alpha(\beta+1)}} \rho^{\eta(\beta,\sigma)} \quad (3)$$

where $\Lambda \equiv \tau^{-\alpha}D$ captures market potential. A higher trade cost τ reduces market potential. $\eta(\beta, \sigma) = \frac{(\beta+1-\phi)(\sigma-1)}{1-\beta(\sigma-1)}$, $\eta'(\beta) > 0$ and $\eta'(\sigma) > 0$. The elasticity of sales revenue to ρ is increasing in the degree of vertical differentiation β . The reason is that a higher demand sensitivity of the consumers to product quality raises the market share of high-quality firms. In addition, the elasticity of sales revenue to ρ is increasing in σ , the elasticity of substitution between varieties within a product. The reason is that higher substitutability between varieties increases goods market

¹³The quality-adjusted price is

$$\tilde{p}(\rho) \equiv \frac{p(\rho)}{a(\rho)} = \left[\left(\tau \left(\frac{w}{\alpha} \right)^{(1+\beta)} \right)^{(1-\alpha)} \left(D \beta^{(1-\alpha)} \right)^{-\beta} \right]^{\frac{1}{1-\alpha(\beta+1)}} \rho^{\eta(\beta,\sigma)}$$

Under Assumption 1 below, quality-adjusted price would be decreasing in ρ , if the marginal utility of quality consumption is sufficiently high, relative to the marginal cost of quality production.

¹⁴See also Mandel (2009).

competition, which in turn magnifies the competitive advantage of the high-quality firms. These relations between product attributes and firm productivity are the drivers of the main theoretical results below.

Notice that when $\beta = 0$ and $\phi = 0$ (when there is no vertical differentiation) as in Melitz (2003), we obtain the standard formula $x(\rho) = [\Lambda (\frac{\alpha}{w})^\alpha]^\frac{1}{1-\alpha} \rho^{\sigma-1}$. If the marginal cost of quality production is independent of quality (i.e., $\phi = 0$), revenue is then unambiguously increasing in ρ .

Before we describe the exporting mode through intermediaries, we make the following assumption regarding the parameters, which would guarantee the standard relationship between export sales, firm productivity, and destination market size.

Assumption 1: $\phi - 1 < \beta < \frac{1}{\sigma-1}$.

The first inequality assumes that marginal cost of goods production is increasing in quality, but not excessively.¹⁵ Without the first inequality, export sales will be decreasing in productivity, which is counterintuitive. The second inequality ensures that revenue is increasing in aggregate demand in the destination country, which is a reasonable assumption.

Finally, the firm's profit under direct exporting is (see appendix for derivation)

$$\begin{aligned} \pi(\rho) &= \pi^o(\rho) - wf_D \\ &= (1 - (1 + \beta)\alpha)x(\rho) - wf_D, \end{aligned}$$

where $\pi^o(\rho)$ stands for firm operating profit, which is equal to the standard formula $(1 - \alpha)x(\rho)$ when vertical differentiation is absent in the model.

2.3 Production and Quality Verification under Indirect Exporting

We now turn to the case of exporting through intermediaries (indirect exporting). We focus on one specific role of intermediaries – quality verification. Other roles played by intermediaries, such as matching and brokering, are admittedly important but are abstracted away in this paper (see Spulber, 1996 and Feenstra and Hanson, 2004 for details). Alternative hypotheses about the role of intermediaries would be carefully controlled for in our empirical analysis.

Under indirect exporting, the firm outsources quality verification tasks to an intermediary. We assume that there is a large number of ex ante identical export intermediaries. Once a firm is randomly matched with an intermediary, the producer makes a take-it-or-leave-it offer to the latter. Perfect competition among intermediaries ensures that the ex ante transfer t adjusts so that all intermediaries have expected profits equal to their ex ante outside options, which are normalized to 0 for simplicity.

Once the intermediary accepts the offer, she chooses her investment level for quality verification,

¹⁵Hallak and Sivadasan (2009) assume that $\phi - 1$ is lower than unity, in their single-sector model without varying degrees of quality differentiation across products.

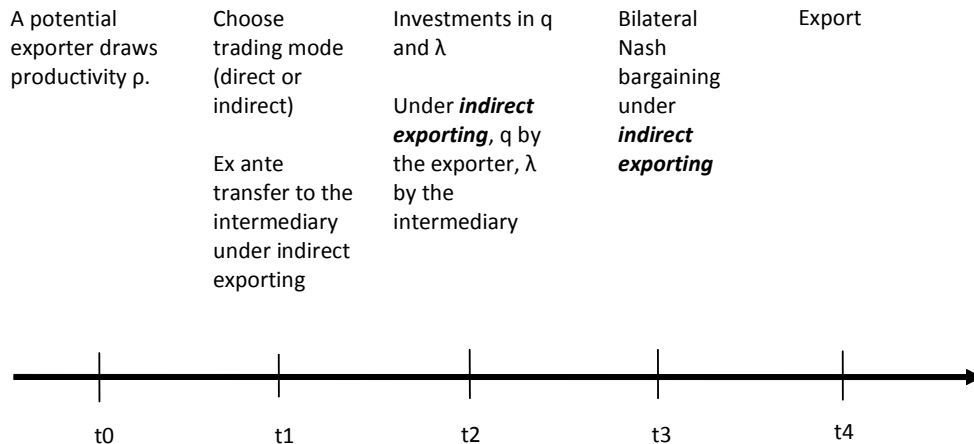


Figure 1: Timing of Events

while the producer chooses the level of quantity exported. Crucially, the two parties cannot sign complete contracts to specify the terms of investments. Under incomplete contracting, the two parties undertake investments, anticipating a share of ex post surplus arising from the relationship. We adopt the symmetric Nash bargaining framework from Antras (2005).¹⁶ Similar to the classic Grossman-Hart (1986) hold-up problem, there will be underinvestment by both sides compared to the first best with complete contracting.

Since the timing of events in Antras (2005) is standard, we will focus on the choices of exporting modes here. At t_0 , each firm draws productivity ρ from a Pareto distribution $G(\rho)$. In our model, ρ also determines the firm's quality. The firm stays in the market if ρ is above a certain productivity threshold. At t_1 , the firm can choose *direct exporting* to export, under which it organizes export activities and undertakes quality verification investments, incurring a higher fixed export cost. Alternatively, the firm can choose *indirect exporting*, under which it outsources *both* exporting and quality verification tasks to an intermediary. After the firm chooses indirect exporting, it will then be matched randomly with a homogeneous intermediary, to whom it makes a take-it-or-leave-it offer (ex ante transfer). The matched parties undertake corresponding investments (quality verification by the intermediary, and production by the firm) non-cooperatively at t_2 , anticipating ex post Nash bargaining over the surplus from the relationship at t_3 . If both parties agree to the terms of bargaining, they share the joint surplus according to the primitive bargaining powers, which will be specified below. The timing of events is summarized in Figure 1.

Let us now solve for the firm's equilibrium under indirect exporting. We assume that the intermediary can re-use some of the invested verification technology or capital for producers outside the relationship. In other words, investments in quality verification by the intermediary are par-

¹⁶Using the Generalized Nash Bargaining framework, as in Antras and Helpman (2004), yields qualitatively similar results, at the cost of complicating the algebra.

tially specific to the relationship with the producer. In particular, the intermediary can recoup a fraction $\delta < 1$ of its sunk investment costs $w\lambda$ by working with a firm outside the relationship. Thus, intermediaries have a lower (endogenous) unit labor requirement for investments in quality verification than a direct exporter. We assume a constant degree of recoverability of investment costs, independent of product categories and industries. Notice that our results are qualitatively robust to a relaxation of this assumption, as long as cost recoverability is non-increasing in vertical differentiation.¹⁷

We normalize the producer's outside option at the stage of bargaining to 0. In other words, the producer cannot sell the finished products locally or to a foreign buyer when bargaining fails.¹⁸ The ex post surplus up for bargaining between the producer and the intermediary is

$$V(q, \lambda) = x(q, \lambda) - \delta w\lambda.$$

Let us assume that the intermediary and the producer engage in a symmetric Nash bargaining game (i.e., the primitive bargaining power of either party is equal to $\frac{1}{2}$). Anticipating ex-post bargaining, the intermediary chooses λ to maximize $\frac{1}{2}V(q, \lambda) + \delta w\lambda - w\lambda + t$ upon matching; whereas the producer chooses q to maximize $\frac{1}{2}V(q, \lambda) - w\rho^{\phi-1}q\tau - t$. The problem for the intermediary becomes

$$\max_{\lambda} \left\{ \frac{1}{2} (x(q, \lambda) - \delta w\lambda) - w\lambda \right\},$$

while that for the producer is

$$\max_q \left\{ \frac{1}{2} (x(q, \lambda) - \delta w\lambda) - w\tau\rho^{\phi-1}q \right\}.$$

Notice that the intermediary's marginal cost of investment in quality verification is lower than the corresponding in-house cost, because the intermediary can recover part of the investment costs outside the relationship as we discussed above. Counteracting this cost advantage is the hold-up on each party. In the situation that the intermediary can only recoup part of the investment costs, it would never obtain enough incentives to undertake first-best investments from the producer's perspective.

Solving these two problems simultaneously yield the firm's price, quantity, and the level of

¹⁷As we will see below, the relation between cost recoverability for the intermediary and the share of intermediated exports is non-monotonic. On the one hand, higher cost recoverability will lower the intermediary's effective cost of quality verification, and will raise the share of intermediated exports in equilibrium. On the other hand, higher recoverability reduces the de facto revenue share of the producer, lowering its incentives to produce. Since the focus of the paper is the prevalence of trade intermediation and vertical differentiation, we will leave the complex relation between intermediation and cost recoverability (related market thickness) for future research.

¹⁸One can argue that the producer would lose only part, but not all of the original sales without the assistance by the intermediary. Our results are robust to this assumption, as long as the the recoverability of sales is weakly decreasing in the scope of quality differentiation (a reasonable assumption).

quality verification as follows:

$$\begin{aligned} q_I(\rho) &= \left[2^{\alpha\beta-1} (2-\delta)^{-\alpha\beta} \right]^{\frac{1}{1-\alpha(\beta+1)}} q_D(\rho), \\ \lambda_I(\rho) &= \left[2^{-\alpha} (2-\delta)^{\alpha-1} \right]^{\frac{1}{1-\alpha(\beta+1)}} \lambda_D(\rho), \\ p_I(\rho) &= 2p_D(\rho) \end{aligned}$$

where subscript D represents the corresponding variable under direct exporting. It can readily be shown that for a given ρ , $q_I(\rho) < q_D(\rho)$, $\lambda_I(\rho) < \lambda_D(\rho)$ and $p_I(\rho) > p_D(\rho)$. In other words, the hold-up effects dominate for all product categories.

The firm's export value is (see appendix for derivation)

$$x_I(\rho) = Ax_D(\rho) \tag{4}$$

where

$$A \equiv \left(2^{-1} (2-\delta)^{-\beta} \right)^{\frac{\alpha}{1-\alpha(1+\beta)}} < 1,$$

and $A_\beta < 0$ and $A_\sigma < 0$.

Let us now go back in time to t_1 when the producer makes a take-it-or-leave-it offer to a matched intermediary. All intermediaries expect zero profits. The binding participation constraint for the intermediary then pins down the ex ante transfer as $t = wf_I - \frac{1}{2}V(q, \lambda) - \delta w\lambda + w\lambda$, where f_I is the fixed export cost incurred by the intermediary.

By rearranging the producer's expected operating profits $\pi^o(\rho) = \frac{1}{2}V(q, \lambda) - w\rho^{\phi-1}q\tau - t$, using (4) and equilibrium values of q_I and λ_I , we obtain the firm's profit under trade intermediation as

$$\begin{aligned} \pi_I(\rho) &= \pi_I^o(\rho) - wf_I \\ &= ABx(\rho) - wf_I, \end{aligned}$$

where $\pi_I^o(\rho)$ stands for operating profit, $A \in (0, 1)$ is defined as above, and

$$B \equiv \left[1 - \alpha \left(2^{-1} + \beta(2-\delta)^{-1} \right) \right] < 1.$$

$B_\beta < 0$ and $B_\alpha < 0$.

Give that $A \in (0, 1)$ and $B \in (0, 1)$, $\pi_I^o(\rho)/\pi_D^o(\rho)$ is smaller than unity $\forall \beta \in (0, 1)$, $\delta \in (0, 1)$ and $\sigma \in (1, \infty[$. Even the intermediary can recover all of the investment costs (i.e., when $\delta = 1$), the cost advantage of the joint "exporting" unit is insufficient to offset the hold-up effects, which give only half of the surplus to either party. From the perspective of the producer, the first-best level in quality verification can never be achieved. Lower quantity exported along with suboptimal quality verification implies lower operating profits, compared to direct exporting.

