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Quality Screening and Trade Intermediaries: Evidence from China

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Highlights

- We examine the quality-screening role played by intermediaries in China's exports.
- We uncover substantial heterogeneity among intermediaries, and distinguish two kinds: generalized and specialized intermediaries.
- We find strong evidence of a quality-verification role for specialized intermediaries: they are more prevalent in products with greater quality dispersion among local exporters and export goods of higher quality than do generalized intermediaries.

RESEARCH AND EXPERTISE
ON THE WORLD ECONOMY

Abstract

We examine the quality-screening role played by intermediaries in international trade, exploiting export data at the product level for Chinese exporters. We uncover substantial heterogeneity among intermediaries, and distinguish two kinds: generalized and specialized intermediaries. We find strong evidence of a quality-verification role for specialized intermediaries: they are more prevalent in products with greater quality dispersion among local exporters and export goods of higher quality than do generalized intermediaries. Our results suggest that specialized intermediaries have the capacity to reduce the incidence of quality problems.

Keywords

Intermediaries, International Trade, Quality screening, Product differentiation, China.

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F13, F14, O25, R11.

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RESEARCH AND EXPERTISE ON THE WORLD ECONOMY

Quality Screening and Trade Intermediaries: Evidence from China

Sandra Poncet* and Meina Xu†

1. Introduction

A considerable proportion of international trade is handled by so-called intermediaries. Intermediaries such as wholesalers, trading companies and import-export companies account for 22% of the exports from the world's largest trading nation, China (Ahn et al., 2011).[1] Understanding the factors that give rise to intermediaries in exporting is thus key. An extensive theoretical literature rationalizes the role of intermediaries in the economy,[2] and in particular in international trade. Three main roles are put forward to explain the prevalence of intermediaries in international trade: (1) helping to match between sellers/exporters and foreign buyers;[3] (2) reducing trade costs;[4] and (3) mitigating adverse selection by checking quality.[5] There is now well-accepted empirical evidence that intermediaries alleviate difficulties in reaching less-accessible markets through the first two channels. However, there is much less consensus on the hypothesis of quality screening.

In this paper we use export data at the product level for Chinese exporters to investigate

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[1]This share is 10% of total exports in the US (Bernard et al., 2010a), 11% in Italy (Bernard et al., 2015), 20% in France (Crozet et al., 2013), and 35% in Chile (Blum et al., 2010).

[2]See Spulber (1996) for a review of the roles of middlemen in general.

[3]The initial models viewed intermediaries as agents who reduce the search costs of finding international buyers and sellers (Rauch and Watson, 2004; Petropoulou, 2008; Antras and Costinot, 2011).

[4]Various recent models extend Melitz (2003) to account for intermediary activity. These typically assume an intermediation technology, which allows intermediaries to exploit some kind of export advantage (such as economies of scope or better knowledge) over small exporting producers (Ahn et al., 2011; Akerman, 2010; Blum et al., 2011; Bernard et al., 2010a; Crozet et al., 2013; Felbermayr and Jung, 2011).

[5]See Biglaiser (1993), Biglaiser and Friedman (1994), and Li (1998).

the quality-screening role played by intermediaries. In theory, an intermediary is in a good position to alleviate quality problems due to prior investment in inspection technology or incentives to protect their reputation as a quality seller (Biglaiser and Friedman, 1994). In the context of international trade where information asymmetry is greater, intermediaries could be used to screen the quality of products and then reveal this quality to consumers (Dasgupta and Mondria, 2013). This quality-verification hypothesis suggests a greater prevalence of trade intermediation in differentiated-good exports. However, when complete contracts are not possible, trade intermediation is prone to hold-up. Intermediaries may shirk from the costly investments in specialized physical and human capital required for quality inspection, and hence underinvest in quality signaling from the perspective of their clients (Tang and Zhang, 2012). These two opposing views mirror the contrasting empirical results on the relationship between vertical product differentiation and the prevalence of trade intermediation (Feentra and Hanson, 2004; Tang and Zhang, 2012; Bernard et al., 2015; Ahn et al., 2011). On the one hand, the quality-sorting role of intermediary firms has clearly been established for traders in Hong Kong (Feenstra and Hanson, 2004). Their role in intermediating trade between China and the rest of the world has been shown to be greater for differentiated products, which Feenstra and Hanson (2004) interpret as evidence that they are able to select Chinese producers that meet foreign quality standards. On the other hand, a negative relationship has been observed between the share of intermediaries in exports and the degree of product differentiation in two different countries: China (Tang and Zhang, 2012)[6] and Italy (Bernard et al., 2015).

Using Chinese firm-level export data we uncover substantial heterogeneity between in-

[6] Ahn et al. (2011) find that the relative price of intermediaries compared to that of direct exporters does not vary significantly with the product's scope for quality differentiation, suggesting little quality-sorting by intermediary firms.

termediaries, and distinguish two types based on the product range: generalized and specialized intermediaries. We propose two empirical results that emphasize the quality-verification role of specialized intermediaries. First, specialized intermediaries are more likely to be found in quality-differentiated products, and, second, they export products of much higher quality than do generalized intermediaries.

Our first set of results refers back to the empirical findings in Tang and Zhang (2012). We use the same data set of Chinese exports in 2005,[7] and follow their approach of looking at the product-level relationship between the prevalence of trade intermediation and the dispersion in export quality.[8] Our approach differs in that we account for two existing types of intermediaries: generalized and specialized.[9] We argue that the latter group is characterized by enhanced quality-verification and a strong product focus. Shanghai Silk International Trade Company (SSTC) is a good illustration. This is an affiliate of Shanghai Silk Group Co. Ltd., whose business line is limited to garments. SSTC claims that the products it delivers are tested extensively in a certified textile-testing laboratory.[10] Their website announces that SSTC has established long-term stable trade relations with over a thousand customers around the world, such as Wal-Mart and ZARA, who chose SSTC for its excellence in the whole process from fashion design and product management to product testing and quality control.[11] We hence expect specialized intermediaries to more

[7] We follow Ahn et al. (2011) and Tang and Zhang (2012) and define intermediaries as firms with certain Chinese characters suggesting a trading role in their name.

[8] We use the structural-based measure of quality proposed by Khandelwal et al. (2013). We hence do not use the dispersion in export prices to proxy for vertical differentiation (Feenstra and Hanson, 2004; Bernard et al., 2015; Ahn et al., 2011) as a result of the well-known drawbacks in using unit values to proxy for quality (Hallak and Schott, 2010).

[9] Our work also differs in that we exploit city-level data and calculate vertical differentiation at the city-product level, which allows us to include product fixed effects to address the issue of confounding factors in the link between product-level quality heterogeneity and intermediation.

[10] The certification is granted by the China National Accreditation Board for Laboratories (CNAL).

[11] The website (http://www.shsilk.com.cn/about/subcmp1.aspx) also claims that the price of each process is lower than that of third-party service suppliers.

likely play a quality-assurance role compared to generalized intermediaries. Misaligned incentives are less likely for two reasons: first, specialized intermediaries are more prone to invest in quality-verification technologies that are specific to their product line, and, second, as niche players they have greater incentives to protect their reputation as reliable suppliers of quality goods. Our results show that accounting for the heterogeneity of intermediaries substantially changes the findings in Tang and Zhang (2012). While we confirm that intermediaries overall focus on products that are less differentiated, we show that specialized and generalized intermediaries differ in that the former are associated with the degree of quality differentiation, attesting to their quality-verification role.

Our second set of results relates to the difference between intermediaries' and direct exporters' quality levels. Exports by generalized intermediaries are shown to be of lower quality than those of specialized intermediaries, with the latter's quality being close to, but less than, that of direct exporters. This is consistent with the price results in the growing literature on trade intermediation, suggesting that intermediaries help relatively less efficient firms to export (Akerman, 2012; Bernard et al., 2010a; Ahn et al., 2011).

Our work here contributes to the literature in a number of dimensions. First, we build on the literature on firm heterogeneity in international trade considering multi-product firms, and on the smaller but emerging body of research on the role of intermediaries in foreign markets. Our main findings stress the heterogeneity of intermediaries regarding their role in mitigating quality problems.[12] We propose to differentiate specialized and generalized intermediaries according to the concentration of their export bundles. We calculate the

[12]Intermediary heterogeneity also appears in some theoretical work: intermediaries vary in terms of their ability to screen product quality (Dasgupta and Mondria, 2011) or the size of their networks (Rauch and Watson, 2004).

Herfindahl index of the firm-level distribution of export sales over products conditional on the effect of ownership and size in a regression framework. Our benchmark approach distinguishes specialized and generalized intermediaries according to the median of this conditional concentration index. Our results are robust to the use of alternative cut-offs and a number of sensitivity checks.

