SELL DEEP? SELL WIDE? OR BOTH? PERCEIVED QUALITY AND PRODUCT SCOPE OF CHINESE EXPORTERS OF ELECTRICAL PRODUCTS

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Abstract

There is a surging trade literature on multi-product exporters who account for a disproportionally large share of total exports. On the other side, it is also well known that new exporters usually start small and many with a single product. In this paper, I bring the two bodies of literature, one on multi-product exporters and one on the post-entry dynamics, together to study how single-product exporters evolve into multi-product exporters, with special attention to the role of perceived quality in this process. I use the detailed price and quantity information on firms' exports between 2000 and 2006 from China's customs data to recover the latent quality as residuals from market- and product-specific demand functions for China's exports. A cross-sectional comparison reveals that relative to a single-product exporter, a multi-product exporter has quality premium in its core products, but quality discount in its peripheral products. But overtime within a firm-destination-product cell, the perceived quality is positively correlated with an exporter's product scope, which I argue is mainly driven by the addition of new product lines at the exact time when the existing products get well accepted by the market. A trade model of heterogeneous firms self-selecting into exporting markets with an once-and-for-all draw of firm- or firm- and product-specific productivity that abstracts away from the process of learning and gradual resolution of uncertainty on the demand side cannot generate these patterns.

JEL Classifications: F12, F14, O12, O14.

Keywords: Trade; Quality; Product Scope; Firm Heterogeneity; Export Uncertainty.

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1. Introduction

There is a surging trade literature on multi-product exporters who account for a disproportionally large share of total exports. On the other side, it is also well known that new exporters usually start small and many with a single product; meanwhile, a lot of them exit within a short period of time, but those who survive experience fast growth and may become multi-product exporter. These two strands of literature on multi-product exporters and on post-entry dynamics have been undergoing almost separate development. In this paper, I bring them together to address the question of how single-product exporters evolve into multi-product exporters and what role perceived product quality plays in this process. More specifically, I use the fine firm-, product-, destination- and year-level export information collected by China's customs of electrical products shipped to the North American and European Union markets to investigate the cross-sectional relationship as well as the co-evolution of the perceived quality, measured as the demand residual that cannot be explained by price, and firms' product scope. The purpose of the analysis is to provide insights into what specific obstacles exporters from a less developed country as China have to overcome to expand their business in developed countries and how government export promotion policies can help.

At the core of the analysis is product quality. For most empirical studies related to quality, the first obstacle to overcome is the lack of direct observation on quality. One common practice is to use unit value as a proxy.[1] However, a high unit value may reflect either high quality or low cost efficiency.[2] When information on both price and quantity is available, a better alternative can be constructed. Conceptually, quality can be taken as a demand shifter that captures all attributes of a product that may affect consumers' willingness to pay.[3] A quality improvement thus shifts a demand curve upward and outward. Holding price constant, larger market share is a reflection of higher quality, which means empirically one can use the residual obtained from estimating a demand function as a measure of quality.[4] The reliability of this empirical measure of quality depends crucially on consistently estimating the demand system. One econometric challenge is that the unobserved quality affects quantity demanded and price simultaneously.[5] As a result, the OLS estimate of the price coefficient would be biased toward zero. In turn, the quality ranking based on the OLS residuals would be reversed for some observations.[6] To address this endogeneity problem,

[1] Hallak and Schott (2011) provide a list of earlier studies based on this measure. More recent examples include Manova and Zhang (2012) and Manova and Zhang (2013).

[2] Eckel et al. (2013) shows that only when the quality-based competence dominates, as in the case of differentiated products, can one expect higher price to reflect higher quality. Identifying differentiated products requires another judgement call and many studies have followed the classification by Rauch (1999).

[3] The attribute can be related to either objective characteristics of a product or subjective evaluation by consumers.

[4] This idea of relating unobserved quality to conditional market share originated from the IO literature. Examples of recent studies on trade based on this idea are Hummels and Klenow (2005), Hallak and Schott (2011), Gervais (2010), and Khandelwal (2010). This method does not distinguish between objective aspects of quality, such as technology and the subjective evaluation by consumers.

[5] Quality is positively correlated with price because higher quality usually costs more to produce; on the other hand, since quality is a demand shifter, it is positively correlated with quantity.

[6] This point is illustrated in Figure 1. In Figure 1, each point represents an observation of a firm exporting product HS85291020 to the United States in year 2006. According to the 8-digit Chinese classification of products, HS85291020 includes "Aerials and aerial reflectors of all kinds; parts suitable for use therewith for radio-broadcast receivers and their combinations, television receivers". For simplicity, I divide the observations into two groups, those of low quality and those of high quality (this division is based on my quality estimation, which will be discussed shortly.) The "x" points represent observations with low quality and the diamond points represent observations revealed to be of high quality. The dashed line represents the OLS fitted line pooling the low-quality points and high-quality points together. The distance of each point to this fitted line would be the quality estimate based on OLS estimation. A reversal means the low-quality "x" points above the fitted line would have higher quality than the diamond points below the OLS fitted line.

I need an instrument that captures only the quality-independent part of the price variation. The rich information I have on the origins and destinations of firms' exports provides a way to construct such an instrument. For each destination market m, I carefully select a set of destinations subject to demand shifters independent of those in m. I then use the average price that firms in the same production location charge in these other destinations as an instrument for the prices they charge in destination market m.[7] As expected, my instrumental variable strategy increases the magnitude of the OLS estimates by 100% on average. Moreover, the estimates are robust to different ways of constructing instruments.[8] To make sure that the demand residuals indeed capture quality information, I also examine the relationship between the recovered quality and firms' input choices for a subset of exporters that can be matched to China's Annual Manufacturing Survey sample. It is assuring that my quality measure is positively correlated with factors that have been suggested by existing literature to contribute to quality upgrading, such as firms' average wage and the use of imported intermediate inputs, especially from the developed countries.[9].

With measures of both quality and product scope in hands, I then examine the relationship between the perceived quality and product scope. Several interesting patterns emerge. First, across Chinese exporters within a market (6-digit HS product, destination country and year triplet), I find product quality on average to be negatively correlated with the number of product lines an exporter sells to the country. This seems to suggest a trade-off in firms' choice in product scope versus product quality, or in other words, a choice between product innovation and process innovation. However, as has been discussed in the flexible manufacturing literature[10], not all product lines are equally important to a multi-product exporter, as a result, this simple negative correlation on average may conceal important heterogeneity across products. Allowing the relationship to vary by the within-firm rank of bilateral sales, I find that the negative correlation is mainly driven by the peripheral products of a multi-product exporter, and that multi-product exporters actually have quality premium in their top products and the premium increases with product scope.

Second, investigating the changes in perceived quality and the number of product lines shipped to a destination country over time, I find the two are positively correlated. I then examine the dropping of existing product lines and addition of new product lines separately. Not surprisingly, I find that products with higher perceived quality are less likely to be dropped; as a consequence, there is a positive correlation between the perceived quality of a product and the length of the history of exporting the product to the destination. Dropping the lower quality lines also implies a negative correlation between product quality and product scope. On the other side, I find firms are more likely to add new product lines when the perceived quality of the existing top products is high. This implies a positive correlation between product scope and product quality. The observed

[7]My instrument is based on the one developed in Hausman (1996) and Nevo (2001). However, I need to take extra caution in selecting the set of destination markets for constructing instrument to address quality differentiation across markets which is absent in Hausman (1996) and Nevo (2001) but important in this paper.

[8]Small changes in the criteria in selecting the set of destinations for instruments do not have a substantial impact on the estimation results. Choosing different products in constructing instruments give similar estimates as well when the estimates are significant.

[9]There is a huge body of literature on the relationship between trade liberalization and increasing skill premium and adoption of new technology is one of the mechanisms proposed. See Goldberg and Pavcnik (2007), Han et al. (2012), Acemoglu (2003), Yeaple (2005),Zhu and Trefler (2005), Harrigan and Reshef (2011), Burstein and Vogel (2012), Verhoogen (2008) and Bustos (2011). Regarding the use of imported intermediate inputs, studies have found positive impacts of imported inputs on productivity in general. Examples are Amiti and Konings (2007) for Indonesia, Kasahara and Rodrigue (2008) for Chile, Halpern et al. (2005) for Hungary, Kugler and Verhoogen (2009) for Colombia, Goldberg et al. (2010) for India, Manova and Zhang (2012) and Manova and Zhang (2013) for China, etc. Kugler and Verhoogen (2009), Manova and Zhang (2012) and Manova and Zhang (2013) emphasize the mechanism through quality upgrading.

[10]For example, Eckel and Neary (2010), Eckel et al. (2013)

positive correlation between the number of product lines and perceived quality on average is the outcome of these two forces combined with the first one dominating. Investigating the sample of the cohort of new exporter and destination pairs that started with single product in year 2002[11] and tracking how the number of product lines and perceived quality evolve overtime, I find that a surviving firm and country pairs switch from single product status to multiple product status exactly in the year when there is a jump of the perceived quality of its existing product.

One possible reason for the overtime positive correlation between product quality and product scope is that it takes time for a new pair of buyer and seller to learn and form relationship and that there is economy of scope in building up sellers' reputation. When a new pair of buyer and seller strikes their first deal, the buyer may not have complete information on the quality of the product or the reliability of the seller, or the seller may not know exactly what attributes the buyer would value highly. As a result, they start small as a trial. In this sense, the perceived quality should be interpreted in a broader way as capturing the possible discount of quality due to information asymmetry. It takes time for both sides to learn and for the uncertainty to resolve. Once reputation is built up, there is economy of scale across different product lines by the same supplier which lowers the launch cost of new product lines. As a result, we observe simultaneous increase in the perceived quality of existing products and expansion of product scope.

There is supportive evidence of this potential mechanism in the data. First, I find that the higher probability of introducing new product lines when perceived quality of existing product is high cannot be explained by just a positive shock on the supply side that affects both the choice of quality and the choice of product scope. The positive correlation between the likelihood of introducing new product lines and perceived quality of existing product lines is robust to the inclusion of firm and year pairwise fixed effects together with destination fixed effects, meaning that in a given year, a multi-destination exporter is more likely to introduce new product lines to markets where the perceived quality of its existing products is higher. This suggests the demand side factors play an important role in the introduction of new product lines. Second, I compare the perceived quality of the newly introduced products by existing exporters to the perceived quality of new single-product exporters' product and that of new multi-product exporters' product. Not surprisingly, the newly introduced products of existing exporters are of lower quality than the products by new single-product exporters, as firms may want to start business in a new destination with their best products. Interestingly, I find the newly introduced products by existing exporters have a quality premium over the peripheral products by new multi-product exporters, suggesting a positive spillover from the reputation of established products to newly introduced products.

This paper contributes to the existing literature in several ways. First, I develop a method to obtain an improved measure of quality at the micro-level using transaction-level trade data. The unit value and quantity information in my data allows me to use demand residual as a measure of quality ranking. Demand residual is an improvement over unit value as a proxy for quality because it is not confounded by differences in cost efficiency.[12] Even though this method is not new, this paper is the first, to my knowledge, to explore the multi-origin and multi-market structure of the transaction-level trade data for identification and to recover the latent quality of exports at the firm- and market-specific level. The multi-market and multi-origin structure of my micro-level trade data

[11] I choose 2002 because there was an update of the Harmonized System in 2002. Identification of new product lines is difficult with two versions of the Harmonized System combined.