2.4 Choices of Exporting Modes

If fixed costs are identical across exporting modes, all firms would use direct exporting instead of indirect exporting, which is associated with hold-ups. Intuitively, since the intermediary specializes in certain products, industries, or destination countries, it enjoys economies of scale in quality verification (Akerman, 2010). Moreover, the intermediary may have established a network of foreign buyers, have experience in marketing in a particular foreign market, or have access to a better technology for inventory management. We capture all these advantages, albeit abstract, by a lower fixed export cost than that incurred by a direct exporter (that is, $f_I < f_D$), similar to Ahn et al. (2010). As long as $f_I < f_D$, some firms may still find it profitable to export via intermediaries, despite the hold-up effects. Figure 2 illustrates heterogeneous firm profits and thus the cutoffs above which direct exporting is more profitable than indirect exporting.

The following zero-profit condition pins down the productivity cutoff, above which firms choose intermediated exports (ρ_I):¹⁹

$$\rho_I : \pi_I(\rho_I) = 0. \quad (5)$$

On the other hand, the productivity cutoff for direct exports (ρ_D) is pinned down by the following condition for a marginal exporter that is indifferent between direct exporting and indirect exporting:

$$\rho_D : \pi_I(\rho_D) = \pi_D(\rho_D). \quad (6)$$

As long as the fixed export cost for direct exporting is significantly larger than that for indirect exporting (i.e., $\frac{f_D}{f_I} > \frac{1-(1+\beta)\alpha}{AB}$), it can be shown that $\rho_D > \rho_I$ (see appendix for the exact expression of the cutoffs).

Following Helpman, Melitz, and Yeaple (2004) and Chaney (2008), we assume that ρ is Pareto-distributed with a cumulative distribution function equal to $G(\rho) = 1 - (\rho_{\min}/\rho)^\kappa$, where $\rho \geq \rho_{\min} > 0$; with the shape parameter $\kappa > \eta(\beta, \sigma) = \frac{(\beta+1-\phi)(\sigma-1)}{1-\beta(\sigma-1)}$.²⁰

For a given product category, the aggregate value of intermediated exports X_I is the sum of export value of all firms with $\rho \in [\rho^I, \rho^D]$, while that of direct exports X_D is the sum of export value of all firms with $\rho \in [\rho^D, \infty]$. They are expressed as follows:

$$\begin{aligned} X_I &= A \left[\Lambda \left(\frac{\alpha}{w} \right)^{\alpha(\beta+1)} \beta^{\alpha\beta} \right]^{\frac{1}{1-\alpha(\beta+1)}} \Theta(\rho_I, \rho_D) \\ X_D &= \left[\Lambda \left(\frac{\alpha}{w} \right)^{\alpha(\beta+1)} \beta^{\alpha\beta} \right]^{\frac{1}{1-\alpha(\beta+1)}} \Theta(\rho_D, \infty) \end{aligned}$$

¹⁹Solving them gives $\rho_I = \left[\frac{1}{AB} \frac{w f_I}{\left[\left(\frac{\alpha}{w} \right)^{\alpha(\beta+1)} \beta^{\alpha\beta} \Lambda \right]^{\frac{1}{1-\alpha(\beta+1)}}} \right]^{\frac{1}{\eta(\beta)}}$,

and $\rho_D = \left[\frac{1}{(1-(1+\beta)\alpha)-AB} \frac{w(f_D-f_I)}{\left[\left(\frac{\alpha}{w} \right)^{\alpha(\beta+1)} \beta^{\alpha\beta} \Lambda \right]^{\frac{1}{1-\alpha(\beta+1)}}} \right]^{\frac{1}{\eta(\beta)}}$.

²⁰In existing research on heterogeneous firms in international trade, the shape parameter, κ , is commonly assumed to be larger than σ . In our case, when there is no quality differentiation across firms ($\beta = 0$ and $\phi = 0$), our assumption is essentially the standard one in the literature.

where $\Theta(z_0, z_1) = \int_{z_0}^{z_1} \rho^\eta dG(\rho) = \Gamma \left[z_0^{\eta-\kappa} - z_1^{\eta-\kappa} \right]$, $\Lambda \equiv \tau^{-\alpha} D$ and $\Gamma \equiv \frac{\kappa \rho_{\min}^\kappa}{\kappa - \eta}$.

The share of intermediated exports in total exports can be solved as

$$\begin{aligned} \frac{X_I}{X_D} &= A \left[\left(\frac{\rho_D}{\rho_I} \right)^{\kappa - \eta(\beta, \sigma)} - 1 \right] \\ &= A \left\{ \left[\left(\frac{f_D}{f_I} - 1 \right) \frac{AB}{[(1 - (1 + \beta)\alpha) - AB]} \right]^{\frac{\kappa - \eta(\beta, \sigma)}{\eta(\beta, \sigma)}} - 1 \right\}. \end{aligned} \quad (7)$$

Notice that the market potential term Λ gets cancelled out in the ratio of intermediated exports to direct exports.

By examining the impact of an increase in β , we arrive at the following claim.

Claim 1 All else equal, the share of intermediated exports is *decreasing* in the degree of quality differentiation (β) across products.

Proof: See Appendix.

The intuition is that a lower level of quality verification provided by the intermediaries reduces the perceived quality and firm quantity supplied in equilibrium. The hold-up effects on exports are stronger for more vertically differentiated products, for which demand is more sensitive to quality and its verification. Figure 3 graphically depicts the comparative static result due to an increase in β . Notice that the profit schedules for both direct and indirect exports pivot upward, because a higher demand elasticity to quality implies higher profits for all exporters. However, because of the hold-up effects under indirect exporting, the extent of the increase in profits is smaller under indirect exporting. As such, the productivity cutoff for direct exporting ρ_D moves toward the origin, implying a larger fraction of firms engaging in direct exporting.

By focusing on hold-up, our model provides insights that appear to contrast the claim that trading companies act as quality verifiers. Instead, Claim 1 provides support to the common view in the business literature that trading companies tend to intermediate simple products in practice (Trabold, 2002; Yoshino and Lifson, 1986).

The model delivers the following result regarding horizontal differentiation.

Claim 2 All else equal, the share of intermediated exports is *increasing* in the degree of horizontal differentiation ($1/\sigma$) across products.

Proof: See Appendix.

The positive relationship between horizontal differentiation of the product and the prevalence of trade intermediation is consistent with Feenstra and Hanson (2004). They show that trade in-

intermediaries in Hong Kong re-export a larger share of more differentiated products from China. According to our model, the reason is not because intermediaries are better quality verifiers. Instead, the result arises from a standard feature in Melitz (2003). When the varieties within a product become more substitutable, the resulting increased competition enhances the competitive edge of the high-quality (productive) firms. While the highest quality firms always export directly in our model, they are also more able to take advantage of their increased competitive edge in the less horizontally differentiated (more competitive) markets to capture a larger market share. As such, in more homogeneous product markets, quality improvement comes with a larger market share.²¹

So far we have been analyzing the cross-product variation in the prevalence of trade intermediation. Recent studies (Ahn et al., 2010; Akerman, 2010) focus on destination country characteristics and examine both theoretically and empirically their effects on trade intermediation. One of the main results is that trade intermediation prevails in exports to countries that are harder to penetrate (e.g. more distant or smaller markets). Given the richness of our data, we can provide further evidence for this line of research; but more importantly, our theoretical results shed light on how vertical and horizontal differentiation affect the distance effects on trade intermediation.

Claim 3 The share of intermediated exports is increasing in the relative fixed cost of direct exports (f_D/f_I) to an importing country. This positive relationship is *mitigated* in markets that are characterized by a *higher* degree of quality differentiation (higher β) or a *lower* degree of horizontal differentiation (lower $1/\sigma$).

Proof: See Appendix.

The first part of this claim is consistent with the recent empirical research on trade intermediation (Ahn et al., 2010; Akerman, 2010). In addition, we show that this positive relation varies across product categories. For products that are characterized with a high elasticity of substitution or a high degree of quality differentiation, firm productivity and quality give a larger cost advantage. Thus, in markets that are already dominated by productive direct exporters (the most vertically differentiated or the most competitive ones), the distribution of direct and indirect exporters is less sensitive to a change in the relative fixed cost of direct exports (e.g. distance). This mitigation is indeed consistent with the main message in Chaney (2008), who theoretically show a lower elasticity of trade flows to distance in sectors that feature less horizontal differentiation (a higher elasticity of substitution between varieties).

²¹Fajgelbaum, Grossman and Helpman (2009) also consider vertical and horizontal differentiation in a discrete-choice model framework. They also postulate that perceived differences in quality among brands are larger if individuals' demand is less sensitive to price changes.

3 Data and Variables

3.1 Customs Data and the Pattern of Intermediated Exports

The main data set for our study is a transaction-level data set that covers the universe of all Chinese exporters and importers in 2005. The data set provides transaction-level information of import and export values, quantities and prices from and to over 200 destination countries at the HS 6-digit level, by type of enterprise (out of 9 types, e.g. state owned, foreign invested, Sino-foreign joint ventures), region or city in China where the product was exported from or imported to (out of around 700 locations), and customs regime (out of 18 regimes, e.g. "Processing and Assembling" and "Processing with Imported Materials").²² We exploit the richness of the data set to examine our hypotheses across industries, product categories, destination countries, and ownership types of firms.

Firms in China are required by the government to register as specialized trading firms if their main business line is importing, exporting, or trade intermediation. Thus, these companies will have names that include phrases such as "trading", "importing" and "exporting." Similar to Ahn et al. (2010), we identify intermediary firms by the presence of the phrase "importer/exporter" or "trading" in their Chinese firm names.²³ It is worth noting that a trading company may not have a name that includes these phrases, as long as it can prove its sufficient engagement in manufacturing or other non-intermediation services. This is particularly relevant after China's accession to the WTO in December 2001, after which many trading companies tried to diversify their businesses. Thus, our current matching method is admittedly imperfect, and provides probably a lower bound of the share of intermediated trade in any product or industry categories.

Table 1 shows the share of intermediaries in aggregate exports and total number of exporters. Between 2000 and 2006, the share of intermediaries in total exports has gradually decreased from 33 percent to 21 percent. This is consistent with the Chinese government liberalization policy that granted trading rights to more manufacturing firms.²⁴ In accordance with the WTO agreements, the Chinese government committed to fully liberalize trading rights by the end of 2004 (3 years after the WTO entry). To circumvent any estimation biases arising potentially from the policy restriction of trading rights before 2004, we use data from 2005.²⁵ In the empirical analysis, we further exclude products that are permitted by the WTO agreements to remain under state trading monopoly (e.g., crude oil and silver).²⁶ Another salient pattern shown in Table 1 is that the share of intermediaries in total number of exporting firms has been stable between 2000 and 2005. There was a large number of entry of private trading companies in 2006, possibly due to a new policy

²²The data also report quantity, quantity units, customs offices (ports) where the transaction was processed (97 in total), and transportation modes.

²³Specifically, we search "mao yi", "wai mao", "wai jing", "jin chu kou", "jing mao", "gong mao", and "ke mao" in firm names.

²⁴Source: "China relaxes trading rights controls," China Daily, Aug 27, 2003

²⁵Our results are robust to using data from 2006.

²⁶The data are obtained from China's WTO entry agreement legal documents. See Annex 2A2 (<http://www.lawbook.com.cn/zdtj/wto/flwj/law06.doc>) and Annex 2B (<http://www.lawbook.com.cn/zdtj/wto/flwj/law07.doc>).

that lowered the entry threshold for the registration of trade intermediaries.

Table 2 provides summary statistics on the number of destination countries served and the number products exported by both direct exporters and intermediaries. Trade intermediaries on average export more products and to more countries. They serve 14.5 countries and export 43 (HS6) products on average, compared to 6.9 countries and 10.6 by the direct exporters. The median numbers also confirm this pattern. Compared to direct exporters, trade intermediaries tend to have a country focus, confirming the findings in Ahn et al. (2010). They export 7.09 products per destination, compared to 3.66 by direct exporters. Intermediaries' average export sales per destination or per product are larger than those of direct exporters.