Our second contribution relates to the way in which we tackle endogeneity. Average price and quality, as well as the scope for vertical differentiation at the product level, are likely to be correlated with many other unobserved characteristics of our HS6 products, which may in turn determine the relative importance of intermediaries in exports. We depart from the traditional use of cross-sectional data across products to address endogeneity, and instead exploit the spatial heterogeneity in quality dispersion. In our robustness checks we also use panel data and show that our results on the relationship between quality differentiation and intermediaries prevalence in the exports of a given city-product pair continue to hold. Adding the city dimension to the analysis allows us to control for unobserved product-specific characteristics via product-level fixed effects. We reveal a systematic correlation between the dispersion of exported qualities across exporters for a given product in a city and the relative role of intermediaries in exports in that city-product pair. Our results here reconcile the contrasting existing results on the quality-verification role of intermediaries. As specialized intermediaries account for only a minority of intermediated trade, it is unsurprising that their quality-verification role cannot be found in aggregate data. The opposing finding of quality-screening among Hong Kong traders exporting Chinese products is consistent with many of these intermediaries being specialized (Feenstra and Hanson, 2004).

Our third contribution relates to the specific issue of the quality of Chinese goods. There are frequent headlines regarding recalls of Chinese goods, which represent two-thirds of global recalls.[13] Our work thus contributes to the relatively scarce literature on product recalls (Candelaria and Hale, 2008; Freedman et al., 2012), and suggests that trade intermediaries, or at least a particular subset of them, can reduce the incidence of quality problems. These findings are of considerable potential interest for both producers and consumers.

The remainder of the paper is structured as follows. Section 2 describes the data and the construction of the variables used in the empirical analysis. It also discusses intermediary heterogeneity and describes how we distinguish specialized from generalized intermediaries. Section 3 presents the results of the regression linking trade intermediation to vertical differentiation. Section 4 then considers the difference in quality levels between our two types of intermediaries. Last, Section 5 concludes.

2. Data and indicators

Our main data set is the Chinese Customs Trade Statistics (CCTS) database, as used by Ahn et al. (2011) and Tang and Zhang (2012). This is compiled by the General Administration of Customs of China, and includes firm-level export values and quantities at the 8-digit HS product-level by country of destination. For each individual export flow, we have both the quantity exported and the corresponding free on board (f.o.b.) value in US Dollars. We can then calculate the unit value of exports for each firm, product and destination. The database also records the destination of exports and contains firm-

[13] These statistics come from http://www.recallowl.com/index.php.

specific information such as ownership (foreign, state or private), name and address. We collapse the data to the annual level and aggregate product data to the 6-digit HS level.

We adopt the common practice in the literature of identifying intermediary firms based on the Chinese characters that have the English-equivalent meaning of "importer", "exporter", and/or "trading" in the firm's name (Ahn et al., 2011; Tang and Zhang, 2012). In particular, we follow the approach in Tang and Zhang (2012) and search for the following pinyin (Romanized Chinese) phrases: "jin4chu1kou3", "jing1mao4", "mao4yi4", "ke1mao4", "wai4jing1", "wai4mao4" and "gong1mao4".[14]

Our benchmark regression applies to the share of intermediary exports in city-HS6 observations[15] in 2005,[16] which is correlated with a proxy for the scope of vertical differentiation.

2.1. Heterogeneity among intermediaries in China

We would like to differentiate between intermediaries exporting a variety of products spanning unrelated sectors and those with a core competency in a single line of business. The former category corresponds to the type of traders that appear in the recent empirical literature, where intermediaries have consistently been found to export more products to more destination markets and more varieties per country than direct firms (Ahn et al., 2011; Bernard et al., 2010a; Crozet et al., 2013). This relative country focus of trading firms suggests that intermediaries arise to help firms send products to destination markets.

[14] These last two terms, which mean "foreign trade" and "industry and trade" respectively, were not considered by Ahn et al. (2011). In robustness tests available in Table 7 we check that our results continue to hold when using this more conservative measure.
[15] China is divided into four municipalities (Beijing, Tianjin, Shanghai and Chongqing) and 27 provinces which are further divided into (4-digit) prefectures. As is common in the literature, we use the term city to refer to the whole prefecture, even though it includes both an urban and a rural part.
[16] By 2005, export licenses had been removed, and any firm that wished to trade directly with foreign partners was free to do so (Ahn et al., 2011).

On the contrary, intermediaries with a restricted core competency, which we will refer to as specialized traders, conform to the image of intermediaries in Dasgupta and Mondria (2011): they screen product quality then reveal this to consumers.

We will distinguish between the two types of intermediaries according to their distribution of export sales over products. For each intermediary firm f, we calculate the share of exports in each product p, s_f^p. We then compute the firm's Herfindahl index by aggregating the squares of the shares of all the products exported by firm f:[17]

$$HI_f = \sum_{p \in S_f} (s_f^p)^2, \tag{1}$$

where S_f is the set of (N_f) products that firm f exports, and s_f^p the export value share of product p over the total export value of firm f. A higher value of HI_f means that the firm's export basket spans a narrower range of varieties. Firm-level product scope is expected to rise with firm size and productivity (Bernard et al., 2010a; Bernard et al., 2011). To control for those mechanical associations in our analysis of the heterogeneity of product concentration across intermediaries, we regress the HI measure on a quadratic polynomial in firm size (proxied by export value) with fixed effects for ownership,[18] and then take the residual, ϵHI_f.

Figure A-1 shows the distribution of HI_f (right panel) and ϵHI_f (left panel) over our sample of intermediaries. The Herfindhal indices are calculated as the sums of product shares s_f^p defining the different products p at the HS6, HS4 or HS2 level respectively. The twin

[17] We do not normalize the Herfindahl (using $1 - \frac{1}{N_f}$ in the denominator) as this would mechanically eliminate mono-product exporters.

[18] We use three ownership-type dummies (State-owned enterprises, private firms, and foreign-invested firms) to account for the well-documented productivity differences between firms according to their ownership (Bloningen and Ma, 2010).

peaks in the figure suggest a bimodal distribution. Two separate groups of intermediaries stand out: that to the right is characterized by a large range of products (i.e. generalized intermediaries) while that to the left concentrates on a narrow product range, which we refer to as specialized intermediaries. Figure A-2 checks that this bimodal distribution does not just reflect the difference between mono-product and multi-product exporters. The distribution is shown after excluding firms which export a single HS6 product. The twin-peak structure remains.

Our benchmark approach to differentiate between specialized and generalized intermediaries is based on the empirical evidence in Figure A-1 and in particular on the median value of ϵHI_f. Intermediaries with HS6-product concentration conditional on size and ownership above the median are defined as specialized; those below the median are generalized. We will later make sure that our results are robust to excluding mono-exporters, and defining the p products in Equation 1 at a more aggregate level (HS4 or HS2).

Table A-1 shows the overall export values for direct exporters and the two types of intermediaries. In 2005, intermediaries accounted for 21.2% of total Chinese exports, and 8.7% of total exports are handled by specialized intermediaries. This proportion is the same regardless of the aggregation level used to define the p products in the firm-level concentration indices. While the share of exports accounted for by intermediaries has fallen over time, the share of specialized intermediaries has remained constant at one third.

Table A-2 lists firm-level summary statistics in 2005 according to firm type (direct exporters, generalized intermediaries and specialized intermediaries). As a small number of exceptionally large firms may dominate trade statistics, we show both means and medi-

ans. The two intermediary types differ in a number of dimensions. With our differentiation between specialized and generalized intermediaries being based on the median, the two types account by construction for the same share of exporters (9.4%). However, as can be seen in row 2, generalized intermediaries are larger (as measured by export sales) than specialized intermediaries. Median export values are 864,283 and 598,946 USD respectively for generalized and specialized traders. Reflecting our use of product concentration to define generalized and specialized intermediaries, the median value of the number of HS6-products exported by the former is 25, more than six times that for the latter (4) and that of the median direct exporter (3). Generalized intermediaries also export to many more markets (8), as compared to the other two firm types (3). Row 3 follows Ahn et al. (2011) and classifies HS codes into one of 15 unrelated sectors[19] to identify the firm's core activity (e.g., animal products, wood products or textiles). The observation in Ahn et al. (2011) that intermediary firms (as a whole) handle products that span entirely unrelated sectors holds only for generalized intermediaries. The median generalized intermediary exports products in six sectors; on the contrary, the two other firm types, direct exporters and specialized intermediaries, only export products in one or two sectors. This is consistent with our description of specialized intermediaries as not only exporting fewer products, but also having a core competency.[20]

[19] HS 01-05 "Animal and Animal Products"; HS 06-15 "Vegetable Products"; HS 16-24 "Foodstuffs"; HS 25-27 "Mineral Products"; HS 28-38 "Plastics/Rubbers"; HS 41-43 "Raw Hides, Skins, Leathers & Furs"; HS 44-49 "Wood and Wood Products"; HS 50-63 "Textile"; HS 64-67 "Footwear/Headgear"; HS 68-71 "Stone/Glass"; HS 72-83 "Metals"; HS 84-5 "Machinery/Electrical"; HS 86-89 "Transportation"; HS 90-97 "Miscellaneous"; and HS 98-99 "Service".