[12] Hallak and Schott (2011) provide a list of research based on unit value as a measure for product quality. The idea of relating unobserved quality to conditional market share originated from the IO literature. Examples of recent studies on trade based on this idea are Hummels and Klenow (2005), Hallak and Schott (2011), Gervais (2010), and Khandelwal (2010). This method does not distinguish between objective aspects of quality, such as technology and the subjective evaluation by consumers.

also provides room for constructing instruments that better satisfy the identifying assumptions of the Hausman-Nevo instrument.[13] More importantly, a quality measure constructed this way suits the purpose of studying the evolution of post-entry demand dynamics and especially the role of uncertainty very well. Unlike direct observations of objective product attributes related to quality, residuals from a demand system provide a measure of quality as perceived by markets[14] and can thus reflect the impact of uncertainty on conditional market shares. When a seller and a buyer meet for the first time, there very likely exists information asymmetry between the two parties. On one side, the seller may not know exactly what the buyer expects and what product attributes the buyer values highly; on the other side, the buyer may not have the same information regarding the true quality of the product as the seller. The uncertainty caused by asymmetric information may prevent the two parties from benefiting from the full potential of trade[15] and this will be reflected as a small demand residual for a given price. Overtime, the seller may gradually learn what product attributes are appealing to the buyer and with trust established, find it worthwhile to carry out the necessary investment to meet the buyer's requitement better; or the buyer may be convinced of the high quality through the trial purchase and start to place larger orders under the same price. Both cases of gradual resolution of uncertainty will be reflected as increasing demand residuals by surviving exporters.

Second, this paper is related to studies on multi-product exporters and especially the relationship between the extensive and the intensive product margins of multi-product exporters. The literature on multi-product exporters is motivated by the fact that multi-product exporters dominate international trade flows and that the within-firm adjustment of product mix could be a potential channel through which trade liberalization affects the efficiency of resource allocation. Different mechanisms at the micro-level have been proposed to explain the adjustment in product scope at the firm level. Following the introduction of flexbile manufacturing by Eckel and Neary (2010), researchers further explore the systematic difference between products within a multi-product exporter. More specifically, products within a multi-product firm are differentiated according to the firm's product-specific compentency, with core product endowed with the highest competency and peripheral product endowed with lower competency. This framework has been adopted by several empirical studies to explain the observed firm- and product-level patterns of exports in different countries.[16] The empirical analysis in this paper is closely related to this literature on the relationship between the extensive and the intensive product margins taking notice of the systematic asymmetry across products within a firm and destination cell, but further extends it in two direc-

[13]Firm-level input prices, which affect production cost, have often been used as price instruments in estimating the output demand function. However, my investigation of the relationship between the estimated quality and firms' input choices suggests input prices are endogenous because firms use different input to produce output of different quality. This calls into question the validity of input prices as instruments for output price in demand estimation. My instrument is less susceptible to this concern because it is origin-destination specific instead of firm specific.

[14]Quality here should be interpreted in a broader way than as traditionally defined in the industrial organization literature where it is associated with vertical product differentiation that requires consumers' concensus in product ranking. Perceived quality here refers to any factor that would allow a firm to sell more at a constant price, which may also capture successful horizontal product differentiation - successful in the sense of being able to cater to a larger group of consumers' horizontal preference.

[15]For example, the seller may not conduct the necessary investment to meet the higher expectation of the seller; or the seller may want to start with a small order as a trial of the product quality.

[16]For example, Iacovone and Javorcik (2008) and Iacovone and Javorcik (2010) find that Mexican firms tend to export their existing core product on domestic markets after trade liberalization; Mayer et al. (2014) and Manova and Zhang (2013) report that exporters, in France and China respectively, drop peripheral products and keep only core products in destinations where competition is tougher; Arkolakis and Muendler (2011) explores sales distribution across products within a firm and destination cell and documents a decline in sales (due to declining product efficiency) with scope as well as declining product entry cost with scope among Brazilian exporters.

tions. First, I focus on the quality aspect of the intensive product margin. Larger trade volume in the intensive product margin could be due to either cost efficiency or quality premium. The existing theoretical or empirical literature on multi-product exporters treats the two dimensions as morphism and does not try to differentiate the contribution of cost versus quality advantages. However, studies in other related areas have taken notice of the different implications of being able to produce with lower cost and being capable of producing higher quality. Specifically, Sutton (2007) and Sutton (2012) address the important role of quality in determining firm success as well as nation wealth in the process of trade liberalization. In the following analysis of this section, I will use the estimates of perceived quality obtained in the previous section to investigate its relationship with export scope. Second, the existing empirical studies on the relationship between the two margins mostly explore the cross-sectional variation, for example, Mayer et al. (2014) and Manova and Zhang (2013) using the within-firm and across-destination variation, and Arkolakis and Muendler (2011) using the within-destination and firm but across product variation. With a well-specified model, treating a snapshot of the export pattern as steady state allows one to use the cross-sectional variation to recover important mechanism; however but this analysis is not as helpful in recovering underlying factors that govern exporters' life-cycle dynamics in a fast changing environment. In addition to cross-sectional pattern, I will also examine the co-movement of the perceived quality and export scope within an exporter and destination cell.

This paper also connects to the literature on the expansion of trade along the extensive margin of the number of exporters and the related dynamics. Globalization offers firms opportunities to explore larger markets. Numerous studies have utilized cross-sectional or overtime variations in observed trade patterns along different dimensions to gain insights into how different forms of trade barriers affect firms' decisions so to shed light on the potential mechanisms through which trade liberalization or government trade promotion policy may work. Many studies find that the extensive margin of the number of exporters, among many other dimensions, is important and accounts for a substantial portion of the overall variation in trade volume.[17] To accommodate this empirical pattern, firm heterogeneity and entry costs are introduced into trade models to generate self-selection of firms into exporting status. Recent development of this line of literature takes one step further to investigate the post-entry dynamics of new exporters.[18] Three key features of the dynamics have been widely documented, for example, as in Rauch and Watson (2003), Iacovone and Javorcik (2008),Iacovone and Javorcik (2010), Arkolakis (2010) and Freund and Pierola (2010), and nicely summarized in Ruhl and Willis (2014). First, new exporters start with small volume. Second, a large proportion of new exporters exit within a short period of time. Third, surviving new exporters grow fast. Since an once-for-all draw of firm-specific productivity and payment of entry costs cannot generate these patterns, gradual resolution of uncertainty overtime is proposed as the underlying force. The uncertainty involved may take different forms and there is a growing literature on how it affects potential exporters' decision and behaviour, for example, Iacovone and Javorcik (2010), Freund and Pierola (2010), Chaney (2014), Albornoz et al. (2012), Nguyen (2012), Eaton et al. (2013), Artopoulos et al. (2013) and Ruhl and Willis (2014). This development actually echoes some earlier studies on the informational barriers in international trade, for example, Rauch (1996), Rauch (1999), Rauch (2001) and Rauch and Trindade (2002), Rauch and Watson (2003) and Rauch and Casella (2003). This paper complements the existing studies by constructing perceived quality from commonly available trade data as a specific measure of the trust between buyers and sellers and investigating the specific dimension along the extensive product margin of export expansion.

[17]For studies on the decomposition of trade along different margins, see ...

[18]For examples of trade models with these features, see ...

In this paper I focus on products classified in Chapter 85 under the Harmonized System. There are three reasons behind this choice. First, this chapter accounts for a large proportion of China's total ordinary trade. Among the 97 2-digit HS chapters, it has been the top one in China's exports through ordinary trade since 2001. The share reached 12% by 2006. Second, electrical products are intensive in R& D and thus have a potential for quality differentiation and upgrading. Third, according to Rauch (1999), almost all products covered in this chapter are classified as differentiated goods, thus the problem of asymmetric information upon entry is more severe. All the analysis can be easily applied to products in other chapters. I leave the comparison between products with different attributes for future work.

The remainder of the paper is organized as following. In Section 2, I give a brief overview of the data explored in this study. In Section 3, I present the demand estimation and recover unobserved quality as the residual from the demand function. In Section 4, I investigation the cross-sectional relationship between product scope and product quality. In Section 5, I present the analysis of the within-firm dynamics of product scope and product quality. I present my conclusion in Section 6.

2. Data

2.1. Customs Data

My primary dataset is China's Customs records for 2000-2006. This dataset provides information on the 8-digit HS product code, quantity, total value, exporter and importer identity, ownership type, origin, destination, form of trade, and transportation method associated with every export and import transaction by firms located in China. The original data are at the monthly level. To estimate the demand functions, I aggregate observations by year in cells defined by exporter identity, destination market, 8-digit HS code and origins of exports at the prefecture level in China. According to customs documents, origin is the location of production in most of the cases. I use origin as one dimension of the cell that defines an observation out of concern that products produced by the same firm at different locations may not be the same.

There are two aspects of China's exports that require special attention. First, a lot of Chinese exporters are involved in processing trade,[19] which can be identified from the "form of trade" variable in the customs data. Due to possible transfer pricing, transaction prices in processing trade may very well reflect only part of the production costs. As a result, these transactions may not be informative about the demand condition on the destination market. For the purpose of estimating price elasticities, I use only export transactions labelled as ordinary trade. Second, a substantial amount of export transactions are conducted by trading agencies instead of manufacturing firms. Trading agencies can be identified by names in the customs data.[20] Since I cannot identify the original producers, I exclude these indirect exports in the analysis.

Direct export in the form of ordinary trade is the focus of this study. Since many of the exports to Hong Kong will be re-exported to other markets not recorded in China's customs, they are also excluded.[21] I also drop transactions where the unit value falls below the 1st and above the 99th percentile within each 8-digit HS product-destination market-year cell.

[19]About half of China's exports are through ordinary trade and the other half are through processing and assembly trade. In processing trade, Chinese firms import parts duty-free from abroad, process and assemble them, and export the final products.

[20]I use Chinese characters with the meaning of "trading" or "importing and exporting" as identifiers. The same practice is also adopted in Khandelwal et al. (2011), Manova and Zhang (2012) and ksw (2013).

[21]For discussions of China's exports through Hong Kong, see Fung and Lau (2003) and Ferrantino and Wang (2008).

2.2. China's Annual Manufacturing Survey Data

The second source of data is China's Annual Manufacturing Survey (AMS) 2000-2006. AMS covers all State Owned Enterprises (SOE) and firms of other types of ownership with annual sales above 5 million RMB. The survey collects information on firms' industry classification (CIC), capital stock, wage cost, total employment, total exports, total output value, VAT on throughput, VAT payables, etc. I match the customs data and the AMS data by firms' names. I summarize the exporting and importing activities of the matched sample in the bottom panel of Table 1. Given that AMS selects firms on size, it is not a surprise that firms in the matched sample are on average larger in export scale. However, there is no substantial and systematic difference in other measures of trading activities between the customs working sample and the matched sample.

2.3. Other Data

Information on destination markets' per capita GDP is from the Penn World Tables. Pair-wise distances between countries are from CEPII.

3. Demand Estimation and Recovered Quality

3.1. Specification

The unit of observation is by exporting firm f, destination market m, 8-digit HS product h and year t. My estimation equation is

$$ln\left(Q_{fmht}\right) = \alpha^{g_{(m)}j_{(h)}} \times ln\left(P_{fmht}\right) + A_{mht} + \xi_{fmht} + \epsilon_{fmht} \quad (1)$$

where $ln\left(Q_{fmht}\right)$ is the log of physical quantity sold of product h by firm f to country m in year t; $ln\left(P_{fmht}\right)$ is the log of the associated unit value; A_{mht} is a market-product-time fixed effect included to absorb demand factors common to all exporters of product h to market m in year t; ξ_{fmht} denotes product quality, which is unobservable and is very likely to affect price and quantity simultaneously; ϵ_{fmht} absorbs all exporter idiosyncratic demand shocks independent of price. $g_{(.)}$ and $j_{(.)}$ refer to the market group that country m belongs to and the product group that product h belongs to, respectively.