3.2 Measuring Vertical Differentiation

Our main measures of vertical differentiation are research and development (R&D) intensity and advertising plus R&D intensity at the product (HS6) level. These measures have been extensively used in the literature (e.g., Sutton 1991, Sutton 1998, Verhoogen, 2008). The theoretical underpinning is that equilibrium R&D and advertising expenditure as a share of sales is increasing in the sensitivity of sales to these expenditures. To construct these variables, we use the above-scale industrial firm data set from China's National Bureau of Statistics (CNBS) in 2005.²⁷ Specifically, for each Chinese firm, we compute R&D (advertising) intensity as the ratio of R&D (advertising) expenditures to sales in 2005. We then compute the average R&D and advertising plus R&D intensity by 4-digit Chinese industry code. Then we use a concordance table provided by the CNBS to map the measures at the 4-digit Chinese industry code to HS 6-digit level.²⁸ An advantage of using Chinese data to construct these measures instead of using data from other countries is that Chinese data better reflect marketing and R&D investment practices of Chinese exporters. The top and bottom 10 vertically-differentiated industries based on these measures are listed in Table A6 in the appendix. The most vertically-differentiated industry is "Soap, organic surface-active agents" (HS2 = 34); while the least vertically-differentiated industry is "Iron and steel" (HS2 = 72).

To ensure robustness of the empirical results, we also use US firm-level data from ORBIS to construct R&D and advertising intensities. Firm-level data from 2005 are used. To the extent that the US is on the global technology frontier, the US-based measures better represent the intrinsic attribute of quality differentiation of a product.

We also use "quality ladder" proposed by Khandelwal (2009) as an alternative measure of vertical differentiation. Using both price and quantity information, Khandelwal estimates a nested logit demand system that allows for both vertical and horizontal attributes. The measure of "quality ladder" of a product is the difference between the estimated maximum valuation and the estimated

²⁷See Brandt, Van Biesebroeck and Zhang (2009) for detailed data description.

²⁸We can also use the standard deviation of unit values across firms within product categories as proxies for vertical differentiation. However, as recent studies suggest, unit value does not fully reflect product quality (e.g., Khandelwal, 2009; Hallak and Schott, 2010). Moreover, dispersion in unit values (prices) can arise from intrinsic search frictions that vary across product markets. It is noted that our results are even more significant when we use price dispersion as our proxy for vertical differentiation.

minimum valuation of the vertical attribute of the product. These measures are constructed based on US import data, available at the HS 10-digit level. We assume that the demand for quality is the same in both importing and exporting countries. The "quality ladder" measures are downloaded from Khandelwal's website.²⁹ The original measures are available at the HS 10-digit level. We aggregate the measures up to HS 6-digit by taking means across HS 10-digits within each HS 6-digit category. Our results are robust to using the medians. The top and bottom 10 vertically-differentiated industries based on these measures are listed in Table A6 in the appendix. The most vertically-differentiated industry is "Prepared feathers, down, and articles made of feathers or down" (HS2 = 67). The least vertically-differentiated industry is "Footware, gaiters and the like; parts of such articles" (HS2 = 71).

3.3 Measuring Horizontal Differentiation

Our main measure of horizontal differentiation is the (inverse) elasticity of substitution between varieties ($1/\sigma$), estimated by Broda and Weinstein (2006). Based on a nested constant-elasticity-substitution utility function, the authors estimate product-specific elasticities of substitution between varieties imported into the US. The data is downloaded from Weinstein's website.³⁰ The measures are available at the HS 10-digit category. We aggregate these numbers up to the HS6 level by taking means. Importantly, the measure of horizontal differentiation is weakly correlated with all measures of vertical differentiation. See Table A2 in the appendix and Figure 8 for a scatter plot of our main measure of vertical differentiation (R&D plus advertising intensity) against $1/\sigma$. There is no significant relationship between the two measures. The lack of association suggests that the the two measures represent two very different attributes of a product. It also ensures that collinearity is not an important concern in our regression analysis.

An alternative measure of horizontal differentiation is Rauch's (1999) classification of simple versus complex goods. Rauch categorizes four-digit SITC industries into three categories: (1) goods that are mainly traded on organized exchanges; (2) goods that are reference priced; (3) goods that neither have reference prices nor are traded on organized exchanges. Using Rauch's data, we construct a dummy for differentiated products. The dummy variable equals one if the product falls into category (3) and zero otherwise. We convert the data into HS 6-digit level using concordance tables between SITC Rev.2 and Rev.3, and between SITC Rev.3 and HS2002 (United Nations Statistics Division).

In the regressions, we also include a wide range of variables of destination country characteristics. See appendix for details.

²⁹We downloaded the measures from http://www0.gsb.columbia.edu/faculty/akhandelwal/papers/ladders_100113.zip.

³⁰<http://www.columbia.edu/~dew35/TradeElasticities/TradeElasticities.html>

4 Empirical Analysis

4.1 Empirical Specification

The regression specification to examine Claims 1 and 2 is

$$S_{sc} = \beta_1 V_s + \beta_2 H_s + Z_s \gamma + F_{ic} + \epsilon_{sc} \quad (8)$$

where s , c , and i stand for product, country, and industry respectively. S_{sc} is the share of intermediated exports in total exports of product s to country c . We define an industry as an HS 2-digit category. V_s is a measure of vertical differentiation of product s , while H_s stands for horizontal differentiation. Z_s is a vector of product/country controls, which include the share of exports by state-owned enterprises (SOE) and foreign-invested enterprises (FIE). Industry-country fixed effects (F_{ic}) are included to control for any unobserved industry-country-specific characteristics that affect the use of trade intermediaries. In other words, the coefficients β_1 and β_2 are interpreted as the effects of the scope of vertical and horizontal differentiation of the product on the prevalence of intermediated exports within a country-industry observation. Claims 1 and 2 postulate that $\beta_1 < 0$ and $\beta_2 > 0$.

To examine Claim 3, we estimate the following specification:

$$S_{sc} = (\delta_1 V_s + \delta_2 H_s) \times \text{direct_trade_cost}_c + [F_s + F_c] + \epsilon_{sc} \quad (9)$$

where $\text{direct_trade_cost}_c$ captures the fixed trade costs of direct exports to country c , relative to fixed trade costs of indirect exports. F_s and F_c are product and country fixed effects, respectively. Claim 3 postulates that $\delta_1 < 0$ and $\delta_2 > 0$.

4.2 Regression Results

4.2.1 Product-level Analysis

Table 3 correlates the share of intermediated exports at the HS 6-digit level with various measures of vertical differentiation. The country dimension is collapsed by aggregating exports across countries to the HS6 level. As a first pass, we include only the share of state-owned enterprises' exports, the share of foreign-invested firms' exports, and HS2 industry fixed effects as controls.

In the first two columns, we use the Chinese-based R&D intensity measure to proxy for vertical differentiation of the product. We find a negative and significant (at the 1% level) relation between R&D intensity and the share of intermediated exports, regardless of whether HS2 fixed effects are included or not. Beta coefficients are reported. The point estimate in column (1) suggests that a one standard-deviation increase in the R&D intensity of the product is associated with a -0.08 standard deviations, or a 1.8 percentage-points decline in the share of intermediated exports.³¹

³¹The product with R&D intensity ranked at the 75 percentile has a share of intermediated exports about 2.6 percentage-points higher than the product ranked at the 25th percentile.

Given that the mean share of intermediated exports is 19.9% in 2005 (see Table 1), the impact corresponds to a 9% decrease in the existing share of intermediated exports. This result remains robust when HS2 industry fixed effects are controlled for in column (2). Notice that the share of exports by state-owned enterprises (SOE) and that by foreign invested enterprises (FIE) are included as regressors to control for the effect of ownership on trade intermediation. One can argue that FIEs are less likely to use trade intermediaries if the Chinese subsidiaries are producing primarily for their foreign parent firms, and are less concerned about fixed trade costs or quality verification than regular exporters. On the other hand, due to government policy, SOEs are less constrained by the trading rights restriction than private firms. The negative coefficients on both dummy variables reported in column (1) show that both SOEs and FIEs are indeed less likely to use intermediaries to export.

Similarly, we find a negative and significant (at the 1% level) correlation between the advertising plus R&D intensity of the product and the share of intermediated exports (columns (3) and (4)). Columns (5) and (6) report almost identical results when US-based measures of quality differentiation are used. In the last two columns, we use Khandelwal’s (2010) quality ladder measures. When we add industry (HS2) fixed effects to examine the within-industry relationship between intermediated exports and vertical differentiation, the estimate on quality ladder remains negative but becomes less precise. In sum, regardless of what measures of vertical differentiation we use, we find a smaller share of exports being handled by trading companies for the more vertically differentiated products.

In Table 4, we use the same sample to examine the relationship between the degree of horizontal differentiation and intermediated exports across products. Controlling for export shares of SOEs and FIEs, we find a positive coefficient on Rauch’s (1999) dummy for differentiated products (although the estimation is imprecise when HS2 fixed effects are controlled for). When we use the inverse of the elasticity of substitution between varieties within products from Broad and Weinstein (2006) to measure horizontal differentiation (the last two columns), we also find a positive correlation. Importantly, this positive correlation is significant even when we control for HS2 fixed effects. In other words, the positive relationship between the share of intermediated exports and horizontal differentiation predicted by our model is supported by cross-product regression results. Importantly, these results lend support to the existing literature that postulates a positive relationship between product differentiation and the share of intermediated exports (e.g. Feenstra and Hanson, 2004).

4.2.2 Product-country Level Analysis

In Table 5, we include both horizontal and vertical differentiation as independent variables. Moreover, we use a sample with observations at the product-country level for analysis. An advantage of using a sample with information disaggregated by product-country is that we can now study the impact of both product attributes and destination country characteristics, which have been the focus of the existing literature on trade intermediation (Ahn et al., 2010; Akerman, 2010; Bernard

et al, 2010a). Moreover, the cross-product results reported so far mask substantial variation in importing country characteristics that would affect the general trade patterns, as well as the pattern of intermediated exports. To this end, we estimate equation (8), controlling for different sets of country and industry fixed effects. Standard errors are now clustered at the HS 6-digit level to take into account within-product correlation of residuals (Moulton, 1990). As Table 5 shows, the relationship between vertical differentiation of the product and the intermediated trade share remains negative for all measures of vertical differentiation, and significant for the measures of R&D intensity and advertising plus R&D intensity. The magnitude of the point estimate ranges between -0.025 (standard-deviations impact) to -0.065. The coefficients on all four vertical differentiation are now more precisely estimated.

On the other hand, the coefficients on $1/\sigma$ is consistently positive and significant in all columns. In other words, we find opposite effects on trade intermediation between vertical and horizontal differentiation of the products, even within industries.

4.2.3 Controlling for Other Determinants of Trade Intermediation

In Table 6, we include more controls at the HS 6-digit level. The main goal is to control for, albeit imperfectly, the market structure, search frictions, and the cost of using intermediaries for a product. Country fixed effects and the controls included in Table 5 remain as regressors. In column (1), we include the measures of the Herfindahl index of intermediaries, the Herfindahl index of direct exporters, the export share of export-processing plants, as well as the ratio of the number of direct exporters to the number of intermediaries at the HS6 level. The purpose of adding the Herfindahl index of intermediaries is to capture the cost of using intermediaries. The idea is that if the intermediary sector is less competitive (represented by a higher Herfindahl index), the cost of using intermediaries would increase, lowering the propensity to export through intermediaries. In addition, the purpose of adding the Herfindahl index of producers is to capture the size distribution of direct exporters in the market. To the extent that the market is dominated by a few large firms, presumably more productive ones, a larger share of direct exports is expected. The ratio of the number of direct exporters to the number of intermediaries is added to proxy for search frictions and the relative bargaining power between the intermediary and the producer. A higher firm-intermediary ratio is interpreted as a higher bargaining power of the intermediary, potentially leading to a small share of exports handled by trade intermediaries. We also control for the export share of export-processing plants in the product to account for the fact that this type of exports involves direct orders from foreign buyers. Naturally, this type of exporters is less likely to use trade intermediaries to export. The point estimates for all these new controls have the signs that are consistent with conventional wisdom are mostly significant. Importantly, the coefficient on R&D intensity is negative and significant (at the 1% level), and the magnitude of the coefficient is quite insensitive to the addition of the new controls (compared to the estimates in Table 5).

In column (2), we add capital and skill intensity at the product level as controls, in addition to all regressors included in column (1). Capital intensity is not significant, while skill intensity is positive

and marginally significant. Importantly, the measures of vertical and horizontal differentiation have the same signs as those reported in Table 5, and remain robust both economically and statistically. In column (3), we add the measure of contract dependence of the product proposed by Nunn (2009) to capture the main theoretical underpinning of the model that focuses on contract incompleteness and hold-up between the intermediary and the producer. We find confirming results that the share of export intermediation is lower for the more contract-dependent products. The estimate on R&D intensity remains negative and significant at the 10% level.