[20] This echoes the emerging theoretical work that introduces core competencies in models of multiple-product firms (Eckel and Neary, 2010; Bernard et al., 2010b).

2.2. Quality differentiation

Our main strategy to see whether intermediaries, or a subset of them, mitigate adverse-selection problems by guaranteeing product quality exploits the variation in the scope for quality differentiation across products and space. We will show that there is substantial heterogeneity for a given product across Chinese cities in terms of quality differentiation (i.e. their "quality ladders"). This heterogeneity determines the prevalence of intermediaries in exports and, more importantly, the importance of the role that specialized intermediaries play in overall intermediation.

We calculate quality dispersion among exporters for every city-product pair. Our approach is similar to that in Tang and Zhang (2012), and builds on the strategy of Khandelwal et al. (2013) to estimate the quality of a variety, which is defined as a specific good sold by a firm in a given destination. The two main elements are that (1) quality is assumed to play the role of a demand shifter, and (2) preferences are assumed to be CES across producers of imperfectly-substitutable varieties. Identification is based on the following demand equation:

$$q_{fpc} = p^{-\sigma_p} \Lambda_{fpc}^{\sigma_p - 1} P_{fpc}^{\sigma_p - 1} Y_{pc} \tag{2}$$

where σ_p is the elasticity of substitution between varieties. Equation 2 shows the demand q_{fpc} addressed to each single producer f as a function of the price p_{fpc} relative to the price index P_{pct}, the quality of its variety Λ_{fpct} and the real demand expressed by the market c, Y_{pc}/P_{pc}.

After log-linearizing, the quality of each variety can be estimated as the residual from a demand equation, controlling for prices at the individual and aggregate level and the nominal demand expressed by the market:

$$\ln q_{fpc} + \sigma_p \; p_{fpc} = \underbrace{(\sigma_p - 1) \ln P_{pc} + Y_{pc}}_{\text{Component specific to pc}} + \underbrace{(\sigma_p - 1) \ln \Lambda_{fpc}}_{\text{residual}} \tag{3}$$

Since price indices and demands are not observed at the product- and destination-level, the standard approach pioneered by Khandelwal et al. (2013) is to capture these variables by fixed effects. Hence our approach is to use the prices p and quantities q observed at the variety (p, c) level and a calibration of the elasticity of substitution σ_p to measure the left-hand side of Equation 3. Our data for σ_p are taken from Imbs and Méjean (2015).[21] For each HS2 sector we then regress this variable on country- and product-level fixed effects. We rescale the estimated residual to reflect the heterogeneity in product-level elasticities of substitution to obtain an estimate of $\ln \Lambda_{fpc}$.

Table A-3 compares average product quality across different firm types (direct exporters and generalized and specialized intermediaries). Column 6 shows the weighted average quality level of exports when the weights are the shares of firm exports in the total exports of the firm type. Average quality for direct exporters is twice that of intermediaries, which is consistent with intermediaries helping relatively inefficient firms, those with low-quality products to export (Akerman, 2012; Bernard et al., 2010a; Ahn et al., 2011; Crozet et al., 2013). Nevertheless, export quality is higher for specialized than generalized intermediaries, with weighted average figures of 4.92 and 3.15 respectively. These statistics

[21] In robustness checks we check that our results continue to hold when using alternative values for σ. We notably set $\sigma = 6$, which is the average estimate of σ for China in Broda and Weinstein (2006).

clearly suggest that specialized intermediaries focus on higher-quality products.

Our measure of quality differentiation uses our estimates of the individual relative qualities. Specifically, we follow Khandelwal (2010) and calculate the quality ladder (the dispersion of quality) for each city-product pair as the standard deviation of the estimated $\ln \Lambda_{fpc}$ across all (firm-product-destination) flows.[22] We use data for 2004, as our empirical strategy relates 2005 intermediary prevalence to the one-year lagged quality ladder at the city-product level. We retain city-product pairs with more than ten (firm-product-destination) export flows in order to ensure that there are enough observations for a reliable quality ladder to be calculated. Table A-4 reveals substantial variation in the quality ladder across Chinese cities, even for rather homogeneous goods (garlic and silicon).

3. Empirical strategy for intermediation prevalence

3.1. Empirical specification

We now formally examine how the prevalence of trade intermediation for the two intermediary types is related to vertical differentiation. We use the following regression model:

$$\text{Intermediary share}_{cp} = \beta \text{ Quality Ladder}_{cp} + \gamma Z_{cp} + \mu_c + \nu_p + \epsilon_{cp} \quad (4)$$

where Intermediary share$_{cp}$ is the share of intermediary exports from Chinese city c in HS6 code p in 2005, and Quality Ladder is the quality heterogeneity across exports for that city-product pair. To mitigate potential endogeneity problems, we lag our proxy for quality differentiation by one year. The Intermediary share will be further decomposed into that

[22] In Section 3.2 we show that the results are robust to defining the ladder using the trimmed or untrimmed standard deviation, the full range (maximum minus minimum) and the inter-quartile range of qualities.

emanating from specialized and generalized intermediaries.

The regressions include both city fixed effects, μ_c, and HS6 fixed effects, ν_p. Product fixed effects capture inherent differences in the amount of intermediation products require. These fixed effects also account for all the intrinsic product factors, common to all Chinese locations, that may be correlated with both the scope for quality differences between firms and the prevalence of intermediaries. These include repercussions from national-level trade protection of imports and exports, the degree of horizontal differentiation and the degree of contract dependence.[23]

City fixed effects control for location-specific characteristics that shape overall supply capacity, such as infrastructure, the technological level and factor endowments. Our empirical strategy hence exploits both within-city variation across products and within-product variation across cities. For a given product we compare the prevalence of trade intermediation between cities where there is a relatively large heterogeneity of qualities among exporters to that in cities where it is lower (after controlling for the city average via city fixed effects).

We further control for city-product characteristics. Chinese export performance varies considerably by firm ownership (Amiti and Freund, 2010). The inclusion of the share of exports by foreign firms and the share of State-owned firms defined at the city-product level is crucial to account for the ability of different cities to export different products without requiring intermediation, as a result of differences in firm-level productivity and

[23]Intermediaries have been shown to be less prevalent for freely-traded products, contract-dependent products and complex products (Ahn et al., 2011; Crozet et al., 2013; Tang and Zhang, 2012). The proxies used in these contributions such as the well-known Rauch (1999) classification for simple and complex goods or the Nunn (2007) measure of contract dependence are measured at the product level and will be reflected in the product fixed effects in our empirical model.

quality pertaining to different ownership structures.[24] Moreover the ownership structure of exporters is likely to have direct repercussions on the relative role of intermediaries and their specific type (specialized versus generalized). State firms are generally less restricted in exporting directly than are private firms, since most of them have their own affiliated State-owned intermediaries to help them export. Foreign firms may also rely less on intermediaries, as they have better knowledge of export markets and may benefit from distribution networks abroad from their parent company. Meanwhile, foreign-invested enterprises do not need intermediaries working to guarantee quality for them, as they primarily export for their parent companies in the destination countries.

Following Tang and Zhang (2012), our set of controls Z_{cp} accounts for the cost of using intermediaries and search costs for buyers. We include the Herfindahl index of intermediaries to control for inherent differences in the local monopoly power of intermediaries for a given product. This may relate to intangible assets such as an established reputation prior to trading-rights liberalization. Following a similar logic we also include the Herfindahl index of direct exporters. We furthermore include the number of direct exporters and the number of intermediaries (in logs) to proxy for the cost for buyers of searching for a producer and an intermediary respectively.

All regressions have standard errors that are clustered at the product level to account for the serial correlation in the error terms across China for a given product (Moulton, 1990).[25]

Our final sample consists of 46,461 observations spanning 2,887 HS6 products and 354

[24] Foreign firms have higher productivity and product quality than do domestic firms in China (Ge et al., 2015). The superior performance of foreign affiliates typically derives from international technology spillovers (Keller and Yeaple, 2009) and fewer financial constraints (Arnold and Javorcik, 2009; Manova et al., 2015).
[25] Clustering standard errors at the city level does not change coefficient significance.

cities.[26]

3.2. Results: intermediation and vertical differentiation

Table 1 shows the estimates of Equation 4. In columns 1 and 2 the dependent variable is the share of intermediary exports. The coefficient on the quality ladder is negative and significant, and is robust to the inclusion of the control variables discussed in Section 3.1. The results are hence in line with those in Tang and Zhang (2012), suggesting that products with longer quality ladders in China are less likely to use intermediaries for their exports. Columns 3 and 4 reproduce column 2 with the dependent variable being respectively the share of specialized and generalized intermediaries in the exports of a city-product pair. Specialized and generalized intermediaries are distinguished using the method described in Section 2.1 based on the median export Herfindahl (HS6-product concentration) indices.