The purpose of estimating the demand function is to recover the latent quality ranking as demand residuals. It is essential to estimate the price coefficient properly. There are two issues that need to be addressed. First, unobserved quality simultaneously determines price on the right-hand side and quantity on the left-hand side, for the reason that varieties of better quality are usually more costly to produce and priced higher and that varieties of better quality are also demanded in larger quantities conditional on price. This leads to an upward bias of the OLS estimates of the price coefficient. To identify the price coefficient, I am going to construct and use a Hausman-Nevo instrument that captures the quality-independent part of the cost variation across different production locations in China. I will discuss this in more detail in the next subsection. The second issue is that the price coefficient is not necessarily the same across markets and products. It is not enough just to be able to consistently estimate an average price coefficient since imposing a constant demand elasticity while heterogeneity exists will contaminate the residual as a quality measure. So I allow the price coefficient α to vary across market group g and product group j. I divide the global market into seven groups according to geographical location and level of development. The seven groups are:[22] the United States and Canada (NA); Latin American countries (LA); European Union member countries (EU); Singapore, Japan and Korea (SJK); other countries in Asia (RAS); Australia and New Zealand (AZ); African countries (AF). Product group g is defined along the 4-digit HS lines.[23] Once I get consistent estimates of the elasticities, I can purge the influence of price by subtracting $\widehat{\alpha}^{g(m)j(h)} \times ln\left(P_{fmht}\right)$ from $ln\left(Q_{fmht}\right)$ as well as the influence of aggregate demand factors A_{mht} by demeaning within each mht cell. In the end, the quality measure would be an estimate of the residual $\xi_{fmht} + \epsilon_{fmht}$, denoted by $\widehat{\xi}_{fmht}$.

3.2. Identification Strategy

Given the rich information I have on the origins and destinations of firms' exports, I can construct a Hausman-Nevo instrument to identify the price coefficients. With multi-market observations on prices, such an instrument uses prices on other markets as instruments. This type of instrument has been used in studies on ready-to-eat cereal markets by Hausman (1997) and Nevo (2001). In general, there are two sources of variation in observed prices: one is variation in supply-side factors, such as production, transportation or distribution cost, and the other is variation in demand-side factors, such as product quality. The first type of variation is useful in identifying the price coefficient in the demand function, while the second causes endogeneity problems and leads to inconsistent estimates if not addressed. A useful instrument must pick up variation of the first type to be relevant, and be free of the second type to be valid. In a multi-market context, the two-source variation argument takes a more specific form: prices charged by firms on two different markets can be correlated either because of common cost shocks or common demand shocks. To capture common cost shocks, I construct the instrument using prices charged by firms producing in the same prefecture in China; to avoid common demand shocks, I use prices from carefully selected markets that are far apart in terms of both geographical distance and levels of development.

For an illustrative example, think about firms in Dongguan, a manufacturing cluster in China's Pearl River Delta area, that export to both Japan and Kenya. Because the two markets are quite far apart both on a geographical map and in levels of economic development, one can reasonably believe they have very different demand structures and are subject to independent demand shocks. On the other hand, these firms may share common cost shocks due to the localization of input markets. This allows me to use the prices that exporters from Dongguan charge in Kenya to construct instruments for the prices they charge in Japan.

I use prefecture as the production-origin identifier[24] and apply two criteria in selecting the set of markets in constructing instruments. For an observation subscripted with $fmht$, the prices charged by any exporter f' shipping goods from location $o_{(f)}$, the prefecture where firm f is located, to any market m' in year t will be used to construct instrument for $ln\left(P_{fmht}\right)$ if

- The geographical distance between country m and m' is above the 30th percentile in the distribution of geographical distance among all country pairs.
- The per capita GDP of country m' is at least 1.5 times the standard deviation of the world distribution lower than that of country m.

[22] I drop the observations associated with exports to the non-EU member European countries. The estimates for this group is very imprecise because of the small number of observations relative to the number of countries and products.

[23] Thus the specification in (1) is equivalent to regressing lnQ on lnP, controlling for market by product and by year fixed effects for each market group and 4-digit HS4 sector separately.

[24] There are about 300 unique locations.

The instrument for $ln\left(P_{fmht}\right)$ is then the average of prices of observations with subscript $f'm'h't$

$$IV_{fmht} = \overline{lnP}_{f'm'h't} \tag{2}$$

Notice the average is taken across all f', m' and h'. The f's and m's are chosen as aforementioned; the h's cover all the 8-digit HS lines in my sample.[25] For identification, the instrument retains the destination- and year-specific, across-prefecture variation in export prices to markets m'. The exclusion restriction, which is embedded in the market-selection criteria, requires in this context that the demand shocks from markets m', where the average is taken, to be independent of the demand shocks in market m, where the price coefficient is to be estimated. The first criterion rules out markets that may share geographically local demand shocks; the second addresses the possibility that exporting firms may ship products of the same quality to markets with a similar degree of development and thus a similar preference for quality.[26]

3.3. Demand Estimation Results

Table 1 summarizes the sample for demand estimation. Column (1) reports the number of observations for each market group. Column (2) and (3) report the number and percentage of observations with non-missing values for instrument. For richer markets such as the United States, Canada, European Union members countries, Australia, New Zealand, Singapore, Japan and Korea, less than 10% of the observations have missing value for instrument. Column (4) reports the number of 4-digit HS lines with negative and significant[27] estimates for the price coefficient. The best results are achieved for the North American market and the EU market, with about 2/3 of the 4-digit product lines having significant and negative estimates. The last two columns report the number and percentage of observations associated with the count in column (4). For the North American and EU markets, more than 85% of the total observations are associated with negative and significant estimates for price coefficients.

Table 2 summarizes the OLS and IV estimates of the price coefficients. The means and medians are over product lines with negative and significant IV estimates using all observations for each market group.[28] Column (1) reports the average of OLS estimates; column (2) reports the average of OLS estimates using only the sample taking non-missing values for the instrument. Column (3) and (4) are for the IV estimates. Column (5) to (8) are the medians of the estimates. In general, for product lines with precise IV estimates, the magnitude of the IV estimates is about 1.5 to 2 times larger than the OLS estimates, suggesting the instrument is correcting the inconsistent OLS estimates in the expected direction. Moreover, the similarity between the estimation results with the full sample and the sub-sample with non-missing values for the instrument suggests the proxy strategy does not affect the estimation substantially.

Given my interest in quality differentiation and the precision of the estimates, I will focus

[25] To average across different products, the product-specific mean is taken out.

[26] There are cases where no observation $f'm'h't$ exists, i.e, there is no firm f' in the same prefecture $o_{(f)}$ as firm f shipping to any market m' that satisfies the two selection criteria in year t. As a result, the instrument constructed as above would take missing value for such observations. By construction, observations in richer markets are less likely to take missing value. When this happens, I use the origin- and destination-specific mean over all years to construct a proxy for the missing value. If it is still missing, I take the average across all destination markets. The last resort is to take the provincial average of the origin prefecture.

[27] The significance level is set at 10%.

[28] This is corresponding to the count in columns (4) to (6) in Table 2.

on two markets groups in the following quality and input analysis. The two market groups are the North American market, which includes the United States and Canada, and the EU member countries. The two panels of Figure 2 show the OLS and IV estimates for these two market groups.

3.4. Robustness Check

3.4.1. Alternative Instruments

The identification strategy in the demand estimation relies on a few key assumptions. Any violation of these assumptions will make the instrument invalid and the estimates of the price coefficient inconsistent. In the end, this will cause reversal in the measured quality ranking as illustrated in Figure 1. In this subsection, I check the robustness of the estimates shown above by constructing several alternative instruments and comparing the estimation results. Results using different instruments are similar, which is assuring.

The key potential threat to the validity of the instrument is the existence of quality differentiation in the set of markets selected in constructing the instrument. This would introduce correlation between the instrument and the endogeneous price variable through the quality channel and make the instrument invalid. To address this concern, I first utilize the large number of markets available in my data and change the criteria in selecting the set of markets in constructing instruments. More specifically, I supplement the main instruments with another two stricter alternative instruments.[29] One of the alternative instruments is constructed by adopting a per capita GDP disparity criterion of 1.75 times the standard deviation away while holding the geographical distance criterion at the 30th percentile; for the second alternative, I hold the per capita GDP criterion at 1.5 times the standard deviation and increase the geographical criterion to be above the 40th percentile. It turns out that the rank correlation coefficients among quality estimates based on different instruments are above 0.98. Figure 3 shows the estimates with the additional IVs together with the ones based on the main IV. An important observation is that stricter rules in selecting markets to construct instruments do not systematically change the magnitude of the estimates. Accordingly, overidentification tests fail to reject the hypothesis that the main instrument is exogenous for 41 out of the 48 product groups in the North American market and 42 product groups in the European market.

The overidentification test is informative about the validity of the main instrument based on the assumption that the stricter instruments are valid. In other words, passing the overidentification test only suggests that the estimates based on different instruments are similar but not necessarily consistent. In cases where exports to even the poorest destinations are vertically differentiated, the estimates would be inconsistent no matter how strict the criteria. To address this concern, I explore the product dimension of my data and use only unit values of products classified as homogeneous goods in Rauch (1999) that are also used as inputs in producing products under HS Chapter 85 as instruments.[30] It turns out that the instruments constructed this way are much weaker and the first stage F-statistic is less than 6 for more than half of the 48 product groups. However, the rank correlation coefficient among quality estimates based on my main instrument and this alternative instrument is still as high as 0.75. Figure 4 shows the comparison between the estimates of price

[29] I face a trade-off between instrument validity and instrument strength in selecting the geographical distance and per capita GDP disparity cut-offs: the farther away the two markets, the more likely they have independent demand shocks and the more confident I am in the validity of the instrument; on the other hand, the stricter I am in selecting markets, the more observations would need proxy values for instruments and the less variation can be utilized, and in turn, the less efficient the estimates would be. Thus it is desirable to find a balance point where the estimation results are robust to small changes in cut-offs.

[30] I use a concordance between the HS product classification and sectors in China's 2002 input-output table to identify inputs.

coefficients that are significant with both instruments. Again, the magnitude of the estimates with the alternative instrument is not systematically larger than that with the main instrument.

3.4.2. Recovered Quality and Input Choices

With price coefficients in hand, I calculate the following firm-, product-, market- and year-specific residuals as a measure of quality.

$$\widehat{\xi}_{fhmt} = ln\left(Q_{fmht}\right) - \widehat{\alpha}^{g_{(m)}j_{(h)}} \times ln\left(P_{fmht}\right) - \widehat{A}_{mht} \tag{3}$$

This measure contains the last two terms $\xi_{fmht} + \epsilon_{fmht}$ in (1). To make sure that the recovered residuals capture not only the random demand shocks in ϵ_{fmht} but are informative of firms' quality choice ξ_{fmht}, I investigate the relationship between the quality estimates and firms' input choices.

The first input choice I investigate is the average wage a firm pays. Skill-biased technology adoption, including quality upgrading, has been proposed by researchers as the key factor contributing to increasing skill premium in all, and especially developing, countries in the process of trade liberalization[31] Acemoglu (2003), Yeaple (2005) and Zhu and Trefler (2005) emphasize the technology change at the firm level. Harrigan and Reshef (2011) and Burstein and Vogel (2012) extend the model by introducing the interaction between the firm heterogeneity in productivity and the skill intensity of production technology to further allow impacts through the reallocation channel. On the empirical side, studies by both Whalley and Xing (2010) and Han et al. (2012) find increasing skill premium in the case of China, especially in the coastal region, where firms are more integrated into the global economy. Verhoogen (2008) and Bustos (2011) also find supportive evidence for this skill-upgrading mechanism in Mexican firms and Argentinian firms respectively, and Verhoogen (2008) explicitly relates it to quality upgrading. Based on these studies, it would be assuring that the recovered residual contains quality information if it is positively correlated with the average wage a firm pays.