Similar patterns of results are obtained when advertising plus R&D intensity is used as the main regressor (columns (4) through (6)); and when US-based R&D intensity measures are used (columns (7) through (9)). Notice that the results are most significant when US-based R&D intensity measures are used. This measure also gives us the largest sample.

4.2.4 Sensitivity Analysis

After confirming that our results are insensitive to adding a number of HS6-level controls, in Table 7, we conduct a host of sensitivity analyses. First, we exclude exports to Hong Kong from the sample, given that Hong Kong is a significant entrepot port for China. Accordingly, Feenstra and Hanson (2004) show that between 1988 and 1998, Hong Kong intermediated 50% of Chinese exports. When we exclude exports to Hong Kong in columns (1) through (4), we continue to find a strongly negative correlation between vertical differentiation and the share of intermediated exports. Notice that we always control for country fixed effects, as well as export shares of state-owned enterprises (SOE), foreign-invested enterprises (FIEs), and export-processing firms, respectively. This negative correlation is robust to using different measures of vertical differentiation (R&D and advertising elasticity).

Our next robustness check is to exclude exports from different ownership types in the calculation of the share of intermediated exports. In columns (5) through (8), we exclude exports from SOEs in the calculation of the share of intermediated exports. In column (9) through (12), we exclude FIE exports and in column (13) to (16), we exclude all export-processing plants' exports in our calculation. The correlation between the share of intermediated exports and vertical differentiation remains consistently negative and significant.

4.2.5 The Impact of Fixed Direct Export Costs

Although the main focus of this paper is on the product-level determinants of trade intermediation, our model also delivers results regarding the effects of fixed trade costs of direct exports on trade intermediation. Our model shows that keeping the fixed intermediated trade costs constant, a higher fixed direct trade costs imply a larger share of exports handled by intermediaries, consistent with Ahn et al. (2010) who construct a heterogeneous model with market-specific fixed direct trade costs. To this end, we examine the effects of a number of fixed trade costs on the share of intermediated exports (at the product-country level) in Table 8. In this exploration of the variation across countries, HS 6-digit fixed effects are always included.

In the first column, we find that exports to larger markets, measured by GDP, is associated with a lower share of intermediated exports. Although our model does not predict a positive relationship between a country’s GDP and the share of intermediated trade, one can intuitively argue that a larger economy implies a higher market potential. In fact, if we incorporate the market penetration technology of Arkolakis (2010), we would obtain a market-varying entry cost that is decreasing in the economic size of the destination country. This resulting lower fixed trade cost would then imply a lower share of intermediated trade to larger markets.³² In addition, we also find that exports to more distant markets are associated with more trade through intermediaries (column (2)). Columns (3) through (5) use import regulations to proxy for fixed direct export costs. More restrictive import regulations are also found to be associated with a larger share of intermediated exports.

In addition to physical distance, it has been argued that language and cultural barriers can be important determinants of the extensive margin of trade. Instead of exploring a number of culture-related measures, we use the measure of genetic distance from Spolaore and Warziarg (2009) to study how cultural and other non-physical distance could affect intermediated trade. Genetic distance is a measure based on differences in the distribution of gene variants across populations between two countries. It has been used in existing literature to study the impact of cultural differences on exchanges (Guiso, Sapienza, and Zingales, 2009) and technology diffusion (Spolaore and Warziarg, 2009). The idea is that exporters would find it more costly to sell to a foreign market, if foreign consumers are more culturally different from the Chinese. In that situation, trade intermediaries can play an important role in reducing the informational and cultural barriers, by providing matching services for both Chinese producers and foreign buyers. Consistent with the findings on physical distance, we find a similar effect arising from genetic distance. Specifically, exports from China to destination countries that are more genetically different tend to be handled by intermediaries (column (7)).

In a similar vein, we use the share of Chinese in the importing country’s population as a proxy for fixed direct trade costs in the last column. The idea is that if the importing country has a proportionally larger Chinese population, the chance that the buyer is a Chinese or who has access to a network of Chinese contacts is higher. As such, the share of Chinese population in the importing country is used as an inverse of information barrier here.³³ We find that a country with a proportionally larger Chinese diaspora is associated with a lower share of intermediated exports.

4.2.6 The Effects of Vertical and Horizontal Differentiation on the “Distance” Effects

In Table 9, we examine Claim 3 by estimating equation (9). Country and HS6 fixed effects are always included. Standard errors are clustered at the HS6 level. According to Claim 3, in the more vertically differentiated product markets, the distance effects reported in Table 8 are mitigated;

³²In Ahn et al. (2010), such negative correlation exists even without marketing technology as in Arkolakis. The reason is that the authors assume zero intermediary fixed trade costs.

³³Rauch and Trinidad (2002) find that bilateral trade flows are higher between China and countries with a larger share of Chinese population.

while the effects are magnified in the more horizontally differentiated markets (higher $1/\sigma$). Thus, we expect a negative coefficient on the interaction term with the vertical differentiation interaction, and a positive coefficient on that for horizontal differentiation. To conserve space, we use only two measures of distance – physical distance and the genetic distance based on the dominant ethnic group of the importing country. Using other measures of distance gives consistent results. In columns (1) through (5) when physical distance is used as a proxy for fixed direct export costs, we find that the coefficients on both vertical and horizontal differentiation are of the sign consistent with the model predictions. Specifically, the interaction term between (log) physical distance and quality ladder is negative and significant at 5% level. Regarding the effects of horizontal differentiation, we obtain a positive and marginally significant (at 10% level) coefficient on the inverse of the elasticity of substitution ($1/\sigma$) when US-based R&D intensity is used as the measure of vertical differentiation.

When genetic distance is used as the proxy for fixed trade costs in the lower panel of Table 9, we obtain a pattern of coefficients largely consistent with the results above. The coefficients are particularly significant for the interaction terms with quality ladder. These fairly significant empirical results provide support to Claim 3, and complement the existing findings on the effects of market penetration and the use of intermediaries.

5 Conclusion

This paper examines theoretically and empirically the relation between the prevalence of trade intermediaries in exports and the degree of vertical and horizontal differentiation of the product. Our model, which features heterogeneous quality across varieties within product categories, delivers a negative relationship between the share of intermediated exports and the scope of vertical differentiation of the product, but a positive relationship with the degree of horizontal differentiation. The reason is that when investments in quality verification are needed to enhance sales, intermediaries may underinvest in quality verification due to hold-up by the producers. The hold-up effects intensify for the more vertically differentiated products. An increase in horizontal differentiation of the product, on the other hand, weakens the competitive advantage of the high-quality (large) producers, which in turn increases the share of low-quality firms and thus intermediated exports.

Using transaction-level data for the universe of Chinese intermediated and direct exports in 2005, we find supporting evidence for the predicted relationships between vertical differentiation, horizontal differentiation, and intermediated trade. While our results contrast the quality-verification view in the existing literature, they support the previously documented positive relationship between product differentiation and the prevalence of intermediated exports. Our model highlights the importance of separating the effects of vertical and horizontal differentiation in the study of trade intermediation.

Complementing the existing studies on trade intermediaries, this paper finds a larger share of intermediated exports to more distant markets, in terms of both physical and cultural distances.

The distance effects appear to be weaker in more vertically-differentiated markets, but are magnified instead in more horizontally-differentiated ones.

6 Reference

1. Ahn, J., A. Khandelwal, and S.J. Wei (2010) "The Role of Intermediaries in Facilitating Trade," mimeo Columbia University.
2. Akerman, A. (2010) "A Theory on the Role of Wholesalers in International Trade based on Economies of Scope," mimeo Stockholm University.
3. Antras, P., and A. Costinot (2010) "Intermediated Trade," mimeo Harvard University.
4. Antras, P. (2005) "Incomplete Contracts and the Product Cycle," *American Economic Review*, Vol. 95, No. 4, pp. 1054-1073.
5. Antras, P., and Elhanan Helpman (2004) "Global Sourcing," *Journal of Political Economy*, Vol. 112, No. 3, pp. 552-580.
6. Arkolakis, C. (2010) "Market Penetration Costs and the New Consumers Margin in International Trade," forthcoming, *Journal of Political Economy*.
7. Bernard, A and M. Grazzi and C. Tomasi (2010a) "Intermediaries in International Trade: direct versus indirect modes of export," mimeo, University of Trento.
8. Bernard, A., B. Jensen, S. Redding, and P. Schott (2010b) "Wholesalers and Retailers in U.S. Trade," *American Economic Review Papers & Proceedings*, vol 100(2), pp. 408-413.
9. Bernard, A., S. Redding, and P. Schott (2010c) "Multiple-Product Firms and Product Switching," *American Economic Review*, Volume 100, no. 1, pp. 70–97.
10. Berman, M. and T. Mayer (2009), "How Do Different Exporters React to Exchange Rate Changes? Theory, Empirics and Aggregate Implications." CEPR Working Paper #7493.
11. Biglaiser, G. (1993) "Middlemen as Experts," *Rand Journal of Economics*, vol 24, pp. 212-23.
12. Biglaiser, G., and J. Friedman (1994) "Middlemen as Guarantors of Quality," *International Journal of Industrial Organization*, Volume 12, Issue 4, pp. 509-531.
13. Brandt, L., J. Van Biesebroeck, and Y. Zhang (2009) "Creative Accounting or Creative Destruction? Firm-Level Productivity Growth in Chinese Manufacturing", NBER Working Paper No. 15152.
14. Broda, C. and D. Weinstein (2006) "Globalization and the Gains from Variety," *Quarterly Journal of Economics*, Volume 121, Issue 2, pp. 541-585.
15. Crozet, M., K. Head, and T. Mayer (2010) "Quality sorting and trade: Firm-level evidence for French wine," CEPR Discussion Papers 7295, C.E.P.R. Discussion Papers.

16. Fajgelbaum, P. and G.M. Grossman and E. Helpman (2009) "Income Distribution, Product Quality, and International Trade," NBER Working Paper, No. w15329.
17. Feenstra, R., and G. Hanson (2004) "Intermediaries in Entrepot Trade: Hong Kong Re-Exports of Chinese Goods," *Journal of Economics & Management Strategy*, Vol 1, pp. 3-35.
18. Feenstra, R., G. Hanson, S. Lin (2004) "The Value of Information in International Trade: Gains to Outsourcing through Hong Kong," *The B.E. Journal of Economic Analysis & Policy*, Berkeley Electronic Press, vol. 0(1).
19. Felbermayr, G. and B. Jung (2009) "Trade Intermediation and the Organization of Exporters," mimeo University of Hohenheim.
20. Grossman, S. and O. Hart (1986) "The Costs and Benefits of Ownership: A theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94(4), pp. 692-719.
21. Guiso, L, P. Sapienza and L. Zingales (2009) "Cultural Biases in Economic Exchange?" *Quarterly Journal of Economics*, Vol. 124, No. 3, pp. 1095-1131.
22. Hallak, J.C. (2006) "Product Quality and the Direction of Trade," *Journal of International Economics*, 68(1), pp. 238-265.
23. Hallak, J.C., and J. Sivadasan (2009) "Firms' Exporting Behavior under Quality Constraints," NBER Working Papers 14928.
24. Hallak, J.C., and P. Schott (forthcoming) "Estimating Cross-Country Differences in Product Quality" *Quarterly Journal of Economics*.
25. Khandelwal, A. (2010), "The Long and Short (of) Quality Ladders," *Review of Economic Studies*, 77(4), 1450-1476.
26. Kugler, M. and E. Verhogeem (2010) "Prices, Plant Size, and Product Quality." mimeo Columbia University.
27. Li, Y. (1998) "Middlemen and Private Information," *Journal of Monetary Economics*, vol 42(1), pp. 131-159.
28. Manova K. and Z. Zhang (2009) "China's Exporters and Importers: Firms, Products, and Trade Partners," mimeo Stanford University.
29. Mandel R. (2009) Heterogeneous Firms and Import Quality: Evidence from Transaction-Level Prices (2009); FRB International Finance Discussion Paper #991.
30. Moulton, B. (1990) "An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Unit," *The Review of Economics and Statistics*, 72(2), 334-38.