The estimated coefficients on the share of specialized and generalized intermediaries are positive significant and negative significant respectively. The overall negative association between prevalence and the heterogeneity of export qualities is thus driven by generalized intermediaries. The positive coefficient for specialized intermediaries suggests that their role is the exact reverse: the greater the heterogeneity of varieties produced, the more specialized intermediaries are used. This is consistent with the latter playing a quality-screening role, as product quality verification becomes more important as supplier heterogeneity rises.

Columns 5 and 6 check that the negative association between specialized intermediation

[26]We address the issue of outliers by excluding the top and bottom one percent of city-product pairs in terms of quality differentiation.

and the quality ladder is robust to controlling for other potential confounders. Column 5 adds three additional controls related to size and quality. We include the total export value as well as the number of countries to which these exports are sent in order to account for outward orientation. It is unclear a priori whether this would reduce the relative attraction of or need for specialized intermediaries. The positive coefficients on export value and the number of destinations suggest that the cost of specialized intermediaries falls with outward orientation. We also add the average quality of exports at the city-product level to control for any correlation between the quality dispersion of local producers and its mean. Our hypothesis (which will be confirmed in Section 4) is that specialized intermediaries export higher quality products than do generalized intermediaries. We should thus control for the quality of product-p exports in the city[27] when looking at the relationship between specialized intermediaries and local quality heterogeneity. As expected, the quality level attracts a positive coefficient, suggesting that specialized intermediaries focus on higher-quality products. Nevertheless, the estimated effect of quality differentiation on the use of specialized intermediaries is unchanged.

In column 6 we check that our results continue to hold with city-HS1 fixed effects, so that we identify off of HS6-product variation within a given (HS1) industry within a city.

Table A-5 in the Appendix reproduces the specifications of columns 5 and 6 in Table 1 with the dependent variable now being the overall export share of intermediaries and the share of generalized intermediaries in turn. Both overall and generalized intermediary use falls with vertical differentiation (Tang and Zhang, 2012).

[27] This is calculated as the weighted average of variety (firm-product-country) quality estimated in Equation 3 using the export share of the corresponding variety (firm-country) in city-product-level exports to calculate a weighted average quality figure for a city-product pair.

Our overall finding is that introducing intermediary heterogeneity substantially changes the conclusions in Tang and Zhang (2012). While overall intermediaries are found for less-differentiated products, we do find evidence of a quality-verification role for specialized intermediaries. These latter contrast sharply with generalized traders in that their prevalence in exports rises with local quality differentiation. This suggests that specialized intermediaries are not subject to the hold-up problems in trade intermediation described in the literature (Felbermayr and Jung, 2011; Tang and Zhang, 2012). The use of specialized intermediaries seems instead to be an effective way for high-quality good producers to signal their quality to consumers.

Table 2 checks that our main finding is robust to alternative ways of differentiating between the two types of intermediary. In the first two columns the Herfindahl indices used to separate specialized from generalized intermediaries are calculated using HS4 and HS2 products respectively. The resulting point estimates are not statistically different from those in our benchmark estimation (column 3 in 1). In column 3, the median cut-off of product concentration is replaced by the 60^{th} percentile, so that specialized intermediaries are a more elite group. The positive association between specialized intermediary export share and vertical differentiation continues to hold. In columns 4 to 6, we change the way quality dispersion is calculated. We first calculate the standard deviation of qualities after excluding extreme values. Column 4 uses the 1% trimmed standard deviation of qualities within a city-product pair, column 5 the inter-decile range, and column 6 the quality ladder defined as the difference between the maximum and minimum quality of varieties within a city-product. We continue to find that Chinese cities with longer quality ladders rely relatively more on specialized intermediaries for their exports.[28]

[28] The small difference between the total number of observations in these columns and that in our benchmark

Table 3 proposes other robustness checks. Column 1 excludes the top and bottom five percent of city-product pairs in terms of quality differentiation. Column 2 excludes mono-product firms: this helps address the concern that the bi-modal distribution of intermediaries observed in Section 2.1 is only picking up the difference between mono-product and multi-product exporters. The last two columns consider specific product features by dropping observations on products that are known to be clearly different from others. Column 3 excludes products for which some restrictions (mostly licenses and quotas) remained in place after China's entry to the WTO.[29] Column 4 excludes homogeneous products (defined using the classification in Rauch, 1999), for which producers are more likely to resort to intermediaries (Ahn et al., 2011; Crozet et al., 2013). Neither of these changes has any impact on our results.

Table 4 considers other types of outliers. Column 1 excludes processing trade.[30] A growing literature has underscored the many ways in which processing and ordinary trade regimes differ. Processing exports are characterized by greater value-added (Koopman et al., 2012), more technological content and higher-quality varieties than are ordinary exports (Wang and Wei, 2010). We thus need to check that our finding of quality verification by specialized intermediaries in China does not simply reflect the particularities of processing exports. Foreign firms are excluded in Column 2, so that all of the indicators are calculated using information solely from domestic firms. In column 3, the data set

specification (46,461) relates to our cleaning procedure. As in the benchmark, we exclude the top and bottom percentile of city-product pairs in terms of quality differentiation. The retained city-product pairs differ according to the quality-ladder measures, with some being dropped from the estimates due to missing observations on control variables.

[29] The list is taken from https://www.wto.org/english/thewto_e/acc_e/completeacc_e.htm. Although all restrictions had been removed by 2005, we may suspect that these products are different from the others.

[30] Processing trade refers to the operations of firms, most often foreign, which obtain raw materials or intermediate inputs from abroad and, after assembling them in China, reexport the value-added final products (Feenstra and Hanson, 2005). Operations in the assembly sector that import inputs to process them in China and re-export the final products accounted for 41% of China's trade between 2002 and 2012.

excludes observations on State-owned firms. Hong Kong plays a very specific role in intermediating trade between China and the rest of the world (Feenstra and Hanson, 2004). Column 4 hence excludes the exports that go to Hong Kong: our main result is robust to this exclusion.

Table 5 turns to a panel specification allowing us to include a rich set of controls, which account for any remaining time-invariant or time-varying confounding factors that may be correlated with both quality dispersion and the use of intermediaries. We here use Chinese customs data from 2002 to 2006,[31] and hence appeal to within variation (over time) for a given city-product pair of the relationship between quality ladders and intermediaries prevalence. In column 1 we introduce city-product fixed effects and add time-varying city-level dummies to account for demand and supply shocks that are common to all products in a given city and year. In column 2 we further add product-year dummies to account for all factors that affect product-level exports irrespective of the city of origin in a given year. Our regressions thus include the three pairwise combinations of fixed effects: city-product, city-year and product-year. Finally in column 3 we add city-HS1-year fixed effects, and so consider variation between HS6 products within a given (HS1) industry for a given city-year. Our results using the panel dataset are fully consistent with our benchmark results for 2005: intermediation is more prevalent for the less vertically-differentiated products, with the pattern for a subset of intermediaries, specialized traders, being the opposite where exported varieties are more heterogeneous, suggesting that they help to check or screen product quality for buyers.

[31] The rationale for starting in 2002 relates to the change in trade restrictions following China's WTO accession and the change in product nomenclature between 2001 and 2002. 2006 is the last year in which firm-level customs data is available to us.

4. Empirical results: intermediation and quality

We now ask whether specialized intermediaries exhibit a "quality premium" relative to generalized intermediaries. We compare the qualities of the products exported by generalized and specialized intermediaries and direct exporters on each market. If specialized intermediaries do indeed screen quality and select the best goods, we expect their measured quality to be higher than that of generalized intermediaries, although this quality should be lower than that of direct exporters.

Our empirical approach is to regress our estimates of the export quality of firms in 2005, $\ln \Lambda_{fpc}$, at the product and country level on dummies for specialized or generalized intermediaries, as described in Section 2.1. The omitted category is direct exporters, so that we expect the dummies on intermediary firms to enter negatively, with the specialized dummy being less negative than the generalized dummy.

Our regressions include product-country fixed effects to account for unobserved factors, including any systematic differences related to the homogeneity, relationship-specificity and non-contractibility of products which may help determine intermediary use. We include the firm's export value (in logs) and its square to control for firm size (Ahn et al., 2011). Moulton (1990) has shown that regressing individual variables on aggregate variables can lead to downward-biased standard errors. In all regressions, standard errors are thus clustered at the firm level.