The second set of input choices of interest are imports. Numerous studies have shown that imports have a positive impact on firm productivity, for example, Amiti and Konings (2007), Kasahara and Rodrigue (2008), Halpern et al. (2005), Kugler and Verhoogen (2009) and Manova and Zhang (2012), and as argued in the last two papers, quality upgrading can be the specific channel through which this positive impact on productivity takes place. Notice that I am using the same data source as Manova and Zhang (2012), but I focus on a different set of firms. Manova and Zhang (2012) study firms involved in processing trade while I focus on firms that export through ordinary trade. The advantage of focusing on processing and assembly exporters is that one knows for sure the related imports will be used in producing for foreign markets. This does not apply to firms exporting through ordinary trade as these firms sell a substantial portion of their output to China's domestic market. However, one may be concerned to what extent firms involved in processing and assembly trade are behaving like profit-maximizing agents in making decisions on input, output and price. Many of the processing firms operate only as a producing unit of a much longer value-generating chain with important decisions made elsewhere. Firms that export

[31] The Stolper-Samuelson theorem in the classical Heckscher-Ohlin model predicts that when trade is liberalized between countries with different endowment of skilled and unskilled labour, skill premium will increase in skill-abundant countries and decrease in skill-scarce countries due to the opposite changes in the relative prices of skill-intensive tradables in the two type of countries. This prediction is inconsistent with what actually happened. Firstly, prices of skill-intensive products in the skill-abundant countries have been stable or declining. Secondly, skill premium has been increasing in the skill-scarce countries.

through ordinary trade are less of concern in this aspect.[32] Moreover, following the literature on the relationship between a country's level of development and the quality of its export by Linder (1961) and Hallak (2010), we would expect the imports form developed countries contribute more to firms' output quality. In summary, it would be assuring that the recovered residual contains quality information if it is positively correlated with usage of imported inputs, especially imports from developed countries.

I calculate the across market and within firm, product and year cell simple average of the demand residuals to construct a fht-level quality measure.

$$\widehat{\xi}_{fht} = \frac{1}{N^m_{fht}} \sum_m \widehat{\xi}_{fhmt} \tag{4}$$

where N^m_{fht} is the number of countries in North America and Europe Union to which firm f ships product h in year t. I get similar results in the following analysis if I use the destination market population weighted average instead of this simple average, which is reassuring that demand residuals in these markets are comparable. The regression specification is

$$\begin{aligned}\widehat{\xi}_{fht} = &\quad \gamma_1 InputChoices_{ft} + \gamma_2 ExportIntensity_{ft} \\ &+ \quad \gamma_3 Log(Employment_{ft}) + \gamma_4 Log(Employment_{ft})^2 + \gamma_5 Log(Employment_{ft})^3 \\ &+ \quad T_{ft} + P_{ft} + S_{ft} + H_{ht} + \nu_{fht} \end{aligned} \tag{5}$$

The variables of interest on the right hand side are different measures of firms' input choices. Because I do not observe the breakdown of inputs between production for domestic sales and oversea sales, I include export intensity as a control variable and exclude firms that also export through processing trade. I use a third order polynomial of employment to control firm size. $T_{(ft)}$ represents a set of pairwise year dummies, one for the year of the observed export performance and the other for the first year when the firm has a record of exporting through ordinary trade in the Customs data; $P_{(ft)}$ represents a set of province dummies; $S_{(ft)}$ represents a set of sector dummies based on the 4-digit Chinese Industrial Classification.[33] H_{ht} is a set of dummies capturing 8-digit product- and year- specific shocks. Error term ν_{fhmt} captures both random shocks that affect firms' quality choice and measurement errors in the estimated quality.

China's customs records provide information on firms' imports of intermediate inputs[34] [35] in as much detail as on firms' exports. This allows me to construct not only extensive measures - importing status dummies - but also intensive measures, such as the total value of imports and the number of imported varieties[36]. Because duty-free imports for processing and assembly are under strict regulation and cannot be used in producing for exports through ordinary trade, I include

[32]Another difference is that Manova and Zhang (2012) cover all HS product lines while I am investigating only one chapter of HS products. I choose not to cover all products in this paper because my quality measure is recovered from estimating a demand system instead of being inferred from unit value alone. Demand systems for different products should be estimated separately and the work here can be easily applied to other HS chapters.

[33]More information on the overtime concordance of this classification system can be found in Brandt et al. (2012).

[34]I identify intermediate inputs with the BEC-HS concordance provided by the United Nations Statistics Division (http://unstats.un.org/unsd/cr/registry/regot.asp). HS product lines matched BEC categories 111, 121, 21, 22, 31, 32, 321, 322, 42 and 53 are identified as intermediate input.

[35]In general, both intermediate input and production equipment matter for the production of quality. I do not include capital goods in the analysis because I only observe a firm's imports for years 2000-2006 and it is too short to construct a meaningful measure of a firm's stock of imported capital goods.

[36]Here I define a variety as one 8-digit product line from a specific country

only a firm's imports through ordinary trade. I further differentiate the origins of a firm's imports. According to whether the imports are from one of the 20 most advanced countries, I divide imports into two categories, those from rich countries and those from other countries.[37] Regarding the types of imported goods, I use the UN's BEC (Classification by Broad Economic Categories) classification and identify imports as either intermediate inputs or capital goods.

Table 3 reports the regression results. Panel A shows that wage is positively associated with unit value and quality. Within a 8-digit HS product, firms that pay wages 10% higher charge prices 3.6% higher on average. Holding price constant, they sell 1.6% more in quantity. The unconditional sales in terms of quantity is 2.8% lower. The association between wage and unconditional revenue from a single 8-digit HS product is positive but not significant. Panel B reports the results from regressing on a dummy indicating whether a firm uses imported intermediate input. I find importers on average have a quality premium. Holding price constant, firms that import can sell about 3% more. Importers and non-importers sell about the same amount in terms of quantity unconditionally, but importers receive higher revenue because of higher prices they charge. In Panel C, I further differentiate whether a firm imports intermediate input from the top 20 rich countries or other countries. It turns out the positive association with quality is totally driven by imports from the rich countries. I introduce intensive measures of importing activities in Panel D and E. In Panel D, I include the log value of imported intermediate inputs from the 20 rich countries and other countries respectively. In Panel E, I use the log of the number of varieties from the rich and other countries. Results in both panel echo the previous finding with the extensive measure - the more intermediate inputs a firm purchases from the rich countries, the higher the recovered quality.

4. Correlations between Exporter Scope and Perceived Quality

In this section, I investigate the cross-sectional and over-time correlations between the extensive product margin - the scope - and the intensive product margin - the perceived quality - of China's exports in HS85. For the cross-sectional analysis I utilize the co-variation of these two variables across firms active on the same market, meaning, firms that sell the same 8-digit product to the same destinaiton in a specific year. For the over-time analysis I use the variation over years within a cell defined by a triplet of exporter, destination and product.

The relationship between the extensive and the intensive product margins has attracted a lot of research interest. Different products by a same firm may be linked on both the demand side and the supply side; moreover, depending on the specific linkage, the across-firm correlation between the two margins could be either positive or negative.[38] Following the introduction of flexbile manufacturing by Eckel and Neary (2010), one strand of this literature further explores the systematic difference between products within a multi-product exporter. More specifically, products within a multi-product firm are differentiated according to the firm's product-specific

[37] The 20 rich countries are: Luxembourg, Norway, the United States, Singapore, Switzerland, Netherlands, Austria, Canada, Iceland, Denmark, Australia, Belgium, Germany, Japan, France, Sweden, Italy, Britain, Finland and Spain.

[38] Bernard et al. (2011) focuses on the supply-side linkage and argues that higher firm-specific ability drives both higher sales per product and larger product scope, and thus generates a positive correlation between the two margins. Nocke and Yeaple (2014) features the supply side trade-off due to the limited supply of organization capital and introduces firm-specific organizational efficiency to govern the degree of this trade-off. As a result, conditional on organization efficiency, the competition for organization capital across product lines leads to a negative correlation between the two margins. Dhingra (2013) emphasizes the demand side linkage arising from the within-brand cannibalization effect and argues that trade liberalization encourages process innovation and discounrages product innovation.

compentency, with core product endowed with the highest competency and peripheral product endowed with lower competency. Several empirical papers have adopted this framework to explain the observed firm- and product-level patterns of exports in different countries.[39]

The empirical analysis in this paper is closely related to this literature on the relationship between the extensive and the intensive product margins taking notice of the systematic asymmetry across products within a firm and destination cell, but further extends it in two directions. First, I will focus on the quality aspect of the intensive product margin. Larger trade volume in the intensive product margin could be due to either cost efficiency or quality premium. The existing theoretical or empirical literature on multi-product exporters treats the two dimensions as morphism and does not try to differentiate the contribution of cost versus quality advantages. However, studies in other related areas have taken notice of the different implications of being able to produce with lower cost and being capable of producing higher quality. Specifically, Sutton (2007) and Sutton (2012) address the important role of quality in determining firm success as well as nation wealth in the process of trade liberalization. In the following analysis of this section, I will use the estimates of perceived quality obtained in the previous section to investigate its relationship with export scope. Second, the existing empirical studies on the relationship between the two margins mostly explore the cross-sectional variation, for example, Mayer et al. (2014) and Manova and Zhang (2013) using the within-firm and across-destination variation, and Arkolakis and Muendler (2011) using the within-destination and firm but across product variation. With a well-specified model, treating a snapshot of the export pattern as steady state allows one to use the cross-sectional variation to recover important mechanism; however but this analysis is not as helpful in recovering underlying factors that govern exporters' life-cycle dynamics in a fast changing environment. In addition to cross-sectional pattern, I will also examine the co-movement of the perceived quality and export scope within an exporter and destination cell.

4.1. Cross-sectional correlation

The benchmark regression specification is as follows.

$$\widehat{\xi}_{fmht} = \beta \times \log(N^{\widehat{h}})_{fmt} + X_{ft}\mathbf{B} + D_{mht} + \nu_{fmht} \tag{6}$$

In regression equation (6), $\widehat{\xi}_{fmht}$ is the recovered quality of product h by firm f shipped to destination m in year t; $(N^{\widehat{h}})_{fmt}$ is the number of 6-digit HS product lines firm f ships to destination m in year t.[40] X_{fmt} is a vector of covariates controlling for input variables that have been identified as key contributors in producing quality in previous analysis.[41] D_{mht} represents a set of destination-product-year triplet dummies capturing the demand shocks common to exporters serving the same

[39] For example, Iacovone and Javorcik (2008) and Iacovone and Javorcik (2010) find that Mexican firms tend to export their existing core product on domestic markets after trade liberalization; Mayer et al. (2014) and Manova and Zhang (2013) report that exporters, in France and China respectively, drop peripheral products and keep only core products in destinations where competition is tougher; Arkolakis and Muendler (2011) explores sales distribution across products within a firm and destination cell and documents a decline in sales (due to declining product efficiency) with scope as well as declining product entry cost with scope among Brazilian exporters.

[40] Here I use a wider definition of product, 6-digit HS line, than in quality estimation. The purpose of this more conservative choice of definition of product in calculating the number of product lines a Chinese exporter ships to a market is to avoid inflating export scope with trivial product differentiation. Results are similar if I use the number of unique 8-digit HS lines.

[41] Such covariates include working capital stock, labour input and the usage of imported intermediate inputs from rich countries. These variables vary at the firm- and year-level and the capital and labour input related information is available only for the customs sample that can be matched to the Chinese Manufacturing Annual Survey data.

market.