31. Nunn N., (2007) "Relationship-Specificity, Incomplete Contracts and the Pattern of Trade," *Quarterly Journal of Economics*, Vol. 122, No. 2, pp. 569-600.
32. Peng, M., and A. Ilinitch (1998) "Export Intermediary Firms: A Note on Export Development Research," *Journal of International Business Studies*, 29, pp. 609-620.
33. Peng, M., Y. Zhou and A.S. York (2006) "Behind Make or Buy Decision in Export Strategy: A Replication and Extension of Trabold," *Journal of World Business*, 41, pp. 289-300.
34. Peng, M. and A.S. York (2001). "Behind Intermediary Performance in Export Trade: Transactions, Agents, and Resources," *Journal of International Business Studies*, vol 32 (2), pp. 327-346.
35. Petropoulou, D. (2010) "Information Costs, Networks and Intermediation in International Trade," University of Oxford, Department of Economics, Discussion Paper.
36. Rauch, J. (1999). "Networks Versus Markets in International Trade," *Journal of International Economics*, vol 48, pp. 7-35.
37. Rauch, J., and V. Trindade (2002) "Ethnic Chinese Networks in International Trade", *Review of Economics and Statistics*, vol 84, pp. 116-130.
38. Rauch, J., and Watson, J. (2004) "Network Intermediaries in International Trade," *Journal of Economics and Management Strategy*, 13(1): 69-93.
39. Rubinstein, A. and A. Wolinsky (1987). "Middlemen," *Quarterly Journal of Economics*, vol 107, pp. 581-593.
40. Spolaore, E. and R. Warziarg (2009). "The Diffusion of Development," *Quarterly Journal of Economics*, Vol. 124, No. 2, pp. 469-529.
41. Spulber, D. (1996). "Market Microstructure and Intermediation," *Journal of Economic Perspectives*, vol 10, pp. 135-152.
42. Sutton, J. (1991). *Sunk Costs and Market Structure*, MIT Press.
43. Sutton, J. (1998). *Technology and Market Structure*, MIT Press.
44. Trabold, H. (2002). "Export Intermediation: An Empirical Test of Peng and Ilinitch," *Journal of International Business Studies*, 33, pp. 327-344.
45. Verhogeem, E. (2008). "Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector," *Quarterly Journal of Economics*, vol. 123, no. 2, pp. 489-530.
46. Yoshino, M.Y. and T. Lifson (1986). *The Invisible Link*, The MIT Press.

A Appendix

A.1 Theoretical Appendix

A.1.1 Deriving the firm's export value under direct exporting

Given that export revenue is $x(\rho) = p^{-(\sigma-1)} a^{\sigma-1} D^\sigma$, we can plug in $q_D(\rho)$ and $\lambda_D(\rho)$ and solve for $x(\rho) = \left(\frac{w\tau\rho^{\phi-1}}{\alpha}\right)^{-(\sigma-1)} \left(\left[\frac{\alpha^\sigma \beta D^\sigma \rho^{(\beta+1-\phi)(\sigma-1)}}{w^\sigma \tau^{\sigma-1}}\right]^{\frac{1}{1-\beta(\sigma-1)}} \rho\right)^{\beta(\sigma-1)} D^\sigma$.

A.1.2 Deriving the firm's operating profits under direct exporting

Given that $\pi^o(\rho) = (aq)^\alpha D - w\tau\rho^{\phi-1}q - w\lambda$. Plugging $q_D(\rho)$ and $\lambda_D(\rho)$ solved in the text, we can solve for the closed form solution of $\pi_D(\rho)$ as $(1 - (1 + \beta)\alpha) = \left[\left(\frac{\alpha}{w}\right)^{\alpha(\beta+1)} \beta^\alpha \rho^{\alpha(\beta+1-\phi)}\right]^{\frac{1}{1-\alpha(\beta+1)}} - wf_D$, where $\Lambda \equiv D\tau^{-\alpha}$. Notice that when $\beta = 0$, $\pi^o(\rho) = x(\rho)/\sigma - wf_D$, which is a standard formula for profits in the monopolistic competition model.

A.1.3 Deriving the export value under indirect exporting

Given that $\pi_I(\rho) = x(q_I, \lambda_I) - w\rho^{\phi-1}q_I\tau - w\lambda_I - wf^I$. Plugging $q_I(\rho)$ and $\lambda_I(\rho)$ solved in the text, we can solve for the closed form solution of $\pi_I(\rho)$ as $\pi_I(\rho) = \left[1 - \left(\frac{1}{2} + \frac{\beta}{2-\delta}\right)\alpha\right] x_I(\rho) - wf^I$.

A.1.4 Conditions that $\rho_I < \rho_D$

The cutoff for direct exports ρ_D is pinned down by equation (x): $\pi_I(\rho_D) = \pi_D(\rho_D)$. Solving it out gives $x(\rho_D) = \frac{w(f_D - f_I)}{(1 - (1 + \beta)\alpha - AB)}$. The cutoff for indirect exports ρ_I is pinned down by equation (x): $\pi_I(\rho_I) = 0$. Solving it out gives $x(\rho_I) = \frac{wf_I}{AB}$. To ensure that $\rho_D > \rho_I$, what we need to show is $x(\rho_D)/x(\rho_I) > 1$, which implies $\left(\frac{f_D}{f_I} - 1\right) > \left(\frac{1 - (1 + \beta)\alpha}{AB} - 1\right) \Rightarrow \frac{f_D}{f_I} > \frac{1 - (1 + \beta)\alpha}{AB}$.

A.1.5 Proof of Claim 1

Recall that $A = \left[2^{-1}(2 - \delta)^{-\beta}\right]^{\frac{\alpha}{1 - \alpha(1 + \beta)}}$ and $B = \left[1 - \left(2^{-1} + (2 - \delta)^{-1}\beta\right)\alpha\right]$. To show that $\frac{X_I}{X_D} = A \left\{ \left[\left(\frac{f_D}{f_I} - 1\right) \frac{AB}{[(1 - (1 + \beta)\alpha) - AB]}\right]^{\frac{\kappa - \eta(\beta, \sigma)}{\eta(\beta, \sigma)}} - 1 \right\}$ is *decreasing* in β , it is sufficient to show that $\zeta \equiv \ln \left[\frac{1 - (1 + \beta)\alpha}{AB}\right]$ is *increasing* in β . Using the fact that $\frac{\partial \ln A}{\partial \beta} = \frac{\alpha}{(1 - \alpha(1 + \beta))^2} [-\alpha \ln(2) - (1 - \alpha) \ln(2 - \delta)]$, $\frac{\partial \ln B}{\partial \beta} = -\frac{\alpha}{2 - \delta} \left[1 - \left(\frac{1}{2} + \frac{1}{2 - \delta}\beta\right)\alpha\right]^{-1}$, we can show that

$$\begin{aligned}
\frac{\partial \zeta}{\partial \beta} &= \frac{\partial \ln(1 - \alpha(1 + \beta))}{\partial \beta} - \frac{\partial \ln A}{\partial \beta} - \frac{\partial \ln B}{\partial \beta} \\
&= -\frac{\alpha}{1 - \alpha(1 + \beta)} + \frac{\alpha [\alpha \ln(2) + (1 - \alpha) \ln(2 - \delta)]}{(1 - \alpha(1 + \beta))^2} + \frac{\alpha}{2 - \delta} \left[1 - \left(\frac{1}{2} + \frac{1}{2 - \delta} \beta \right) \alpha \right]^{-1} \\
&= \frac{\alpha}{1 - \alpha(1 + \beta)} \left\{ \frac{[\alpha \ln(2) + (1 - \alpha) \ln(2 - \delta)]}{1 - \alpha(1 + \beta)} - \frac{1}{1 - \alpha \left(\frac{1}{2} + \frac{1}{2 - \delta} \beta \right)} \left(\frac{1 - \delta}{2 - \delta} + \frac{\delta}{2 - \delta} \frac{\alpha}{2} \right) \right\} \\
&= \frac{\alpha}{(1 - \alpha(1 + \beta))^2} \left[\alpha \left(\ln(2) - \frac{\Psi}{2} \right) + (1 - \alpha) \left(\ln(2 - \delta) - \Psi \left(\frac{1 - \delta}{2 - \delta} \right) \right) \right]
\end{aligned}$$

where $\Psi = \frac{1 - \alpha(1 + \beta)}{1 - \alpha(2^{-1} + (2 - \delta)^{-1} \beta)} < 1$. Since all the terms inside parentheses are positive, $\frac{\partial \zeta}{\partial \beta} > 0$ and thus $\frac{\partial(X_I/X_D)}{\partial \beta} < 0$, $\forall \alpha \in (0, 1)$, $\delta \in (0, 1)$, and $\beta \in \left(\phi - 1, \frac{1}{\sigma - 1} \right)$ (under Assumption 1).

A.1.6 Proof of Claim 2

Similar to the proof for claim 1, to show that $\frac{X_I}{X_D}$ is *decreasing* in α , it is sufficient to show that $\zeta \equiv \ln \left[\frac{(1 - (1 + \beta)\alpha)}{AB} \right]$ is *increasing* in α .

$$\frac{\partial \ln A}{\partial \alpha} = \frac{\ln[2^{-1}(2 - \delta)^{-\beta}]}{(1 - \alpha(1 + \beta))^2} \quad \text{and} \quad \frac{\partial \ln B}{\partial \alpha} = -\frac{(2^{-1} + (2 - \delta)^{-1} \beta)}{1 - (2^{-1} + (2 - \delta)^{-1} \beta)\alpha}.$$

$$\begin{aligned}
\frac{\partial \zeta}{\partial \alpha} &= \frac{\partial \ln(1 - (1 + \beta)\alpha)}{\partial \alpha} - \frac{\partial \ln A}{\partial \alpha} - \frac{\partial \ln B}{\partial \alpha} \\
&= \frac{(1 + \beta)}{1 - (1 + \beta)\alpha} \left[\frac{\ln(2) + \beta \ln(2 - \delta)}{(1 + \beta)(1 - (1 + \beta)\alpha)} + \frac{(2^{-1} + (2 - \delta)^{-1} \beta) - (1 + \beta)}{(1 - (2^{-1} + (2 - \delta)^{-1} \beta)\alpha)(1 + \beta)} \right] \\
&= \frac{1}{1 - (1 + \beta)\alpha} \left[\frac{\ln(2) + \beta \ln(2 - \delta)}{1 - (1 + \beta)\alpha} - \frac{\left(\frac{1}{2} + \frac{1 - \delta}{2 - \delta} \beta \right)}{(1 - (2^{-1} + (2 - \delta)^{-1} \beta)\alpha)} \right] \\
&= \frac{1}{(1 - (1 + \beta)\alpha)^2} \left[\left(\ln(2) - \frac{1}{2} \Lambda \right) + \beta \left(\ln(2 - \delta) - \frac{1 - \delta}{2 - \delta} \Lambda \right) \right],
\end{aligned}$$

where $\Lambda < 1$ is defined as above. It can be readily shown that the term inside the square brackets is always positive, $\forall \alpha \in (0, 1)$, $\gamma \in (0, 1)$, $\delta \in (0, 1)$ and $\beta \in \left(\phi - 1, \frac{1}{\sigma - 1} \right)$ (under Assumption 1).

A.1.7 Proof of Claim 3

According to equation (5), it can be readily shown that $\frac{\partial \ln(X_I/X_D)}{\partial \ln(f_D/f_I)} > 0$. This proves the first part of the claim. The fact that $\frac{\kappa - \eta(\beta, \sigma)}{\eta(\beta, \sigma)}$ is decreasing in β and σ , respectively, proving that the positive distance effect is mitigated for products that are more vertically differentiated or less horizontally differentiated.

A.2 Data Appendix

A.2.1 Country Variables

1. GDP: World Bank World Development Indicators.
2. GDP per capita: World Bank World Development Indicators.
3. Distance: Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)
4. Rule of law: World Bank Governance Indicators
5. Population: World Bank World Development Indicators
6. Chinese population around the World: Ohio University Shao Center's Distribution of the Ethnic Chinese Population Around the World
7. Genetic distance: Spolaore and Warziarg (2009). Both population-weighted average and unweighted average, based on the dominance of ethnic groups in the country.