The results appear in Table 6. Column 1 looks at the overall effect of intermediaries on quality, and in column 2 we decompose the intermediary dummy into specialized and generalized dummies. Column 3 reproduces Column 2 excluding the product-country

pairs for which intermediaries make up less than 1% or more than 99% of exports, while column 4 excludes product-country pairs for which intermediaries make up less than 5% or more than 95% of exports. Export quality is significantly lower for goods handled by intermediaries. This is consistent with the growing literature suggesting that intermediaries systematically handle the exports of less-efficient firms, those with low-quality products to export (Akerman, 2012; Bernard et al., 2010a; Ahn et al., 2011; Crozet et al., 2013). Column 2 suggests that this quality discount comes mainly from generalized intermediaries. For specialized intermediaries, the coefficient on quality is negative but much smaller. While this is significant at the 10% confidence level in column 2 it becomes insignificant when the sample is restricted to product-country pairs for which the intermediary share is strictly above 1% and below 99% (column 3) and for which the intermediary share is strictly above 5% and below 95%. The F-test at the foot of each column indicates that we can reject (at the 1% confidence level) the null hypothesis that the specialized and generalized intermediary coefficients are equal. Overall, our findings suggest a significant quality gap between specialized and generalized intermediaries. While the products handled by generalized intermediaries are of much lower quality than those of direct exporters, the difference between specialized intermediaries and direct exporters is much smaller and insignificant in most specifications. This suggests quality screening by specialized intermediaries that enables them to select products of the same quality as those of direct exporters.

Table 7 checks that our results are robust to different ways of distinguishing specialized from generalized intermediaries. In column 1, the product (Herfindahl) concentration cut-off is the 60^{th} percentile instead of the median. We thus apply a stricter threshold

to identify specialized intermediaries, cutting the number of observations on specialized intermediaries in half. In column 2 we return to the median but calculate Herfindhal indices at the HS4 instead of the HS6 level; in column 3 we use the even more aggregated HS2 level. Our results are not affected. In column 4 we adopt the more conservative approach in Ahn et al. (2011) to identify intermediary firms based on Chinese characters. Compared to our benchmark measure of Tang and Zhang (2012), we drop firms whose names include "foreign trade" or "industry and trade" as intermediaries. In column 5, we exclude firms that export a single HS6 product from our analysis to see whether the quality gap between specialized and generalized intermediaries is just reflecting a general difference between mono- and multi-product exporters. We continue to find lower quality for intermediaries that is almost entirely driven by generalized intermediaries: specialized intermediaries handle significantly higher quality goods than do generalized intermediaries.

In unreported robustness checks available upon request we show that our results hold with alternative quality measures. We first check with unit values, where there is no attempt to account for price differences relating to product- and destination-level factors (Khandelwal et al., 2013). Second, we calculate quality using Equation 3 but with an alternative and simpler method as proposed by Martin and Méjean (2014), which consists in demeaning the left-hand side of Equation 3 in the (p, c) dimension. The approach here is to use prices p and quantities q observed at the variety (p, c) level and a calibration of the elasticity of substitution σ_p to measure the left-hand side of Equation 3. This is then demeaned in the (p, c) dimension and rescaled to account for heterogeneity in the product-level elasticities of substitution to yield an estimate of $\ln \Lambda_{fpc}$.[32] In unreported robustness checks available

[32] This strategy leaves us with an estimate of the distribution of the individual qualities of Chinese producers, for each product and destination. As stressed by Martin and Méjean (2014), the estimated qualities obtained here cannot be interpreted in levels as they are defined as deviations from the mean quality of exports across

upon request we further find that our results are not affected by trimming. The quality premium of specialized over generalized intermediaries is significant at the 1% confidence level when we exclude observations whose unit price is in the bottom or top five percentiles of the overall sample, or whose unit price is in the bottom or top five percentiles for the product-country pair.

Table 8 repeats our analysis for some particular samples. We repeat the regression of column 2 in Table 6 excluding foreign firms (column 1) and then State firms (column 2). In column 3 we remove products which obtained their trade license after 2001, and in column 4 we exclude homogeneous goods traded on an organized exchange, as defined by Rauch (1999). The negative quality premium for intermediaries, and especially for generalized intermediaries, compared to direct exporters continues to hold.

Table 9 ensures that our results are robust to a variety of tests related to the origin and destination of exports. Column 1 excludes the four cities with province status (Beijing, Tianjin, Shanghai, and Chongqing), which stand out by their greater political autonomy and smaller surface area. Columns 2 and 3 tackle China's interior-coast divide. Coastal locations are significantly different from the rest of the country: they have more outward-oriented economies and have had great success in attracting foreign investment. Column 2 excludes export flows from coastal locations while column 3 excludes inland locations. Our main result is robust to these exclusions. Column 4 drops export flows to Hong Kong (column 5) and to less developed countries (column 6), as these may differ from the bulk of Chinese exports. In all cases, generalized intermediaries handle the lowest qualities with the export quality of specialized intermediaries being slightly lower than that of direct

Chinese firms serving the same destination market. However, our focus here is on the between component as we wish to measure the dispersion of individual qualities within a given location for a particular product.

exporters, and the difference not being statistically significant in some specifications.

5. Conclusion

This paper has contributed to the analysis of intermediary exporting firms. We use Chinese firm-level customs data to show that separating generalized from specialized intermediaries is key to understanding the quality-screening role played by intermediaries in international trade. We show that specialized and generalized intermediaries differ in that the former are more prevalent when there is a greater degree of quality differentiation, i.e. where quality verification would seem to be the most needed. Consistent with specialized intermediaries reducing the incidence of quality problems, we find that the quality of their exports is higher than that of generalized intermediaries. Our results suggest a consistent sorting into export markets, whereby higher quality-producers export directly and specialized intermediaries help buyers to screen quality and avoid quality problems among the remaining varieties.

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Table 1 – Intermediation and Quality Differentiation: Benchmark Results

Dependent variable	Share in city-HS6 exports of					
	All intermediaries		Specialized intermediaries	Generalized intermediaries	Specialized intermediaries	
	(1)	(2)	(3)	(4)	(5)	(6)
Quality ladder	-0.0141[a]	-0.0061[a]	0.0025[a]	-0.0086[a]	0.0020[b]	0.0018[b]
	(0.0014)	(0.0008)	(0.0008)	(0.0010)	(0.0008)	(0.0008)
Foreign export share		-0.2706[a]	-0.0698[a]	-0.2008[a]	-0.0802[a]	-0.0751[a]
		(0.0042)	(0.0030)	(0.0040)	(0.0031)	(0.0032)
State export share		-0.2746[a]	-0.1040[a]	-0.1706[a]	-0.1017[a]	-0.1057[a]
		(0.0056)	(0.0042)	(0.0055)	(0.0042)	(0.0045)
Herfindahl of intermediaries		0.2488[a]	0.2220[a]	0.0267[a]	0.2027[a]	0.2149[a]
		(0.0045)	(0.0058)	(0.0063)	(0.0056)	(0.0058)
Herfindahl of direct exporters		-0.2506[a]	-0.0655[a]	-0.1851[a]	-0.0878[a]	-0.0644[a]
		(0.0045)	(0.0040)	(0.0048)	(0.0043)	(0.0041)
Ln Number of intermediaries		0.1778[a]	0.0815[a]	0.0963[a]	0.0691[a]	0.0790[a]
		(0.0013)	(0.0016)	(0.0018)	(0.0015)	(0.0016)
Ln Number of direct exporters		-0.1996[a]	-0.0533[a]	-0.1462[a]	-0.0728[a]	-0.0528[a]
		(0.0012)	(0.0013)	(0.0015)	(0.0021)	(0.0013)
Ln Number of countries					0.0166[a]	
					(0.0026)	
Ln export value					0.0140[a]	
					(0.0011)	
Ln average export quality					0.0016[a]	
					(0.0004)	
HS6-product Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City Fixed effects	Yes	Yes	Yes	Yes	Yes	n.a.
City-HS1 Fixed effects	No	No	No	No	No	Yes
Observations	46,461	46,461	46,461	46,461	46,461	46,461
R-squared	0.30	0.74	0.35	0.57	0.36	0.41
No. HS6	2,887	2,887	2,887	2,887	2,887	2,887
No. Cities	354	354	354	354	354	354

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level.