With this specification, coefficient β captures the correlation between an exporter's product scope to a destination country and the simple average of the perceived quality of its products. This specification treats all products by the same firm equally, as a result, it may be misspecified if there is asymmetry across products within a firm. I then allow the correlation between product scope and product quality to vary according to the "importance" of the product. Specifically, I use the rank of the product[42] in bilateral sales among all products by exporter f to the same destination m in year t as a measure for the "importance" of the product. I then run the following regression

$$\widehat{\xi}_{fmht} = \sum_{r=1}^{5} \beta^r \times I_{fmht}(rank = r) \times \log(N^{\widehat{h}})_{fmt} + X_{ft}\mathbf{B} + D_{mht} + \nu_{fmht} \tag{7}$$

In regression (7), $\beta^r \log(N^{\widehat{h}})_{fmt}$ has the convenient interpretation as the quality premium in products under 6-digit HS line $\widehat{h}$ by an exporter shipping $(N^{\widehat{h}})_{fmt}$ products, among which product $\widehat{h}$ is ranked number r, over a single product exporter that sells only $\widehat{h}$ to the market. I group all products ranked 5 and above by a multi-product firm together.[43]

Table 4 reports the regression results. The coefficient estimates in column (1) suggest that an exporter's product scope is negatively correlated with the simple average of the quality of its products. Column (2) shows that controlling for the firm-level input choices does not change this negative relationship, suggesting that this correlation is partly driven by unobserved firm-specific factors. Results for specification (7), where the correlation between product scope and product quality is allowed to vary according to the within-exporter product ranking of bilateral sales, are reported in column (3). An interesting pattern that was covered up in regression (6) emerges: there is indeed asymmetry in quality across different products by the same multi-product exporter. More specifically, multi-product exporters do have quality premium in its top-ranked core products; moreover, the larger the produce scope of a multi-product exporter, the higher the quality premium in its core product. The lower down on the ranking list, the lower the quality premium of multi-product exporters and the premium disappears and becomes quality discount when one moves further enough from the core products. Again, adding input controls in column (4) does not change this pattern.

Quantitatively, according to the regression results in column (3) of Table 4, the quality premium of the top product by an exporter that ships 3 product lines to a destination is about $1.306 \times \log(3) = 1.43$, meaning if it charges the same price as the average single-product exporter of the same product, the multi-product exporter will be able to sell 143% more. Similarly, holding price the same, the same multi-product firm can sell $0.129 \times \log(3) = 14\%$ more of its 2nd product. When it comes to the 3rd product, the market share of the multi-product firm will be $0.25 \times \log(3) = 27\%$ less, reflecting a quality discount in its last and most peripheral product. The within-firm asymmetry across products identified here is consistent with the findings from several recent theoretical and empirical studies on flexible manufacturing in international trade, for example, Iacovone and Javorcik (2008), Eckel and Neary (2010), and Bernard et al. (2011), Manova and Zhang (2013) and Mayer et al. (2014).

[42] More precisely, it is the rank of the 6-digit product category that the 8-digit product belongs to among all 6-digit product lines the Chinese exporter ships to one market.

[43] Among the 125,385 combinations of firm, destination and year triplet combination (fmt), over 2000 and 2006 in the North American and European Union countries, shipment of more than 5 6-digit product lines only happened for 3325 triplets, which is less than 3%.

Some studies use unit value as a proxy for product quality[44]. In column (5) I investigate the correlation between product scope and unit value by simply replacing the quality estimates on the left hand side variable in regression (6) with unit values. I find a similar pattern of declining premium by multi-product exporters relative to an average single product exporter when moving down the ranking of the multi-product exporter's bilateral sales. In column (6) I further added a third order polynomials of the quality estimates as controls and the pattern disappears. This result lends some support to the practice of using unit value as a measure for product quality.

This cross-sectional pattern of how the relative quality and price vary along with product ranking reveals something interesting about multi-product exporters' decision making process. Firms' decisions are based on benefit and cost comparison. An exporter would decide to introduce a new product if net profit from launching and selling the product is positive. So one way to rationalize the introduction of quality inferior peripheral products by multi-product exporters is to allow product-specific entry costs that depend on an exporter's history of presence in a destination country; more specifically, a well-established core product can make the introduction of new and peripheral products easier in the sense of lowering the launching cost. This mechanism is similar to that in Arkolakis and Muendler (2011) - declining production efficiency as well as entry cost with product scope. However Arkolakis and Muendler (2011) draws inference only from cross-sectional patterns, while the Chinese data allows me to investigate the overtime co-variation of export scope and product quality directly. I turn to this analysis of the overtime co-evolution of the two margins in the next subsection.

4.2. Overtime Correlation

In this subsection, I investigate the simple within-firm correlation between product scope and produce quality. Since product scope varies at the firm, destination and year level while product quality also varies at the product level, this regression will only capture the relationship on average across all products a firm ships to a destination in a specific year. The within-firm correlation is obtained through the control of firm, destination and product fixed effects. The baseline regression specification is as following.

$$\widehat{\xi}_{fmht} = \beta \log(N^{\widehat{h}})_{fmt} + X_{ft}\mathbf{B} + D_{fmh} + D_t + \nu_{fmht} \tag{8}$$

The regression results are reported in column (1) of Table 5. Within a cell defined by exporter, destination and product, I find a positive correlation between the scope and perceived quality on average over time. Adding input controls has no substantial impact on the correlation, as shown in column (2), suggesting the positive correlation between the two margins overtime is not mainly driven by these quality-related input choices.

As a robustness check, I use demeaned and first differenced variables respectively, within cells defined by firm, destination and product for the perceived quality $\widehat{\xi}_{fmht}$ and cells defined by firm and destination for export scope $\log(N^{\widehat{h}})_{fmt}$. This allows me to add destination, product and year triplet fixed effects to control for country, product and year specific demand shocks.[45] The specifications are as follows. For demeaned variables,

$$d\widehat{\xi}_{fmht} = \beta d \log(N^{\widehat{h}})_{fmt} + D_{mht} + \nu_{fmht} \tag{9}$$

[44] For example, Hallak and Schott (2011), Manova and Zhang (2012) and Manova and Zhang (2013)

[45] The is somewhat equivalent to replacing the D_t dummy variables with D_{mht} dummy variables.

For first differenced variables,

$$\Delta\widehat{\xi}_{fmht,t-1} = \beta\Delta\log(N^{\widehat{h}})_{fmt,t-1} + D_{mht} + \nu_{fmht} \tag{10}$$

The results, reported in column (3) and (4) of Table 5, are similar to those obtained with the baseline specification.

I further allow the overtime correlation betweent the two margins to vary with market attributes. I focus on the level of competition, income level and market size, measured by the number of Chinese exporters shipping the same product to the market, the destination country's per capita GDP and GDP respectively. The specification is

$$\begin{aligned}\widehat{\xi}_{fmht} = &\quad \beta_0\log(N^{\widehat{h}})_{fmt} + \beta_1\log(N^{\widehat{h}})_{fmt}\times\log(N^f)_{mht} + \beta_2\log(N^{\widehat{h}})_{fmt}\times\log(pcgdp)_{mt} \\ &+ \quad \beta_3\log(N^{\widehat{h}})_{fmt}\times\log(gdp)_{mt} + X_{ft}\mathbf{B} + D_{fmh} + D_t + \nu_{fmht}\end{aligned} \tag{11}$$

where N^f_{mht} is the number of Chinese exporters that ship product $\widehat{h}$ to destination m in year t. The regression results are reported in column (6) in Table 5. The results suggest the degree of competition plays a role in determining the strength of the overtime correlation between the two margins - an increase in the number of Chinese exporters strengthens the association between export scope and perceived quality.

5. Within Firm-Market Dynamics of Product Scope and Product Quality

Fixed costs were introduced by Krugman as an important factor in explaining aggregate intra-industry trade pattern in the New Trade Theories in the 1970s. Recent development has further explored its role in explaining export participation and export volume pattern at the firm level observed in the emerging micro trade data (e.g., Andrew B. Bernard and Kortum (2003), Melitz (2003),Albornoz et al. (2012)). Arkolakis (2010) enriches the structure of market access costs by making it consumer instead of market specific, arguing that "...firms reach individual consumers rather than the market in its entirety". In a similar way, the sunk costs of penetrating a market can also be product-specific, as selling new products very often means searching for new consumers or extra efforts need to be made to convince even existing consumers to try new products. Frictions discussed in Drozd and Nosal (2012) may very well exist at the product level.

The idea that the fixed costs of launching a new product might depend on an exporter's existing products on the market echoes the role of network in explaining firm-level export dynamics. Network has long been realized to affect how trade expands. Rauch (1999), Rauch (2001) and Rauch and Trindade (2002) argue that network helps to overcome one of the most important trade obstacles, informational barriers. Chaney (2014) provides a formal model in which exporters conduct both direct search and search through existing network to serve new markets. Chaney (2014) thus endogenizes the exogeneous market accessibility in the heterogeneous firm trade models of Andrew B. Bernard and Kortum (2003) and Melitz (2003) by making it dependant on firm-specific export history.

5.1. Product dropping, product adding and perceived quality

The change in the number of product lines is the combined outcome of product adding and product dropping. In this subsection, I investigate them separately the relationship between the dropping of existing product lines and their perceived quality before being dropped, as well as the relationship between the addition of new product lines and the perceived quality of an exporter's existing product on a market.

The main regression specification for the dropping of product lines is

$$Drop_{fm\widetilde{h}t+1} = \beta_0 \widehat{\xi}_{fmht} + X_{fmt}\mathbf{B} + D_{mht} + \nu_{fmht} \tag{12}$$

and

$$Drop_{fm\widetilde{h}t+1} = \beta_0 \widehat{\xi}_{fmht} + X_{fmt}\mathbf{B} + D_{fmh} + D_t + \nu_{fmht} \tag{13}$$

where $Drop_{fm\widetilde{h}t+1}$ is an indicator whether a 6-digit HS product line $\widetilde{h}$ firm f ships to country m in year t is dropped in year $t+1$. $\widehat{\xi}_{fmht}$ is the estimate of perceived quality of 8-digit HS product h. The control variables in X_{fmt} include firm f's total exports to country m in year t and the number of 6-digit HS lines it ships to m in year t. The two specifications differ in the set of fixed effects controlled. Specification (12) uses the within-market across firm variation and specification (13) uses the within fmh cell overtime variation. The regression results are reported in column (1) and (4) of Table 6. The results suggest that the higher the perceived quality the less likely the product line is dropped. The results are robust to the inclusion of additional input choices in column (2) and (5). Furthermore, adding interactions of quality and market attributes in column (3) and (6), I find the negative relationship between quality and the probability of dropping a product is weaker in larger markets and stronger in markets with tougher competition.