A.2.2 Product Variables

1. Research and Development (R&D) Intensity; = Average of R&D Expenditure/ Sales across firms; Source: China's National Bureau of Statistics (CNBS) in 2005
2. R&D and Advertising Intensity: = Average of R&D Expenditure/ Sales across firms; Source: China's National Bureau of Statistics (CNBS) in 2005
3. R&D Intensity (USA): = Average of R&D Expenditure/ Sales across firms; Source: Orbis in 2005
4. Elasticity of Substitution (σ): Broad and Weinstein (2006)
5. Differentiated-good Indicator: Rauch (1999)
6. Other variables: Computed from China's transaction-level customs data

Figure 2: Exporter profits under different trading mode in a product market

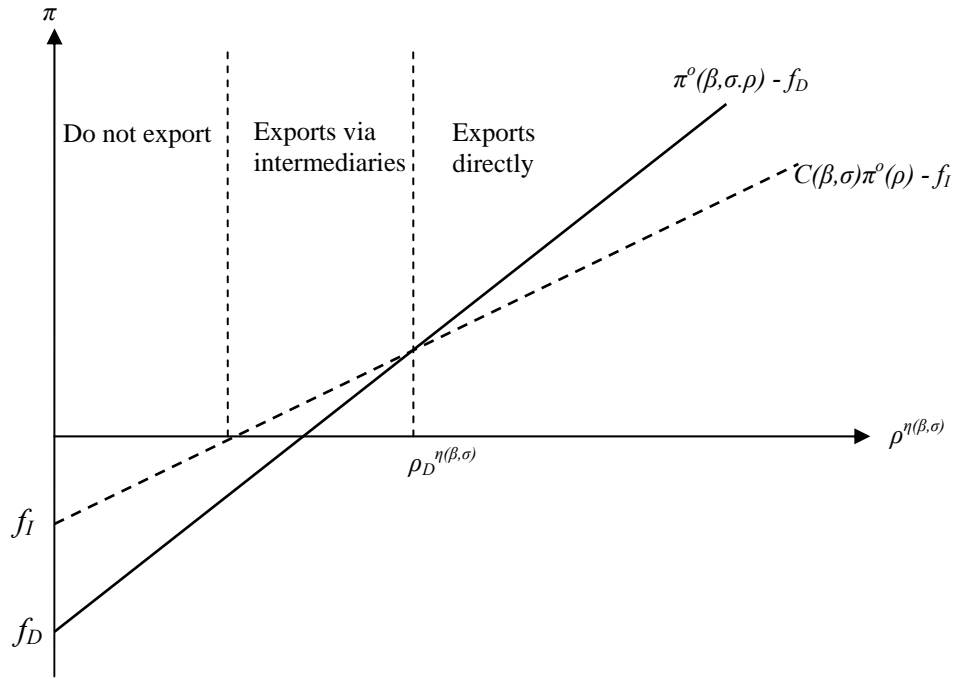


Figure 3: Exporter profits under different trading mode in products with different quality differentiation

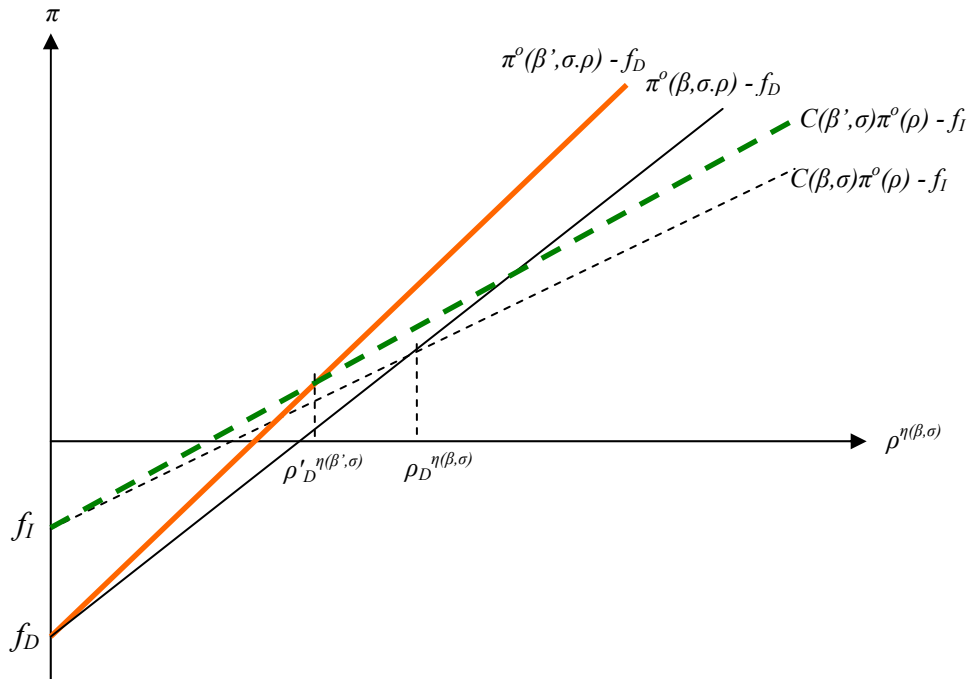
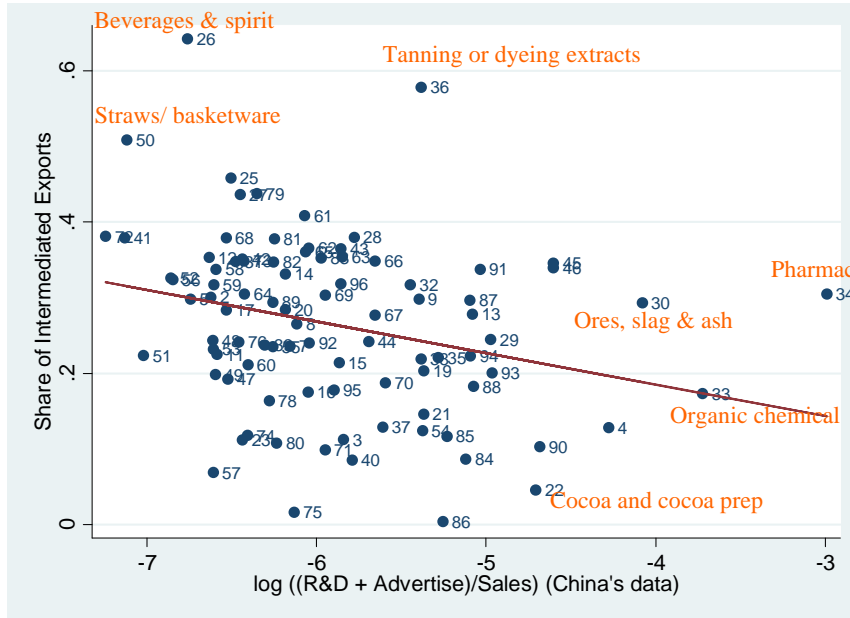


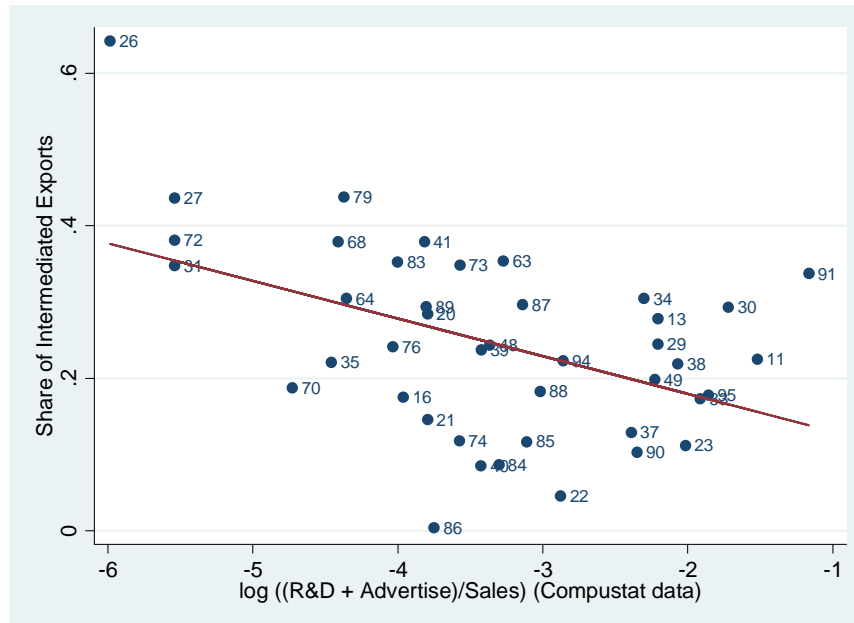
Figure 4: Share of Intermediated Exports and R&D and Advertising Cost Share (Chinese-based Measures)



$$\text{Share} = .018 - 0.0417 * (\text{R\&D_Adv/Sales})$$

(0.19) (-2.57); N=90

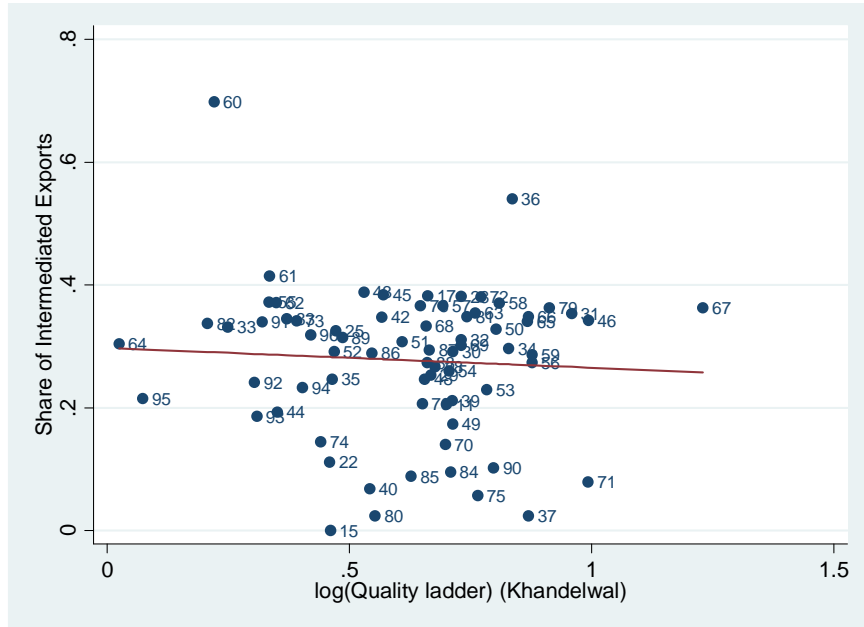
Figure 5: Share of Intermediated Exports and R&D and Advertising Cost Share (US-based Measures)



$$\text{Share} = .081 - 0.0493 * (\text{R\&D_Adv/Sales})$$

(1.39) (-2.81); N=42

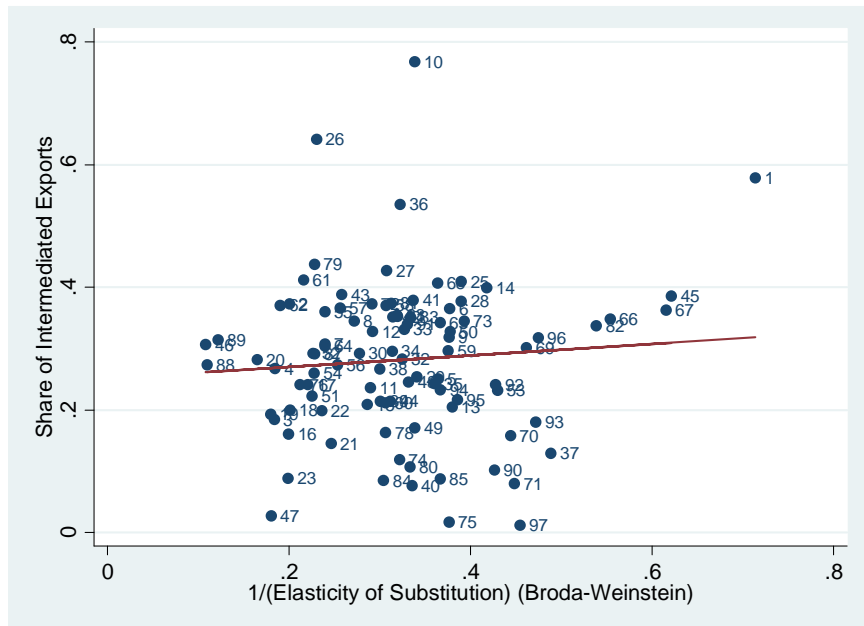
Figure 6: Share of Intermediated Exports and Quality Ladder (US-based Measures)



$$\text{Share} = 0.297 - 0.032 * Q_ladder$$

(6.54) (-0.47); N=71

Figure 7: Share of Intermediated Exports and 1/Elasticity of Substitution (US-based Measures)



$$\text{Share} = 0.251 - 0.0943(1/\sigma)$$

(6.06) (-0.73); N=94

Figure 8: Relationship between Vertical (R&D+Adv/Sales (China's data) Chinese Firms) and Horizontal Differentiation (1/σ)