Table 2 – Specialized Intermediaries and Quality Differentiation: Indicator Checks

Dependent variable	Share in city-HS6 exports of specialized-intermediaries					
	Herfindhal cut-off			Ladder measure		
	Median HS4	Median HS2	60^{th} HS6	Standard deviation 1^{st}-99^{th}	Inter-decile range	Max-Min range
	(1)	(2)	(3)	(4)	(5)	(6)
Quality ladder	0.0026[a]	0.0015[c]	0.0017[a]	0.0026[a]	0.0008[a]	0.0004[b]
	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0003)	(0.0002)
Foreign export share	-0.0606[a]	-0.0544[a]	-0.0328[a]	-0.0698[a]	-0.0698[a]	-0.0693[a]
	(0.0028)	(0.0028)	(0.0023)	(0.0030)	(0.0030)	(0.0030)
State export share	-0.0881[a]	-0.0909[a]	-0.0599[a]	-0.1038[a]	-0.1039[a]	-0.1033[a]
	(0.0039)	(0.0037)	(0.0033)	(0.0042)	(0.0042)	(0.0041)
Herfindahl of intermediaries	0.1781[a]	0.1525[a]	0.1359[a]	0.2220[a]	0.2217[a]	0.2225[a]
	(0.0053)	(0.0055)	(0.0049)	(0.0058)	(0.0057)	(0.0057)
Herfindahl of direct exporters	-0.0490[a]	-0.0513[a]	-0.0338[a]	-0.0655[a]	-0.0654[a]	-0.0654[a]
	(0.0036)	(0.0036)	(0.0029)	(0.0040)	(0.0040)	(0.0040)
Ln Number of intermediaries	0.0665[a]	0.0669[a]	0.0468[a]	0.0816[a]	0.0813[a]	0.0812[a]
	(0.0016)	(0.0016)	(0.0014)	(0.0016)	(0.0016)	(0.0016)
Ln Number of direct exporters	-0.0403[a]	-0.0444[a]	-0.0250[a]	-0.0533[a]	-0.0534[a]	-0.0543[a]
	(0.0012)	(0.0012)	(0.0010)	(0.0013)	(0.0013)	(0.0013)
HS6-product Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,461	46,461	46,461	46,328	46,454	46,451
R-squared	0.31	0.32	0.30	0.35	0.35	0.35

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) using the median in all columns, except in column 3 where the 60^{th} percentile is used. The products in the Herfindhal calculations are defined at the HS6 level, except in columns 1 and 2 which use the HS4 and HS2 levels respectively.

Table 3 – Specialized Intermediaries and Quality Differentiation: Sample Checks (1)

Dependent variable Sample	Share in city-HS6 exports of specialized intermediaries			
Restriction	W/o top & bottom 5% quality ladder	No mono producers	No restricted products	No Homogeneous goods
	(1)	(2)	(3)	(4)
Quality ladder	0.0028[a]	0.0028[a]	0.0025[a]	0.0029[a]
	(0.0010)	(0.0008)	(0.0008)	(0.0009)
Foreign export share	-0.0699[a]	-0.0622[a]	-0.0701[a]	-0.0708[a]
	(0.0031)	(0.0030)	(0.0030)	(0.0031)
State export share	-0.1007[a]	-0.1009[a]	-0.1042[a]	-0.1014[a]
	(0.0043)	(0.0042)	(0.0042)	(0.0044)
Herfindahl of intermediaries	0.2264[a]	0.2102[a]	0.2217[a]	0.2181[a]
	(0.0060)	(0.0058)	(0.0058)	(0.0060)
Herfindahl of direct exporters	-0.0679[a]	-0.0649[a]	-0.0655[a]	-0.0667[a]
	(0.0041)	(0.0041)	(0.0040)	(0.0042)
Ln Number of intermediaries	0.0816[a]	0.0760[a]	0.0813[a]	0.0784[a]
	(0.0016)	(0.0016)	(0.0016)	(0.0017)
Ln Number of direct exporters	-0.0531[a]	-0.0503[a]	-0.0532[a]	-0.0520[a]
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
HS6-product Fixed effects	Yes	Yes	Yes	Yes
City Fixed effects	Yes	Yes	Yes	Yes
Observations	42,853	46,233	46,406	41,966
R-squared	0.36	0.34	0.35	0.34
No. HS6	2,814	2,879	2,878	2,298
No. Cities	335	347	354	332

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level.

Table 4 – Specialized Intermediaries and Quality Differentiation: Sample Checks (2)

Dependent variable Sample	Share in city-HS6 exports of specialized-intermediaries			
Restriction	No processing exports (1)	No foreign exports (2)	No State exports (3)	No Hong-Kong destination (4)
Quality Ladder	0.003[a]	0.002[c]	0.002[b]	0.002[b]
	(0.0011)	(0.0012)	(0.0012)	(0.0010)
Foreign export share	-0.065[a]		-0.053[a]	-0.067[a]
	(0.0088)		(0.0035)	(0.0099)
State export share	-0.096[a]	-0.094[a]		-0.101[a]
	(0.0094)	(0.0093)		(0.0079)
Herfindahl of intermediaries	0.212[a]	0.253[a]	0.172[a]	0.218[a]
	(0.0128)	(0.0294)	(0.0045)	(0.0204)
Herfindahl of direct exporters	-0.067[a]	-0.074[a]	-0.054[a]	-0.066[a]
	(0.0064)	(0.0078)	(0.0043)	(0.0066)
Ln Number of intermediaries	0.081[a]	0.094[a]	0.071[a]	0.081[a]
	(0.0043)	(0.0055)	(0.0012)	(0.0045)
Ln Number of direct exporters	-0.054[a]	-0.060[a]	-0.048[a]	-0.054[a]
	(0.0032)	(0.0033)	(0.0011)	(0.0032)
HS6-product Fixed effects	Yes	Yes	Yes	Yes
City Fixed effects	Yes	Yes	Yes	Yes
Observations	46,166	45,642	35,353	42,846
R-squared	0.33	0.33	0.31	0.36
No. HS6	2880	2872	2610	2823
No. Cities	354	354	308	351

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level.

Table 5 – Specialized Intermediaries and Quality Differentiation: Panel Estimates

Dependent variable	Share in city-HS6 exports of specialized-intermediaries Years 2002-2006		
	(1)	(2)	(3)
Quality ladder	0.0010[b]	0.0009[c]	0.0008[c]
	(0.0004)	(0.000)	(0.000)
Foreign export share	-0.1204[a]	-0.1206[a]	-0.1208[a]
	(0.0031)	(0.003)	(0.003)
State export share	-0.1769[a]	-0.1753[a]	-0.1749[a]
	(0.0038)	(0.004)	(0.004)
Herfindahl of intermediaries	0.1375[a]	0.1360[a]	0.1348[a]
	(0.0032)	(0.003)	(0.003)
Herfindahl of direct exporters	-0.0510[a]	-0.0515[a]	-0.0515[a]
	(0.0027)	(0.003)	(0.003)
Ln Number of direct exporters	-0.0479[a]	-0.0477[a]	-0.0464[a]
	(0.0012)	(0.001)	(0.001)
Ln Number of intermediaries	0.0600[a]	0.0578[a]	0.0577[a]
	(0.0011)	(0.001)	(0.001)
City-HS6 product Fixed effects	Yes	Yes	Yes
HS6 product-year Fixed effects	No	Yes	Yes
City-year Fixed effects	Yes	Yes	n.a.
City-HS1-year Fixed effects	No	No	Yes
Observations	237,202	237,202	237,202
R-squared	0.69	0.72	0.74

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. Source: Authors' calculations from Chinese transactions data in 2002-06. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level.

Table 6 – Intermediation and Quality Level: Benchmark Results

Dependent variable	Firm quality of exports (product-country) in 2005: $\ln \Lambda_{fpc}$			
Sample restriction			Wholesaler share >1% & <99%	>5% & <95%
	(1)	(2)	(3)	(4)
Intermediary	-1.2464[a]			
	(0.0720)			
Specialized intermediary		-0.1866[c]	-0.1282	-0.0500
		(0.1119)	(0.1014)	(0.0941)
Generalized intermediary		-1.5063[a]	-1.4703[a]	-1.3881[a]
		(0.0656)	(0.0627)	(0.0602)
Ln export value	0.0058	0.1582	0.2083	0.2274
	(0.3022)	(0.2978)	(0.2627)	(0.2467)
Ln (export value)^2	0.0078	0.0025	0.0006	-0.0002
	(0.0105)	(0.0103)	(0.0091)	(0.0085)
HS6 product-Country Fixed effects	Yes	Yes	Yes	Yes
Observations	4,351,275	4,351,275	4,212,508	4,025,788
R-squared	0.15	0.15	0.13	0.12
F-Test $\beta_{spec} = \beta_{gen}$		247	305	346
Proba>F		0.001	0.001	0.001

Notes: Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. Firm quality, $\ln \Lambda_{fpc}$, is calculated based on Equation 3. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level. Column 3 excludes product-country pairs for which wholesalers make up less than 1% or more than 99% of exports. Column 4 excludes product-country pairs for which wholesalers make up less than 5% or more than 95% of exports. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Table 7 – Intermediation and Quality Level: Robustness Checks (1)