As a result of this process of product selection, one may expect a positive correlation between the tenure of a product line in a market and its perceived quality. In Table 7 I report the results from regressing the quality estimates on dummies indicating the year of introduction for each year. I control for firm and destination pair fixed effects to explore the within firm across product variation. The reported coefficient estimates should be interpreted as the difference from the average quality of surviving products introduced in year 2002. This pattern can could be a result of either a natural selection mechanism in which firms start with random products and only the fit survive or a mechanism in which firms intentionally break into a new destination with the best products. But overall, the dropping of products with lower perceived quality would imply a negative correlation between quality and scope overtime. There must be other forces at work driving the positive correlation presented in Table 5. In the next subsection, I turn to the addition of new product lines and investigate the relationship between the probability of adding a new product line and the perceived quality of an exporter's existing products. The regression specification is

$$New_{fmt} = \sum_{r=1}^{5} \beta^r \times \widehat{\xi}_{fmt}^{rank=r} + X_{fmt}\mathbf{B} + D_m + D_{ft} + \nu_{fmt} \tag{14}$$

and

$$New_{fmt} = \sum_{r=1}^{5} \beta^r \times \widehat{\xi}_{fmt}^{rank=r} + X_{fmt}\mathbf{B} + D_{fm} + D_t + \nu_{fmt} \tag{15}$$

New_{fmt} is an indicator whether firm f introduces a new 6-digit HS product line to country m in year t. $\widehat{\xi}_{fmt}^{rank=r}$ is the perceived quality of firm f's rth product line shipped to country m in year t according to the bilateral sales. I include the demeaned unit value by the ranking of the products as additional controls. The two specification differ in the set of fixed effects controlled. Specification (14) uses the within firm and year ft across country m variation and specification (15) uses the within firm and country fm overtime t variation. The results are shown in Table 8, column (1) for specification (14) and column (2) for specification (15). There is robust positive correlation between the introduction of new product lines and the perceived quality of existing top products. More importantly, the results suggest demand side factors play a role in the introduction of new products. One may argue the positive correlation reported in column (2) can be driven by supply side factors, for example, a positive productivity shock or favourable input price shock that is not captured in the input controls, which provides firms incentive to upgrade the quality of a firm's existing products and to expand its product scope. However, results in column (1) suggests that when the time specific firm fixed effects are controlled, we still find firms would add product lines in markets where the perceived quality of its existing products are high. The results are robust to the inclusion of inputs as additional control variables.

5.2. *Timing of the introduction of new product lines*

In this section, I track the evolution of product quality and product scope of a new cohort of exporter and destination pairs that start in 2002 to provide further evidence to support the hypothesis that well established products makes the introduction of new products easier. I choose the 2002 cohort because it is the year the 2002 version of the HS coding system was put in use. Working between different versions of the coding system makes the identification of new product lines less precise.

Table 9 provides the summary statistics on the multi-product status of the new cohort of firm and market pairs that start in 2002. Not surprisingly, most of the new pairs, 77%, start with single product. Focusing on these single-product pairs, I find that more than 50% of the pairs do not survive the first year; meanwhile, a substantial proportion of the surviving pairs, about 30%, become multi-product pairs. Table 10 provides more detailed information on the exit status and evolution of the number of product lines for this cohort.

Table 12 and 11 provide statistics for the balanced panel of pairs that survive till 2006. It is clear from the information in Table 12 that the single-turned multi-product pairs are catching up with the multi-product pairs at birth in terms of export values. In Table 13, I divide the pairs in the balanced panel into groups according to the year in which the pair switches to multi-product status. The top panel shows the average of the perceived quality by group and year. The panel in the middle shows the between-group difference in the average quality from the "never switch" group. The bottom panel shows the year-to-year first difference of the between-group difference. I find an interesting jump in the perceived quality exactly in the year a pair switches from single-product status to multi-product status.

I further test the timing of switch using the sample of the unbalanced panel. For each year from 2003 to 2006, I use the sample of pairs that remain single-product till the previous year and check the correlation between the probability of switching to multi-product status and the perceived quality of its existing top product. The regression specification is

$$Switch_{fm} = \beta_1 \times \widehat{\xi}_{fm}^{rank=1} + \beta_2 \times \widehat{\xi}_{fm2002}^{rank=1} + \beta_3 \times dlog(uv)_{fm}^{rank=1} + \beta_2 \times \times dlog(uv)_{fm2002}^{rank=1} + D_m + D_f + \nu_{fmh} \quad (16)$$

where $Switch_{fmt}$ is an indicator whether a fm pair switches to multi-product status in year t. $\widehat{\xi}_{fmt}^{rank=1}$ is the quality of the pair's top product in year t and $dlog(uv)_{fmt}^{rank=1}$ is the deviation of the unit value of the pair's top product from the product-, country- and year-specific mean in year t. $\widehat{\xi}_{fm2002}^{rank=1}$ and $dlog(uv)_{fm2002}^{rank=1}$ are the corresponding variables in year 2002. I further control the country and firm fixed effects. The regression is run year by year. The results are reported in Table 14. Again I find robust positive correlation between the probability of switching to multi-product status and the perceived quality of existing top products.

5.3. Perceived quality of newly introduced products

In this section, I investigate the perceived quality of newly introduced products to provide further evidence to support the hypothesis that well established products make the introduction of new products easier. The strategy is to show that existing exporters enjoy a quality premium in its newly introduced products over the peripheral products by a new multi-product exporter.

The specification of the regression is

$$\widehat{\xi}_{fmht} = \sum_{r=1}^{5} \beta^r \times I_{fmht}(rank = r) \times New_{fm\widetilde{h}t} + D_{mht} + \nu_{fmht} \quad (17)$$

where $New_{fm\widetilde{h}t}$ is an indicator that takes value 1 if the observation is a newly introduced product line by an existing exporter and takes value 0 if the observation is a product by a new exporter to the market. I further divide the new exporters to a country into two groups, the single-product group and the multi-product group. For the single-product group, I do not differentiate the ranking of products by the existing exporter so the summation in regression equation (17) collapses. The regression results are reported in column (1) and (2) of Table 15. Column (1) is for the comparison to new single-product exporters. It is not surprising that the quality by new single-product exporters is higher than the newly introduced products by existing exporters, as exporters are likely to start business in a new market with their core product. More interesting is the comparison to the new multi-product exporters. Results in column (2) suggests that if the newly introduced product turns out to be the top product of the existing exporter, the quality of this product is not significantly different from the core product of a new multi-product exporter. However, if the newly introduced product does not become the top product, the incumbent would enjoy a premium in perceived quality when compared to the peripheral products of a new multi-product exporter. This is suggestive of a positive spillover of the reputation from established products to newly introduced products.

6. Conclusion

Using the detailed price and quantity information on firms' exports between 2000 and 2006 from China's customs data, I estimate the market- and product-specific demand functions for China's exports and recover the latent quality as the demand residual. With these estimates, I investigate the choices on product quality and product scope by Chinese exporters. I find a cross-sectional quality premium in a multi-product exporter's top product and a positive correlation between product scope and product quality within an exporter and country pair overtime. I put forward a hypothesis that the overtime positive correlation is driven by exporters' incentive to explore the economy of scope in building reputation and choose to introduce new products only when the existing products are well accepted in the markets. The underlying factor shaping this behaviour pattern could be the information barriers and gradual resolution of uncertainty in international trade.

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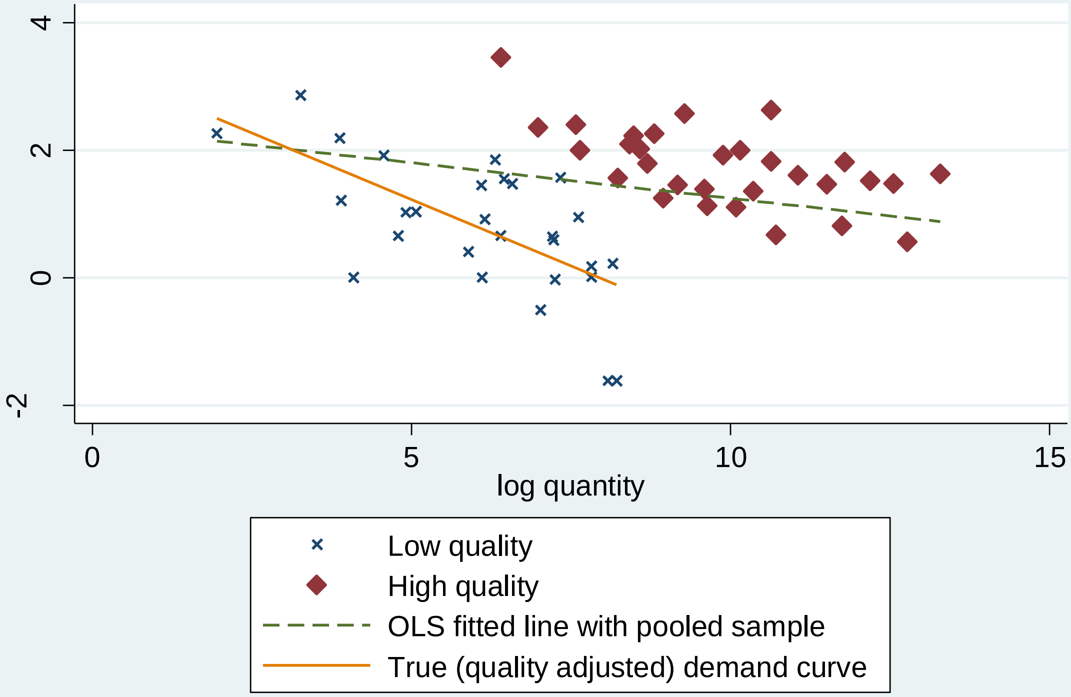
Figure 1: Demand and quality estimation (e.g., HS85291020)