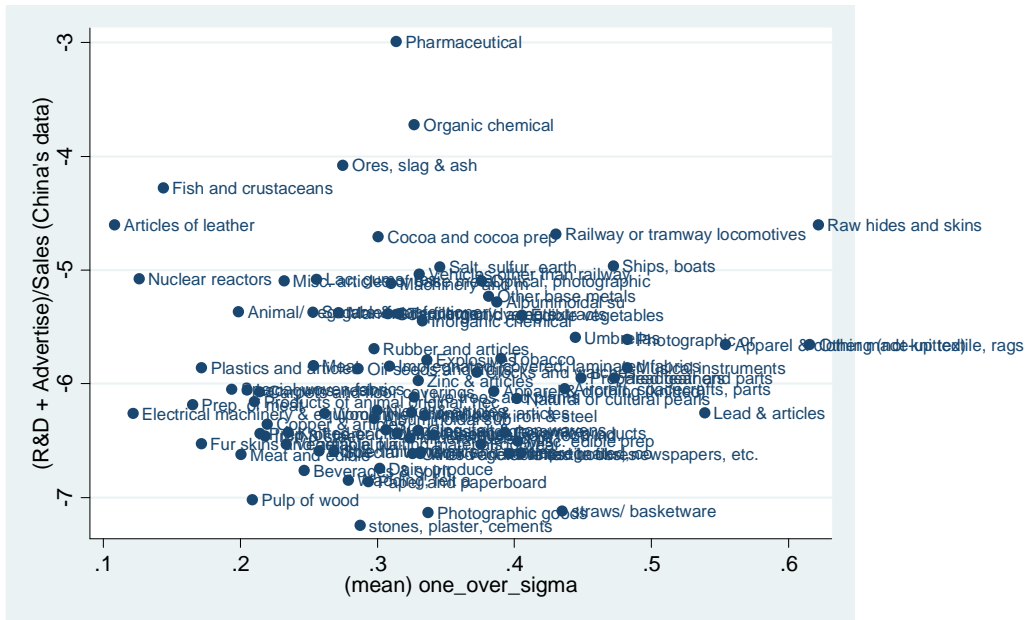


Table 1: Direct Exporters vs. Intermediaries in China's Exports (2000-2006)

This table reports the evolution of the shares of direct versus intermediated exports from 2000 to 2006.

Year	Direct Exporters' Export Value (billion USD)	Intermediaries Export value (billion USD)	Share in Total Value (%)	Num. Direct Exports	Num. Intermediaries	Share (%)
2000	167.1	82.2	33.0	54,968	7,803	12.4
2001	184.8	81.0	30.5	59,500	8,572	12.6
2002	235.5	90.1	27.7	68,966	9,646	12.3
2003	328.5	109.8	25.0	82,959	12,670	13.2
2004	463.2	130.5	22.0	103,822	16,767	13.9
2005	610.2	151.4	19.9	128,064	19,866	13.4
2006	764.5	204.0	21.1	135,548	37,024	21.5

Source: Authors' calculations from China's transaction-level customs database.

Table 2: Number of Destination Countries and Products by Type of Exporters in 2005

This table reports the summary statistics of the number of destination countries and number of products served by direct exporters and trade intermediaries, respectively.

	Mean	Median	St. Dev.	Min	Max
<u>Direct Exporters</u>					
Number of destination countries	6.9	3	10.2	1	152
Number of products	10.6	3	37	1	2455
Number of products per destination	3.66	1	13.12	1	1732
Export sales per destination (USD)	197609	21445.2	2543245	1	6.55E+08
Export sales per product (HS6) (USD)	102115.8	5837.667	1852768	1	7.85E+08
<u>Intermediaries</u>					
Number of destination countries	14.5	6	19.7	1	169
Number of products	43	11	90.5	1	1454
Number of products per destination	7.09	2	18.53	1	1316
Export sales per destination (USD)	88187.81	17452.8	1337737	1	4.28E+08
Export sales per product (HS6) (USD)	52525.21	6566	720910.4	1	3.05E+08

Source: Authors' calculations from China's transaction-level customs database.

Table 3: Share of Intermediate Exports and Vertical Differentiation (by HS 6-digit)

This table explores the relationship between vertical differentiation and the share of intermediated exports across HS 6-digit product categories. Four measures of vertical differentiation are used. R&D intensity is the average of the ratio of R&D expenditure to sales, based on firm-level data in 2005 from China's National Bureau of Statistics. Adv + R&D intensity is the average of the ratio of advertising plus R&D expenditure to sales, based on firm-level data from the same NBS data set. R&D intensity (USA) is the average ratio of R&D expenditure to sales of the sample USA firms in the ORBIS database. Quality ladder is obtained from Khandelwal (2009).

Dependent Var. = Share of Exports Through Intermediaries in each HS6 cell								
Vertical Diff (V)	R&D Intensity		Adv + R&D Intensity		R&D Intensity (USA)		Quality Ladder	
V	-0.081***	-0.086***	-0.084***	-0.055**	-0.105***	-0.070***	-0.039**	-0.001
	(-5.16)	(-3.49)	(-5.08)	(-2.28)	(-6.91)	(-3.17)	(-2.17)	(-0.06)
State Share	-0.174***	-0.162***	-0.181***	-0.165***	-0.166***	-0.160***	-0.191***	-0.166***
	(-6.26)	(-5.81)	(-6.57)	(-5.94)	(-6.42)	(-6.07)	(-6.48)	(-5.53)
Foreign Share	-0.473***	-0.453***	-0.475***	-0.456***	-0.492***	-0.470***	-0.516***	-0.495***
	(-17.87)	(-16.54)	(-18.03)	(-16.60)	(-20.26)	(-18.36)	(-18.72)	(-16.73)
HS 2-digit FE	No	Yes	No	Yes	No	Yes	No	Yes
N	3164	3164	3164	3164	3608	3608	2732	2732
R-squared	.166	.262	.166	.261	.186	.26	.185	.262

t statistics in parentheses; beta coefficients are reported; standard errors are clustered at the HS 6-digit level; * p<0.10; ** p<0.05; *** p<0.01

Table 4: Share of Intermediated Exports and Horizontal Differentiation (by HS 6-digit)

This table explores the relationship between horizontal differentiation and the share of intermediated exports across HS 6-digit product categories. Two measures of horizontal differentiation are used. Rauch's diff-good dummy is obtained from Rauch (1999). $1/\sigma$ is the inverse of the elasticity of substitution estimated by Broda and Weinstein (2006).

Dependent Var. = Share of Exports Through Intermediaries in each HS6 cell				
Horizontal Diff. (H)	Rauch's Diff. Dummy		1/ σ	
H	0.050***	0.020	0.021	0.044***
	(3.25)	(0.73)	(1.34)	(2.70)
State Share	-0.167***	-0.144***	-0.179***	-0.155***
	(-7.16)	(-6.05)	(-6.93)	(-5.90)
Foreign Share	-0.488***	-0.444***	-0.477***	-0.446***
	(-21.58)	(-18.84)	(-19.11)	(-16.76)
HS 2-digit FE	No	Yes	No	Yes
N	4169	4169	3413	3413
R-squared	.165	.255	.157	.248

t statistics in parentheses; beta coefficients reported; standard errors clustered at HS 6-digit;
 * p<0.10; ** p<0.05; *** p<0.01

Table 5: Share of Intermediated Exports and Vertical and Horizontal Differentiation (by HS 6-digit x country)

This table includes vertical differentiation and horizontal differentiation as regressors simultaneously. The sample consists of all combinations of HS 6-digit product and destination country. Country fixed effects are always controlled for. Other controls include the shares of exports from FIEs and SOEs.

Vertical Diff. (V)	R&D Intensity			Adv + R&D Intensity			R&D Intensity (USA)			Quality Ladder		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
V	-0.055***	-0.025**	-0.024**	-0.046***	-0.027**	-0.025**	-0.065***	-0.043***	-0.044***	-0.025***	-0.008	-0.007
	(-7.84)	(-2.24)	(-2.10)	(-6.53)	(-2.41)	(-2.19)	(-10.39)	(-4.92)	(-4.92)	(-3.53)	(-1.17)	(-1.01)
1/σ	0.024***	0.031***	0.031***	0.021***	0.031***	0.031***	0.026***	0.031***	0.030***	0.014**	0.029***	0.029***
	(3.61)	(4.61)	(4.54)	(3.11)	(4.62)	(4.55)	(4.17)	(4.93)	(4.83)	(2.13)	(4.49)	(4.48)
HS 2-digit FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Country FE	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Country x HS2 FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
N	180584	180584	180584	180584	180584	180584	204399	204399	204399	194304	194304	194304
R-squared	.011	.0595	.159	.0101	.0595	.159	.0131	.0583	.149	.00882	.0564	.142

t statistics in parentheses; beta coefficients reported; standard errors clustered at HS 6-digit;

* p<0.10; ** p<0.05; *** p<0.01

Table 6: Robustness Checks; more HS6 controls

This table conducts the same analysis of Table 5, with a progressive set of HS6-specific control variables added. The dependent variable is the share of Exports Through Intermediaries in each HS6-country cell. Country fixed effects, export share of state-owned enterprises, and export share of foreign firms are always controlled for. All columns include the following controls: (1) export share of export-processing exporters; (2) Herfindahl index of intermediaries' sales; (3) Herfindahl index of direct exporters' sales; (4) number of direct exporters over number of intermediaries.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Vertical Diff. (V)	R&D Intensity			Adv + R&D Intensity			R&D Intensity (USA)			Quality Ladder		
V	-0.034*** (-3.15)	-0.037*** (-3.27)	-0.024* (-1.82)	-0.031*** (-2.96)	-0.033*** (-3.00)	-0.023* (-1.80)	-0.033*** (-3.93)	-0.037*** (-4.37)	-0.038*** (-3.73)	-0.007 (-1.18)	-0.008 (-1.25)	-0.007 (-0.88)
1/σ	0.022*** (3.44)	0.023*** (3.55)	0.024*** (3.20)	0.022*** (3.49)	0.023*** (3.61)	0.024*** (3.23)	0.022*** (3.85)	0.022*** (3.72)	0.024*** (3.55)	0.020*** (3.43)	0.020*** (3.35)	0.022*** (3.14)
Capital Intensity		-0.003 (-0.31)	-0.002 (-0.14)		-0.004 (-0.35)	-0.002 (-0.14)		-0.007 (-0.79)	-0.007 (-0.67)		-0.006 (-0.58)	-0.009 (-0.81)
Skill Intensity		0.022* (1.82)	0.026* (1.94)		0.021* (1.75)	0.025* (1.90)		0.017 (1.35)	0.020 (1.48)		0.011 (0.92)	0.018 (1.34)
Contract Dependence			-0.033** (-2.32)			-0.035** (-2.39)			-0.036*** (-2.96)			-0.021* (-1.66)
Exp. Shr. Exp. Process	-0.052*** (-4.79)	-0.052*** (-4.76)	-0.067*** (-5.44)	-0.051*** (-4.72)	-0.051*** (-4.69)	-0.067*** (-5.42)	-0.051*** (-4.92)	-0.051*** (-4.95)	-0.064*** (-5.35)	-0.049*** (-4.54)	-0.049*** (-4.55)	-0.061*** (-4.82)
Hurf. Intermediaries	0.005 (0.60)	0.004 (0.51)	0.000 (0.02)	0.005 (0.60)	0.004 (0.50)	0.000 (0.03)	0.007 (0.88)	0.007 (0.91)	0.004 (0.48)	-0.000 (-0.05)	-0.000 (-0.02)	-0.004 (-0.39)
Hurf. Direct Exp.	-0.010 (-1.23)	-0.010 (-1.25)	-0.000 (-0.00)	-0.010 (-1.33)	-0.011 (-1.36)	-0.001 (-0.06)	-0.010 (-1.46)	-0.010 (-1.38)	0.000 (0.05)	-0.012 (-1.62)	-0.012 (-1.60)	-0.001 (-0.13)
Num. Direct Exp./ Num. Intermed.	-0.119*** (-11.01)	-0.119*** (-10.72)	-0.123*** (-8.95)	-0.118*** (-11.06)	-0.119*** (-10.78)	-0.123*** (-8.99)	-0.123*** (-12.08)	-0.124*** (-11.96)	-0.133*** (-10.21)	-0.117*** (-10.95)	-0.118*** (-10.76)	-0.130*** (-9.03)
Controls	State Shares; Foreign Shares											
Country x HS2 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	180454	176311	136866	180454	176311	136866	204280	203985	159100	194244	192993	147191
R-squared	.171	.168	.185	.171	.168	.185	.162	.162	.177	.154	.154	.168

t statistics in parentheses; beta coefficients reported; standard errors clustered at HS 6-digit; * p<0.10; ** p<0.05; *** p<0.01