Dependent variable	Firm quality of exports (product-country) in 2005: $\ln \Lambda_{fpc}$				
Restriction on intermediary identification	Herfindahl cut-off 60^{th} HS6 (1)	Herfindahl cut-off median HS4 (2)	Herfindahl cut-off median HS2 (3)	Conservative definition of intermediaries (4)	No mono-producers (5)
Specialized intermediary	-0.0916	-0.0488	0.0349	-0.1868^{c}	-0.1638
	(0.1575)	(0.1121)	(0.1034)	(0.1109)	(0.1113)
Generalized intermediary	-1.3791^{a}	-1.4928^{a}	-1.5244^{a}	-1.5114^{a}	-1.4611^{a}
	(0.0703)	(0.0714)	(0.0743)	(0.0657)	(0.0649)
Ln export value	0.0975	0.0992	0.0597	0.1357	0.3232
	(0.3123)	(0.3143)	(0.3184)	(0.3004)	(0.3260)
Ln (export value)^2	0.0049	0.0049	0.0063	0.0033	-0.0022
	(0.0108)	(0.0109)	(0.0110)	(0.0104)	(0.0111)
HS6-Country Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	4,351,275	4,351,275	4,351,275	4,347,497	4,261,859
R-squared	0.15	0.15	0.15	0.15	0.15
F-Test $\beta_{spec} = \beta_{gen}$	82	238	300	239	240
Proba>F	0.001	0.001	0.001	0.001	0.001

Notes: Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. Intermediary firms are defined following the procedure in Tang and Zhang (2012), except in column 4 where we use the conservative definition in Ahn et al. (2011). See the text. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level, except in columns 3 and 4 where the HS4 and HS2 levels are used. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Table 8 – Intermediation and Quality Level: Robustness Checks (2)

Dependent variable	Firm quality of exports (product-country) in 2005: $\ln \Lambda_{fpc}$			
Sample restriction	No Foreign firms (1)	No State firms (2)	No restricted products (3)	No homogeneous products (4)
Specialized intermediary	0.1445	-0.1945[b]	-0.1851[c]	-0.1814
	(0.1061)	(0.0823)	(0.1119)	(0.1187)
Generalized intermediary	-1.1146[a]	-2.1073[a]	-1.5060[a]	-1.5372[a]
	(0.0651)	(0.0627)	(0.0656)	(0.0678)
Ln export value	0.1406	-1.2061[a]	0.1594	0.1575
	(0.2900)	(0.2208)	(0.2977)	(0.3156)
Ln (export value)^2	0.0026	0.0504[a]	0.0024	0.0027
	(0.0099)	(0.0081)	(0.0103)	(0.0109)
HS6 product-Country Fixed effects	Yes	Yes	Yes	Yes
Observations	3,797,682	3,195,913	4,345,660	4,104,906
R-squared	0.18	0.18	0.15	0.15
F-Test $\beta_{spec} = \beta_{gen}$	258	483	248	230
Proba>F	0.001	0.001	0.001	0.001

Notes: Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Table 9 – Intermediation and Quality Level: Robustness Checks (3)

Dependent variable	Firm quality of exports (product-country) in 2005: $\ln \Lambda_{fpc}$				
Sample restriction	No 4 province cities (1)	No coast locations (2)	Only coast locations (3)	No HK destinations (4)	No LDC destinations (5)
Specialized intermediary	-0.1505	0.1210	-0.2017	-0.1729[c]	-0.1911[c]
	(0.1220)	(0.1514)	(0.1258)	(0.1037)	(0.1128)
Generalized intermediary	-1.5238[a]	-1.1471[a]	-1.4924[a]	-1.3112[a]	-1.5211[a]
	(0.0678)	(0.1762)	(0.0675)	(0.0663)	(0.0660)
Ln export value	0.2145	0.1373	0.1923	0.3866	0.1669
	(0.3134)	(0.2670)	(0.3263)	(0.2827)	(0.2978)
Ln (export value)^2	0.0011	-0.0017	0.0019	-0.0060	0.0022
	(0.0108)	(0.0096)	(0.0113)	(0.0098)	(0.0103)
HS6 product-Country Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	3,774,566	397,912	3,953,363	3,824,135	4,258,295
R-squared	0.16	0.42	0.15	0.14	0.14
F-Test $\beta_{spec} = \beta_{gen}$					
Proba>F	0.001	0.001	0.001	0.001	0.001

Notes: Heteroskedasticity-robust standard errors clustered at the firm level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level. The F-test shown at the foot of each column tests the equality of the estimated coefficients on the two intermediary types. The probabilities (below 0.01) indicate that this equality is rejected at the 1% confidence level.

Appendix

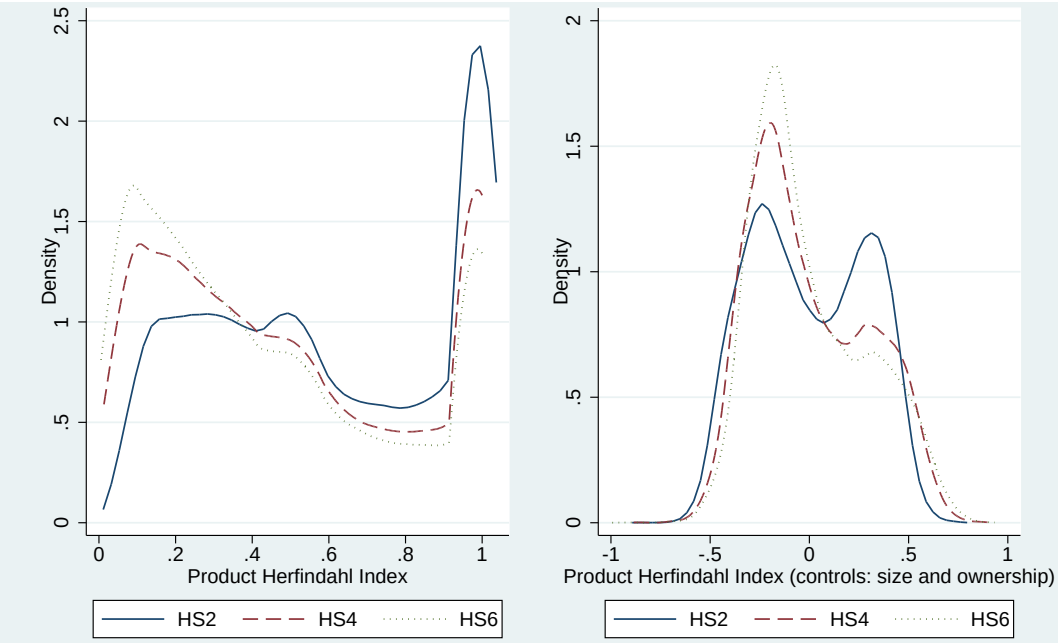

Figure A-1 – Distribution of the Firm-level Herfindahl Indices

The Herfindahl indices are calculated following Equation 1 with products p defined at the HS6, HS4 or HS2 levels. The right-hand panel shows the distribution of the Herfindahl indices after conditioning on a quadratic polynomial in firm size and firm ownership. See the text.

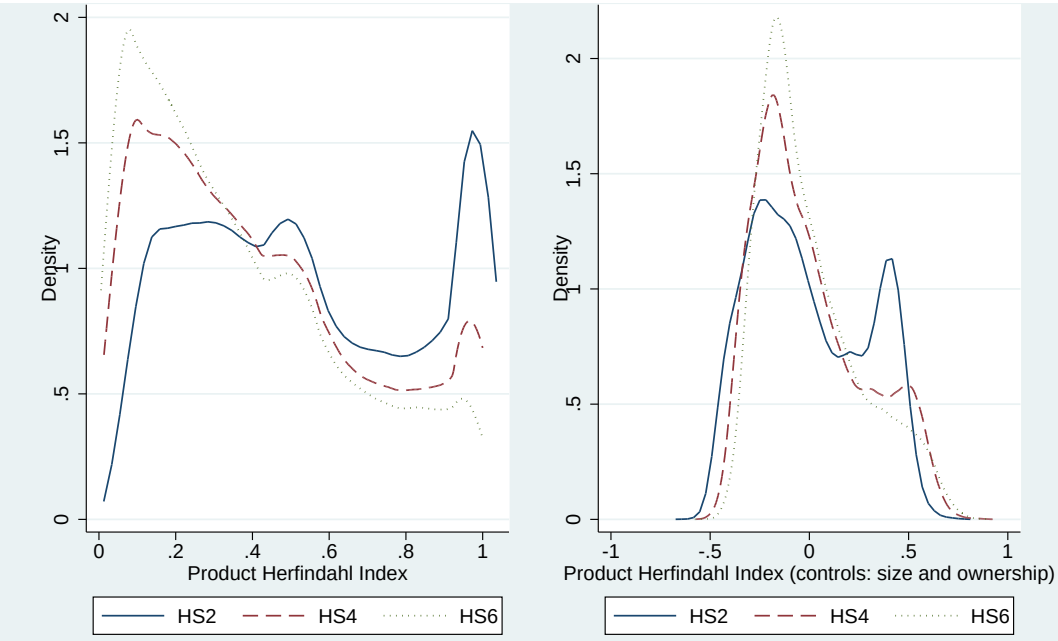

Figure A-2 – Distribution of Firm-level Herfindahl Indices - after excluding mono-producers

The Herfindahl indices are calculated following Equation 1 with products p defined at the HS6, HS4 or HS2 levels. The right-hand panel shows the distribution of the Herfindahl indices after conditioning on a quadratic polynomial in firm size and firm ownership. Firms exporting a single product are excluded. See the text.