Exports to the U.S. in 2006; Quality classification based on my own estimation

Figure 2: OLS and IV estimates

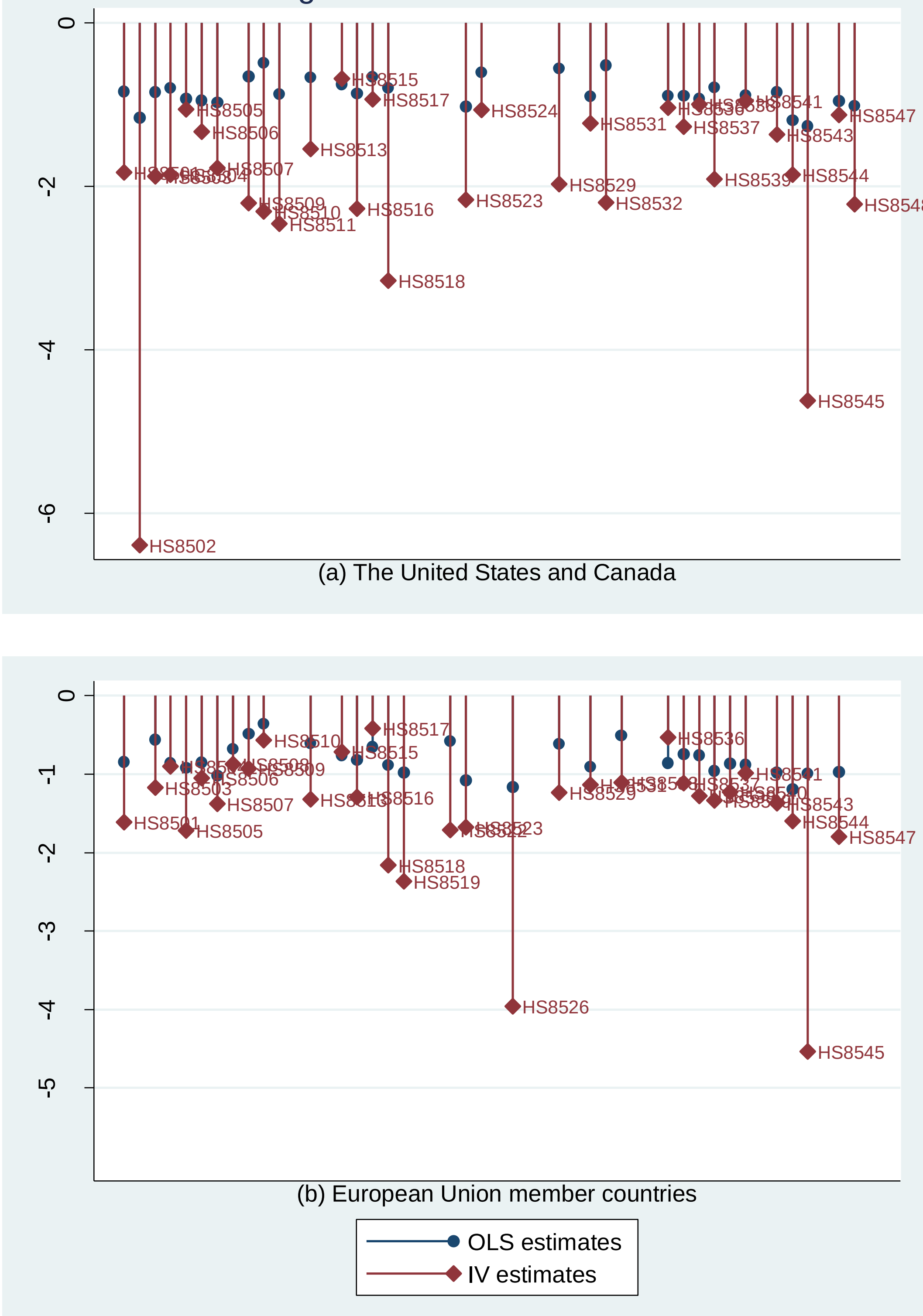


Figure 3: IVs based on different market selection criteria

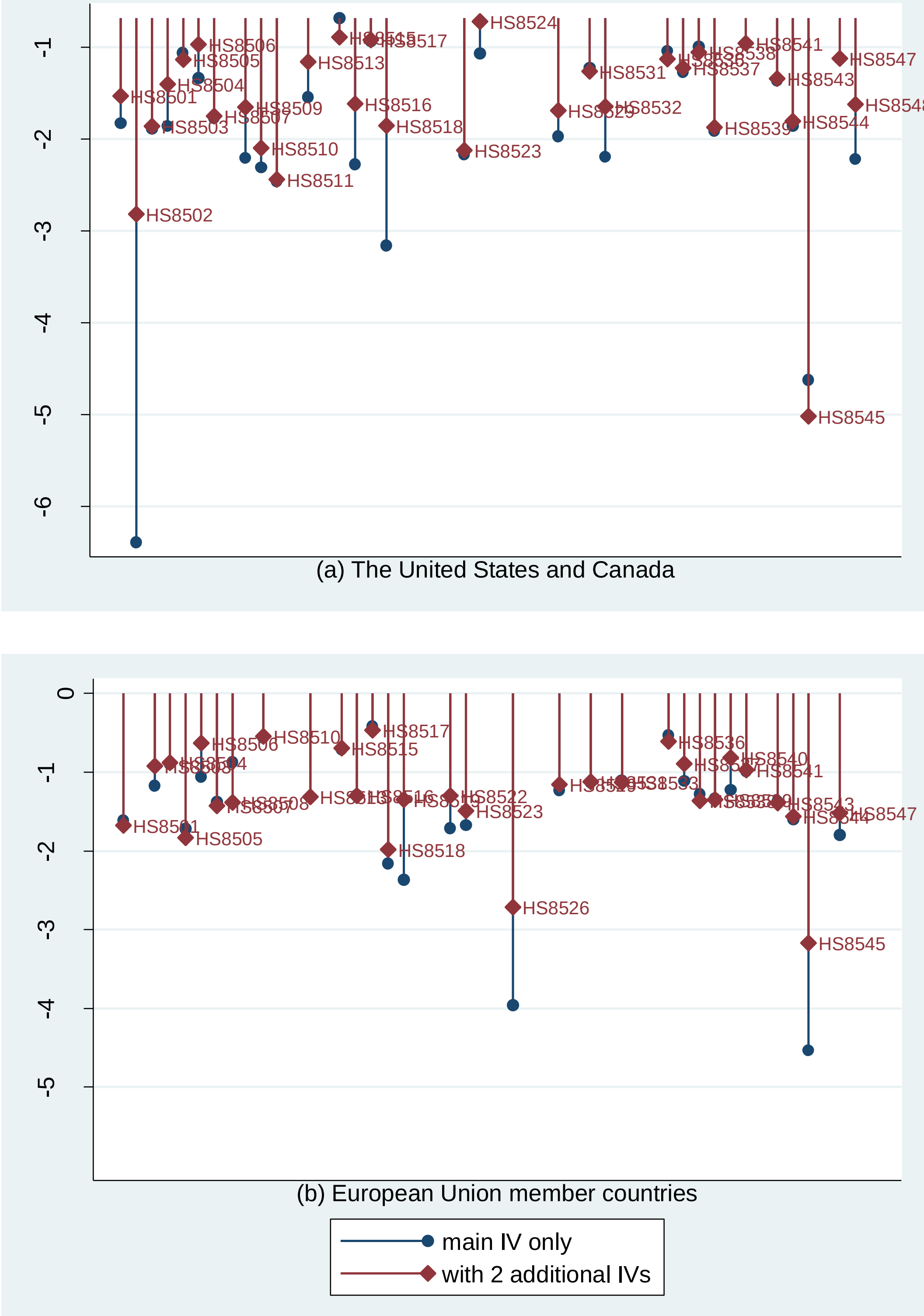


Figure 4: IV based on homogeneous input

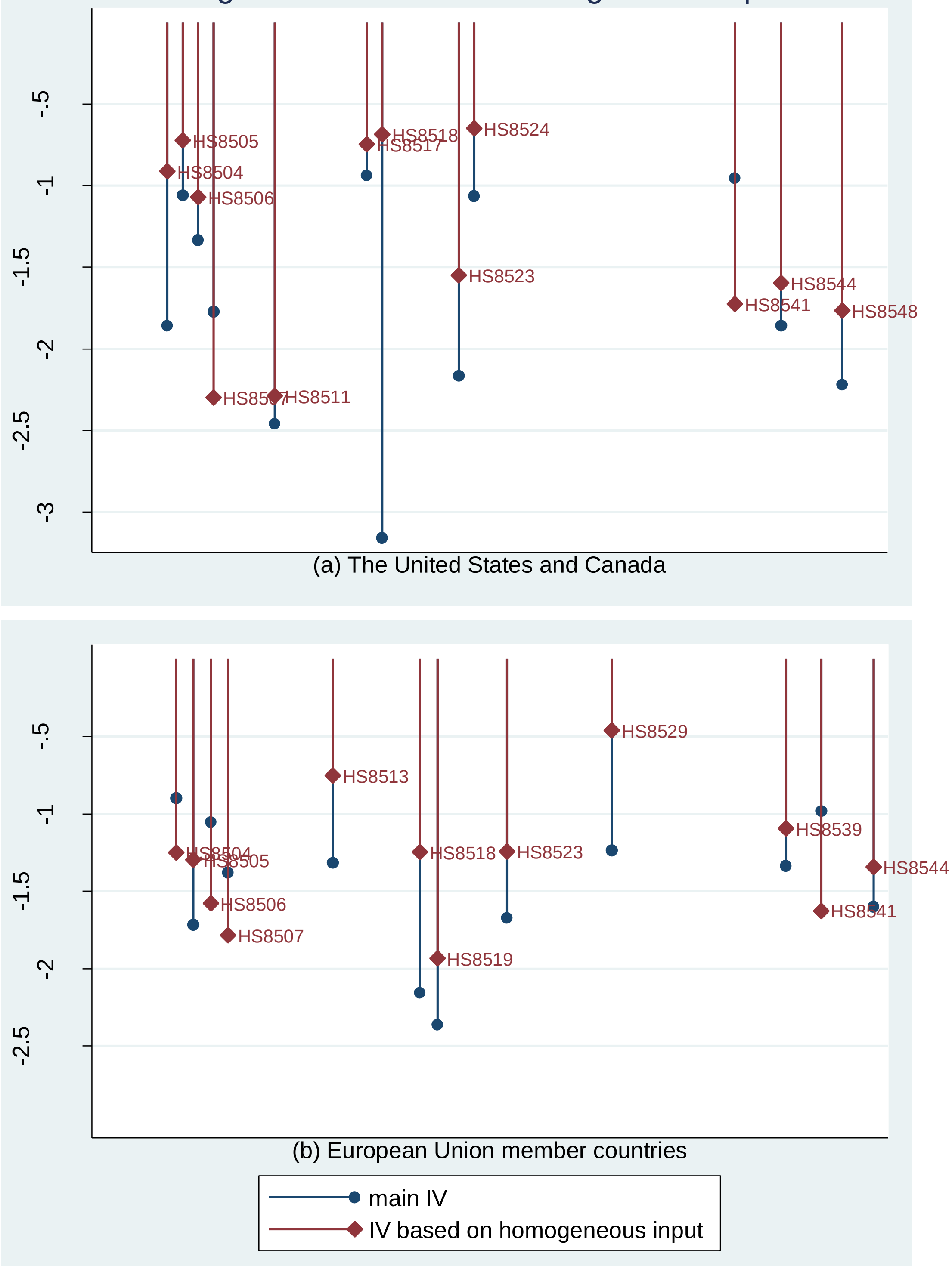


Table 1: Demand estimation: sample summaries

Market group	(1) # of obs.	(2) # of obs. non-missing value for IV	(3) % of obs. non-missing value for IV	(4) # of HS4 lines with sig. & neg. est. of price coef. (of 48)	(5) # of obs. with sig. & neg. est. of price coef.	(6) % of obs. with sig. & neg. est. of price coef.
U.S. and Canada	67,714	66,346	98%	30	57,967	86%
European Union countries	177,444	165,824	93%	31	155,188	87%

Table 2: Demand Estimation: Results Summaries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mean				Median			
Market group	OLS Estimation		IV Estimation		OLS Estimation		IV Estimation	
	all obs.	non-missing IV only	all obs.	non-missing IV only	all obs.	non-missing IV only	all obs.	non-missing IV IV only
U.S. and Canada	-0.85	-0.85	-1.92	-2.04	-0.87	-0.87	-1.84	-1.61
European Union countries	-0.82	-0.81	-1.45	-1.38	-0.86	-0.85	-1.28	-1.31

Table 3: Export performance measures and input choices

	(1)	(2)	(3)	(4)
	$\log(revenue_{fht})$	$log(quantity_{fht})$	$\log(uv_{fht})$	$\bar{\hat{\xi}}_{fht}$
Panel A: wage				
$\log(average\, wage_{ft})$	0.125**	-0.274***	0.394***	0.137**
	(2.44)	(-4.59)	(10.92)	(2.34)
Panel B: usage of imported intermediate input - status dummy				
$I_{ft}(Import > 0)$	0.293***	-0.100	0.385***	0.276***
	(4.26)	(-1.25)	(8.90)	(3.34)
Panel C: usage of imported intermediate input - status dummy by origin				
$I_{ft}(import\, from$ $rich\, countries > 0$	0.334***	-0.0599	0.392***	0.333***
	(4.47)	(-0.70)	(8.80)	(3.88)
$I_{ft}(import\, from$ $other\, countries > 0)$	0.0166	-0.159*	0.163***	-0.0345
	(0.20)	(-1.68)	(3.16)	(-0.36)
Panel D: usage of imported intermediate input - value of imports by origin				
$\log(import\, value\, from\, rich_{ft})$	0.0307***	-0.0159*	0.0465***	0.0341***
	(4.04)	(-1.79)	(9.68)	(4.20)
$\log(import\, value\, from\, other_{ft})$	0.000161	-0.00803	0.00662	-0.00702
	(0.02)	(-0.82)	(1.24)	(-0.77)
Panel E: usage of imported intermediate input - number of varieties by origin				
$\log(import\, variety\, from\, rich_{ft})$	0.119**	-0.0754	0.199***	0.204***
	(2.26)	(-1.28)	(6.90)	(3.52)
$\log(import\, variety\, from\, other_{ft})$	0.0320	0.0101	0.0113	-0.0565
	(0.41)	(0.12)	(0.29)	(-0.78)
product-year ht pairwise FE	Y	Y	Y	Y
first year and current year pairwise FE	Y	Y	Y	Y
4-digit Chinese industry FE	Y	Y	Y	Y
province FE	Y	Y	Y	Y
other controls$^+$	Y	Y	Y	Y
N	15451	15451	15451	15427