Table 7: Sensitivity Analysis

This table conducts the identical analysis of column 1 in Table 6 over different samples or using dependent variables. The dependent variable is the share of Exports Through Intermediaries in each HS6-country cell. In columns (1) to (4), observations to Hong Kong are excluded. In calculating the share of intermediated exports, state-owned enterprises' (SOE) exports are excluded in columns (5) to (8); foreign invested firms' (FIE) exports are excluded in columns (9) to (12); exports by export-processing (XP) firms are excluded in columns (13) to (16). Country fixed effects, export share of SOEs, export share of FIEs and export share of XP firms are controlled for in all specifications. Dependent variables are different measures of shares of intermediated exports.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Vertical Diff. (V)	R&D	Adv + R&D	R&D (USA)	Ladder	R&D	Adv + R&D	R&D (USA)	Ladder
	Exclude exports to Hong Kong				Share of intermediated exports (non-SOE)			
V	-0.034***	-0.031***	-0.034***	-0.007	-0.032***	-0.030***	-0.032***	-0.006
	(-3.14)	(-2.97)	(-3.97)	(-1.20)	(-2.76)	(-2.65)	(-3.58)	(-0.95)
1/σ	0.021***	0.022***	0.022***	0.020***	0.021***	0.021***	0.019***	0.018***
	(3.37)	(3.42)	(3.81)	(3.38)	(3.06)	(3.10)	(3.14)	(2.86)
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Vertical Diff. (V)	R&D	Adv + R&D	R&D (USA)	Ladder	R&D	Adv + R&D	R&D (USA)	Ladder
	Share of intermediated exports (non-FIE)				Share of intermediated exports (non-XP)			
V	-0.029***	-0.022**	-0.026***	-0.010*	-0.035***	-0.029***	-0.032***	-0.006
	(-2.90)	(-2.28)	(-3.44)	(-1.81)	(-3.51)	(-3.01)	(-4.19)	(-1.00)
1/σ	0.016***	0.017***	0.017***	0.016***	0.019***	0.019***	0.018***	0.016***
	(2.70)	(2.78)	(3.07)	(2.74)	(3.06)	(3.14)	(3.33)	(2.84)

t statistics in parentheses; beta coefficients reported; standard errors clustered at HS 6-digit; * p<0.10; ** p<0.05; *** p<0.01

Table 8: Share of Intermediated Exports and Distance (by HS 6-digit x country)

This table explores the relationship between fixed trade barriers and the share of intermediated exports across countries. HS 6-digit fixed effects are always included.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Country Measures	ln(GDP)	ln(Dist.)	ln(Import Doc.)	ln(Import Days)	ln(Import Cost)	Legal Inst.	ln(Gen. Dist.)	Chinese Pop. Share
Dest. Country Var.	-0.087*** (-28.15)	0.059*** (25.20)	0.002 (0.93)	0.026*** (7.60)	0.004* (1.84)	-0.041*** (-10.13)	0.061*** (25.56)	-0.031*** (-14.62)
HS 6-digit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	228254	228254	221792	221792	221792	228254	196411	179653
R-squared	.137	.136	.134	.135	.134	.134	.14	0.147

t statistics in parentheses

Standard errors are clustered at the HS 6-digit level.

* p<0.10, ** p<0.05, *** p<0.01

Table 9: Share of Intermediated Exports, Distance, and Product Characteristics (by HS 6-digit x country)

This table examines how vertical and horizontal differentiation affects the distance effects on trade intermediation explored in Table 6. HS 6-digit and country fixed effects are always included

Dependent Var. = Share of exports through intermediaries in each HS6-country cell

	(1)	(2)	(3)	(4)
Distance Measure (Dist.)	ln(dist)			
Product Measure (V or H)	R&D	Adv + R&D	R&D (USA)	Ladder
Dist. X V	-0.052 (-1.13)	-0.057 (-1.25)	-0.043 (-1.13)	-0.096** (-2.49)
Dist. X H	0.038 (0.91)	0.035 (0.85)	0.068* (1.79)	0.048 (1.23)
Fixed Effects	HS6 FEs and Country FEs			
N	162153	162153	183707	174657
R-squared	.151	.151	.148	.142
	(5)	(6)	(7)	(8)
Distance Measure	ln(Genetic dist)			
Product Measure	R&D	Adv + R&D	R&D (USA)	Ladder
Dist. X V	-0.021 (-0.70)	0.040 (1.31)	-0.014 (-0.57)	-0.047** (-2.11)
Dist. X H	-0.014 (-0.58)	-0.015 (-0.64)	0.006 (0.27)	-0.017 (-0.73)
Fixed Effects	HS6 FEs and Country FEs			
N	148203	148203	167693	159264
R-squared	.155	.155	.152	.146

t statistics in parentheses

Standard errors are clustered at the HS 6-digit level.

* p<0.10, ** p<0.05, *** p<0.01

Appendix Tables

Table A1: Summary Statistics of Product-level Variables

Product	Num.						Std.	Mean
	Obs	10th	25th	50th	75th	90th	Dev.	
Share of Interm. Exp.	4490	0	0.010	0.282	0.430	0.596	0.223	0.309
Share of Interm. Exp. (non-SOE)	4478	0.053	0.169	0.337	0.516	0.722	0.251	0.366
Quality Ladder	3050	0.000	0.738	1.816	2.444	3.036	0.895	1.844
R&D Intensity	3574	-7.696	-7.227	-6.496	-5.915	-4.920	1.021	-6.456
R&D + Advertising Intensity	3574	-7.118	-6.452	-5.829	-5.006	-4.495	0.936	-5.721
R&D Intensity (USA)	4030	-6.198	-5.104	-4.199	-3.587	-3.028	1.249	-4.397
Rauch Diff. Classification	4722	0	0	1	1	1	0.490	1
1/σ (Horizontal diff.)	3813	0.040	0.136	0.286	0.455	0.606	0.206	0.308

Table A2: Correlation of Product-level Variables

	Share of Interm. Exp.	Shr Int Exp. (non-SOE)	Quality Ladder	R&D Intensity	R&D Advertising Intensity	R&D Intensity (USA)	Diff
Share of Interm. Exp.	1						
Share of Interm. Exp. (non-SOE)	0.889	1					
Quality Ladder	-0.0279	-0.0002	1				
R&D Intensity	-0.1871	-0.1301	0.1128	1			
R&D Advertising Intensity	-0.1352	-0.1057	0.0352	0.7723	1		
R&D Intensity (USA)	-0.1686	-0.1409	0.1177	0.6032	0.5063	1	
Diff	0.0037	-0.0188	-0.1172	0.126	0.1229	0.0418	1
1/Sigma	0.0281	0.0127	0.0226	0.011	-0.0082	0.0881	0.0183

Table A3: Summary Stats of Country Variables

	Num. Obs.	10th	25th	50th	75th	90th	Mean
ln(GDP)	157	7.016	8.576	9.726	11.693	13.090	10.044
ln(Dist.)	157	8.269	8.794	9.028	9.375	9.536	8.989
Share of Chinese pop.	114	0.000	0.000	0.001	0.002	0.024	0.007
ln(Gen. Dist.)	156	6.295	6.892	7.084	7.580	7.994	6.940
ln(Gen. Dist. Pop Wgted)	156	6.339	6.941	7.085	7.539	7.925	7.076

Table A4: Correlation Country-level Variables

	ln(GDP)	ln(Dist.)	Share of Chinese pop	ln(Gen. Dist.)	ln(Gen. Dist. Pop Wgted)
ln(Dist.)	-0.3052	1			
Share of Chinese pop.	0.0651	-0.1834	1		
ln(Gen. Dist.)	-0.2415	0.6283	-0.389	1	
ln(Gen. Dist. Pop Wgted)	-0.3145	0.6771	-0.434	0.9757	1

Table A5: Most and Least Vertically-differentiated Products (Based on Chinese Firms' Advertising+R&D/Sales)

Top 10

Rank	HS2	V	Industry
1	34	0.050	Soap, organic surface-active agents
2	33	0.024	Essential oils and resinoids; perfumery, cosmetic or toilet preparations
3	30	0.017	Pharmaceutical products
4	4	0.014	Dairy produce; birds eggs; natural honey;
5	46	0.010	Manufactures of straw, of esparto or of other plaiting materials
6	45	0.010	Cork and articles of cork
7	90	0.009	Optical, photographic, cinematographic, measuring, checking, precision, med ...
8	22	0.009	Beverages, spirits and vinegar
9	93	0.007	Arms and ammunition; parts and accessories thereof

Bottom 10

Rank	HS2	V	Industry
81	2	0.001	Meat and edible meat offal
82	12	0.001	Oil seeds and oleaginous fruits
83	5	0.001	Products of animal origin, not elsewhere specified
84	26	0.001	Ores, slag and ash
85	56	0.001	Wadding, felt and non-wovens; special yarns, twine, cordage, ropes and cabl ...
86	52	0.001	Cotton
87	51	0.001	Wool, fine or coarse animal hair; horsehair yarn and woven fabric
88	50	0.001	Silk
89	41	0.001	Raw hides and skins (other than fur skins) and leather
90	72	0.001	Iron and steel

Table A6: Most and Least Vertically-differentiated Products (Based on Khandalwel's Quality Ladder)

<u>Top 10</u>			
Rank	HS2	V	Industry
1	67	3.422	Prepared feathers and down and articles made of feathers or of down
2	46	2.700	Manufactures of straw, of esparto or of other plaiting materials
3	71	2.700	Natural or cultured pearls, precious or semi-precious stones
4	31	2.610	Fertilizers
5	79	2.493	Zinc and articles thereof
6	56	2.404	Wadding, felt and non-wovens; special yarns, twine, cordage, ropes
7	59	2.404	Impregnated, coated, covered or laminated textile fabrics
8	37	2.388	Photographic or cinematographic goods
9	66	2.386	Umbrellas, sun umbrellas, walking sticks, seat sticks, whips, riding-crops
10	65	2.382	Headgear and parts thereof
<u>Bottom 10</u>			
Rank	HS2	V	Industry
62	61	1.399	Articles of apparel and clothing accessories, knitted or crocheted
63	55	1.396	Man-made staple fibers
64	91	1.377	Clocks and watches and parts thereof
65	93	1.362	Arms and ammunition; parts and accessories thereof
66	92	1.355	Musical instruments; parts and accessories of such articles
67	33	1.283	Essential oils and resinoids; perfumery, cosmetic or toilet preparations
68	60	1.247	Knitted or crocheted fabrics
69	82	1.230	Tools, implements, cutlery, spoons and forks, of base metal
70	95	1.076	Toys, games and sports requisites; parts and accessories thereof
71	64	1.025	Footwear, gaiters and the like; parts of such articles

Table A7: Most and Least Horizontally-differentiated Products (Broda-Weinstein $1/\sigma$)

<u>Top 10</u>			
Rank	HS2	H	Industry
1	1	0.714	Live animals
2	45	0.622	Cork and articles of cork
3	67	0.616	Prepared feathers and down and articles made of feathers or of down
4	66	0.554	Umbrellas, sun umbrellas, walking sticks, seat sticks, whips, riding-crops
5	82	0.539	Tools, implements, cutlery, spoons and forks, of base metal
6	37	0.489	Photographic or cinematographic goods
7	96	0.475	Miscellaneous manufactured articles
8	93	0.472	Arms and ammunition; parts and accessories thereof
9	69	0.462	Ceramic products
10	97	0.455	Works of art, collectors' pieces and antiques
<u>Bottom 10</u>			
Rank	HS2	H	Industry
85	23	0.199	Residues and waste from the food industries
86	62	0.190	Articles of apparel and clothing accessories, not knitted or crocheted
87	4	0.185	Dairy produce; birds eggs; natural honey
88	3	0.184	Fish and crustaceans, molluscs and other aquatic invertebrates
89	47	0.180	Pulp of wood or of other fibrous cellulose material
90	19	0.180	Preparations of cereals, flour, starch or milk; bakers' wares
91	20	0.165	Preparations of vegetables, fruit or nuts
92	89	0.122	Ships, boats and floating structures
93	88	0.110	Aircraft, spacecraft, and parts thereof
94	46	0.108	Manufactures of straw, of esparto or of other plaiting materials

Table A8: Requirements for Chinese Trading Companies

	Pre-WTO	Post-WTO
Organization form	Joint Venture	Foreign-invested enterprise
Total Sales	US \$5 billion	US \$10 million
Average trade volume prior to application	US \$30 million annually	US \$1 million annually
Registered Capital	RMB 100 million	RMB 10 million
<u>Domestic Companies</u>		
Average import-export volume prior to application	US \$200 million annually	US \$2 million annually
Average export volume prior to application	US \$100 million annually	US \$1 million annually
Registered Capital	RMB 5 million	RMB 10 million

Zeng (2002)