Table A-1 – Summary Statistics: The Role of Intermediaries

Year	Total export value ($ million)	Share in export value: Direct exporters	Indirect exporters	Specialized intermediaries HS6	HS4	HS2
	(1)	(2)	(3)	(4)	(5)	(6)
2002	325,632	72.5	27.5	9	8.3	8.4
2003	417,548	75.7	24.3	8.2	7.6	7.6
2004	593,644	77.4	22.6	8.8	8.3	8.3
2005	761,484	78.8	21.2	8.7	8.1	8.1
2006	966,690	79.1	20.9	8.8	8.4	8.8

This table lists the summary statistics from China's export transactions data. Column 1 shows values in millions of U.S. Dollars. Columns 2 to 6 show the share of column (1)'s total in %. See the text for the definition of intermediary firms. HS6, HS4 and HS2 refer to the level of aggregation used to define products in the Herfindahl calculations (Equation 1) separating specialized and generalized intermediaries: see the text.

Table A-2 – Firm-level Summary Statistics for Exporting Firms, 2005.

Firm type	Direct firms		Generalized-intermediaries		Specialized-intermediaries	
Number	116,375		13,414		13,413	
	Mean	Median	Mean	Median	Mean	Median
Export value by firm ($)	5,109,242	534,601	5,334,534	864,283	6,601,557	598,946
No. of markets	6.84	3	17.21	8	8.98	3
No. of industries (combined HS2)	1.99	1	6.78	6	3.03	2
No. of industries (HS2)	2.91	2	15.79	10	4.85	2
No. of industries (HS4)	5.68	2	44.26	18	9.63	3
No. of varieties (HS6)	8.66	3	70.83	25	14.21	4

Source: Authors' calculations from Chinese transactions data in 2005. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level.

Table A-3 – Summary Statistics on Export Quality by Firm Type, 2005.

	Firm-level Quality					
	(1)	(2)	(3)	(4)	(5)	(6)
Firm type	Mean	Median	Bottom 25%	Top 25%	Standard deviation	Weighted average
Direct firms	2.96	2.51	0.39	4.78	6.39	9.9
Specialized intermediaries	2.55	2.29	0.53	4.12	4.29	4.92
Generalized intermediaries	1.40	1.58	-0.23	3.08	3.58	3.15

Source: Authors' calculations from Chinese transactions data in 2005. See the text for the definition of intermediary firms. Specialized and generalized intermediaries are identified based on their Herfindahl index (Equation 1) with products defined at the HS6 level. Firm-level quality is calculated as a weighted average with the share of the firm-product-country exports in firm total exports as the weights. The weights used in column 6 are firm total exports as a percentage of the total exports for the corresponding firm type (direct exporter, generalized intermediary and specialized intermediary). These figures refer to the data after trimming the 1% outliers.

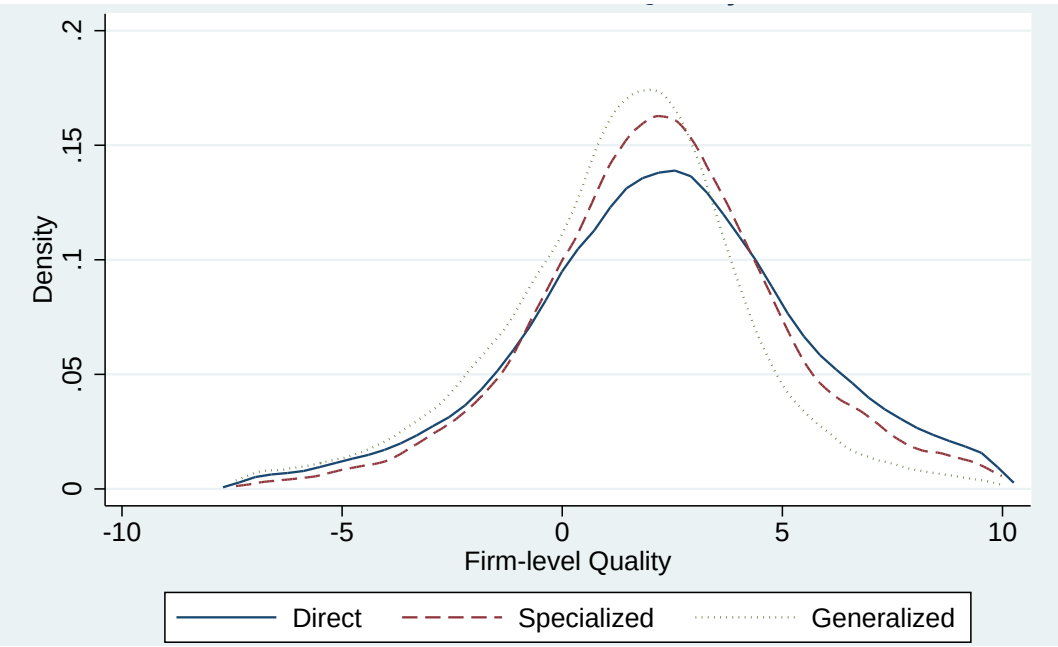

Figure A-3 – Distribution of Firm-level Quality (trimming 1%)

The firm average is calculated as a weighted average using the share of the transaction (product-country) is the firm's exports.

Table A-4 – Variation in the Quality Ladder across Cities, Selected Products

	No. of exporting	Quality ladder (standard deviation of quality)			
Product	cities	Mean	Bottom decile	Median	Top decile
Garlic, fresh or chilled (HS=070320)	31	2.27	1.61	2.02	3.16
Silicon (HS=280469)	53	1.72	1.30	1.67	2.24
Candles, Tapers and the Like (HS=340600)	76	2.67	1.77	2.69	3.70
Mats of vegetable materials (HS=460120)	45	2.37	1.52	2.32	3.24
Cotton T-shirts (HS=610910)	115	3.14	2.32	2.94	4.18
Motorcycles (HS=871190)	42	2.26	1.78	2.21	2.78

Source: Authors' calculations from Chinese transactions data in 2004.

Table A-5 – Total Intermediation and Quality Differentiation

Dependent variable	Share in city-HS6 exports of Intermediaries		Share in city-HS6 exports of Generalized intermediaries	
	(1)	(2)	(3)	(4)
Quality ladder	-0.0050[a]	-0.0061[a]	-0.0070[a]	-0.0079[a]
	(0.0008)	(0.0009)	(0.0009)	(0.0010)
Foreign export share	-0.2544[a]	-0.2793[a]	-0.1742[a]	-0.2042[a]
	(0.0042)	(0.0044)	(0.0040)	(0.0042)
State export share	-0.2756[a]	-0.2897[a]	-0.1738[a]	-0.1840[a]
	(0.0055)	(0.0057)	(0.0054)	(0.0057)
Herfindahl of intermediaries	0.2587[a]	0.2498[a]	0.0561[a]	0.0349[a]
	(0.0048)	(0.0046)	(0.0062)	(0.0063)
Herfindahl of direct exporters	-0.2431[a]	-0.2558[a]	-0.1553[a]	-0.1914[a]
	(0.0045)	(0.0045)	(0.0050)	(0.0049)
Ln Number of direct exporters	-0.2035[a]	-0.2002[a]	-0.1307[a]	-0.1474[a]
	(0.0016)	(0.0012)	(0.0022)	(0.0015)
Ln Number of intermediaries	0.1744[a]	0.1772[a]	0.1053[a]	0.0982[a]
	(0.0017)	(0.0013)	(0.0019)	(0.0018)
Ln Number of countries	0.0558[a]		0.0392[a]	
	(0.0029)		(0.0032)	
Ln export value	-0.0184[a]		-0.0324[a]	
	(0.0011)		(0.0012)	
Ln average export quality	0.0007[c]		-0.0009[c]	
	(0.0004)		(0.0005)	
HS6-product Fixed Effects	Yes	Yes	Yes	Yes
City Fixed effects	Yes	n.a.	Yes	n.a.
City-HS1 Fixed Effects	No	Yes	No	Yes
Observations	46,461	46,461	46,461	46,461
R-squared	0.75	0.76	0.59	0.61
No. HS6	2,887	2,887	2,887	2,887
No. Cities	354	354	354	354

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels. See the text for the definition of intermediary firms.