$^+$Other controls include export intensity, whether exporting through processing trade as well as polynomials of firms' employment size. t statistics in parentheses. Standard errors are clustered at firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Scope and quality: a cross-sectional comparison

	(1) $\widehat{\xi}_{fmht}$	(2) $\widehat{\xi}_{fmht}$	(3) $\widehat{\xi}_{fmht}$	(4) $\widehat{\xi}_{fmht}$	(5) $\log(uv_{fmht})$	(6) $\log(uv_{fmht})$
$\log(N^{\widetilde{h}}_{fmt})$	-0.159***	-0.132***				
	(-7.61)	(-3.55)				
$I_{fmht}(rank = 1)$ $\times \log(N^{\widetilde{h}}_{fmt})$			1.306***	1.468***	0.111***	-0.00887
			(51.05)	(31.63)	(9.42)	(-0.75)
$I_{fmht}(rank = 2)$ $\times \log(N^{\widetilde{h}}_{fmt})$			0.129***	0.0997**	0.0126	0.00100
			(4.93)	(2.31)	(1.14)	(0.09)
$I_{fmht}(rank = 3)$ $\times \log(N^{\widetilde{h}}_{fmt})$			-0.251***	-0.286***	-0.0215*	0.00174
			(-9.03)	(-6.31)	(-1.82)	(0.15)
$I_{fmht}(rank = 4)$ $\times \log(N^{\widetilde{h}}_{fmt})$			-0.445***	-0.541***	-0.0490***	-0.00838
			(-13.42)	(-9.75)	(-3.86)	(-0.67)
$I_{fmht}(rank = 5)$ $\times \log(N^{\widetilde{h}}_{fmt})$			-0.574***	-0.855***	-0.0950***	-0.0429***
			(-15.68)	(-15.04)	(-7.13)	(-3.27)
polynomials of $\widehat{\xi}$						Y
destination-product-year mht triplet FE	Y	Y	Y	Y	Y	Y
input controls^{+}		Y		Y		
N	220480	97196	220480	97196	220930	220480

$^{+}$Input controls include second-order polynomials of capital and labour inputs, average wage, the value and number of varieties of imported intermediate inputs from rich countries. t statistics in parentheses. All standard errors are robust and clustered at the firm (f) and destination (m) level. The standard errors in column (6) are calculated with bootstrapping. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Scope and quality: overtime co-movement

	(1)	(2)	(3)	(4)	(5)
	$\widehat{\xi}_{fmht}$	$\widehat{\xi}_{fmht}$	$d\widehat{\xi}_{fmht}$ $^{+}$	$fd\widehat{\xi}_{fmht}$ $^{++}$	$\widehat{\xi}_{fmht}$
$log(N^h_{fmt})$	0.391***	0.406***			1.298
	(8.01)	(5.83)			(0.96)
$d\,log(N^h_{fmt})$			0.395***		
			(14.78)		
$fd\,log(N^h_{fmt})$				0.355***	
				(11.43)	
$log(N^h_{fmt}) \times log(N^f_{mht})$					0.0675**
					(2.02)
$log(N^h_{fmt}) \times log(pcgdp_{mt})$					-0.113
					(-0.74)
$log(N^h_{fmt}) \times log(gdp_{mt})$					0.00161
					(0.04)
firm-destination-product fmh triplet FE	Y	Y			Y
year t FE	Y	Y			Y
destination-product-year mht triplet FE			Y	Y	
input controls^{+++}		Y			
N	173301	79976	173301	63721	173301

$^{+}$ Variables starting with d are demeaned within fmh cell; $^{++}$ Variables starting with fd are the first difference within fmh cell over time. $^{+++}$Input controls include second-order polynomials of capital and labour inputs, average wage, the value and number of varieties of imported intermediate inputs from rich countries. t statistics in parentheses. Standard errors are robust and clustered at the firm (f) and destination (m) level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Perceived quality and dropping of product lines

	(1)	(2)	(3)	(4)	(5)	(6)
	$Drop_{fm\tilde{h}t+1}$ +	$Drop_{fm\tilde{h}t+1}$	$Drop_{fm\tilde{h}t+1}$	$Drop_{fm\tilde{h}t+1}$	$Drop_{fm\tilde{h}t+1}$	$Drop_{fm\tilde{h}t+1}$
$\widehat{\xi}_{fmht}$	-0.0121***	-0.0137***	-0.0939**	-0.0142***	-0.0172***	-0.173***
	(-4.00)	(-4.01)	(-1.23)	(-4.39)	(-3.63)	(-4.35)
$log(TotalEX_{fmt})$	-0.0347***	-0.0245***	-0.0310***	-0.0552***	-0.0416***	-0.0522***
	(-9.45)	(-5.36)	(-5.99)	(-16.34)	(-11.51)	(-18.03)
$log(N^h_{fmt})$	-0.0299***	-0.0199***	-0.0331***	0.0607***	0.0365***	0.0558***
	(-3.63)	(-2.13)	(-3.67)	(6.39)	(2.42)	(6.15)
$\widehat{\xi}_{fmht}$ $\times log(N^f_{mht})$			-0.0137***			-0.00574***
			(-5.64)			(-5.08)
$\widehat{\xi}_{fmht}$ $\times log(pcgdp_{mt})$			-0.00449			0.0102***
			(-0.46)			(2.20)
$\widehat{\xi}_{fmht}$ $\times log(gdp_{mt})$			0.00783***			0.00319***
			(4.35)			(2.49)
destination-product-year mht triplet FE				Y	Y	Y
firm-destination-product fmh triplet FE	Y	Y	Y			
year t FE	Y	Y	Y			
input controls++		Y			Y	
N	163179	69676	163179	163179	69676	163179

+The dependant variable is a dummy indicating whether the 6-digit HS line ($\tilde{h}$) that h belongs to is withdrawn by firm f from destination country m in year $t+1$. ++Input controls include second-order polynomials of capital and labour inputs, average wage, the value and number of varieties of imported intermediate inputs from rich countries. t statistics in parentheses. Standard errors are robust and clustered at the destination (m) level. All standard errors are calculated with bootstrapping. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Perceived quality, unit value and the length of exporting history

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\widehat{\xi}_{fmh2003}$	$\widehat{\xi}_{fmh2004}$	$\widehat{\xi}_{fmh2005}$	$\widehat{\xi}_{fmh2006}$	$dlog(uv_{fmh2003})$	$dlog(uv_{fmh2004})$	$dlog(uv_{fmh2005})$	$dlog(uv_{fmh2006})$
Introduced in 2003	-1.188***	-0.609***	-0.497***	-0.431***	0.0134	-0.0196	-0.0317	-0.0639**
	(-11.47)	(-5.36)	(-3.63)	(-2.85)	(0.74)	(-0.82)	(-1.15)	(-2.05)
Introduced in 2004	.	-1.640***	-0.777***	-0.515***	.	-0.0261	-0.0367	-0.0756**
	.	(-14.19)	(-5.02)	(-3.35)	.	(-1.27)	(-1.37)	(-2.58)
Introduced in 2005	.	.	-1.835***	-0.963***	.	.	-0.0572**	-0.121***
	.	.	(-13.52)	(-6.65)	.	.	(-2.42)	(-4.58)
Introduced in 2006	.	.	.	-2.049***	.	.	.	-0.134***
	.	.	.	(-15.21)	.	.	.	(-5.60)
Constant	0.747***	1.102***	1.268***	1.328***	-0.0299***	0.00858	0.0461**	0.134***
	(11.37)	(13.30)	(11.43)	(11.65)	(-2.60)	(0.54)	(2.26)	(6.22)
firm-destination fm pair FE	Y	Y	Y	Y	Y	Y	Y	Y
N	26957	38017	51026	57301	26957	38017	51026	57742

t statistics in parentheses. All standard errors are robust and clustered at the firm (f) and destination (m) level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Perceived quality and addition of product lines

	(1) New_{fmt}	(2) New_{fmt}	(3) New_{fmt}	(4) New_{fmt}
$\widehat{\xi}_{fmt}^{rank=1}$	0.0166***	0.0213***	0.0140***	0.0201***
	(10.46)	(7.76)	(11.74)	(4.98)
$\widehat{\xi}_{fmt}^{rank=2}$	0.0162***	0.0238***	0.0143***	0.0284***
	(6.16)	(5.90)	(5.68)	(4.84)
$\widehat{\xi}_{fmt}^{rank=3}$	0.0126*	0.0237***	0.0198**	0.0192*
	(1.86)	(2.59)	(2.41)	(1.84)
$\widehat{\xi}_{fmt}^{rank=4}$	0.00224	0.0179	-0.00667	-0.0335
	(0.22)	(1.19)	(-0.56)	(-1.50)
$\widehat{\xi}_{fmt}^{rank=5}$	-0.0240*	-0.0167	0.00173	-0.0217
	(-1.71)	(-0.71)	(0.09)	(-0.73)
$dlog(uv_{fmt})^{rank=1}$	0.00196	0.0127***	0.00247	0.00823**
	(0.66)	(3.61)	(0.49)	(2.30)
$dlog(uv_{fmt})^{rank=2}$	-0.0168	-0.00132	-0.0376**	-0.0192
	(-1.62)	(-0.14)	(-2.53)	(-1.38)
$dlog(uv_{fmt})^{rank=3}$	0.0194	0.0125	0.0331	-0.00467
	(0.81)	(0.47)	(0.88)	(-0.12)
$dlog(uv_{fmt})^{rank=4}$	-0.111**	-0.125**	-0.127*	-0.0708
	(-2.57)	(-2.38)	(-1.92)	(-1.06)
$dlog(uv_{fmt})^{rank=5}$	0.0426	0.0584	-0.202*	-0.207*
	(0.64)	(0.78)	(-1.91)	(-1.79)
destination m FE	Y		Y	
firm-year ft pair FE	Y		Y	
year t FE		Y		Y
firm-destination fm pair FE		Y		Y
input controls^{+}			Y	Y
N	45394	45394	26676	26676

$^{+}$Input controls include second-order polynomials of capital and labour inputs, average wage, the value and number of varieties of imported intermediate inputs from rich countries. t statistics in parentheses. Standard errors are robust and clustered at the firm (f) level. All standard errors are calculated with bootstrapping. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Count of firm and destination pairs by the number of product lines

Firms starting exporting in 2002(1660)		Number of products in 2002					
	total	one		two	three	four	more than 4
Year 2002	3028	2341		459	131	52	45
		Survive	MP				
Year 2003		1199	316				
Year 2004		988	304				
Year 2005		827	285				
Year 2006		699	249				

Table 10: Evolution in the number of products of the new cohort of firm and country of 2002

# of prod.	# of pairs				Total # of	Exit rate				Average # of products				
2002	2003	2004	2005	2006	pairs in 2002	2003	2004	2005	2006	2002	2003	2004	2005	2006
1	**1199**	**988**	**827**	**699**	**2341**	**49%**	**58%**	**65%**	**70%**	**1**	**1.41**	**1.56**	**1.68**	**1.72**
2	**321**	**258**	**240**	**193**	**459**	**30%**	**44%**	**48%**	**58%**	**2**	**2.19**	**2.22**	**2.49**	**2.45**
3	**87**	**71**	**71**	**63**	**131**	**34%**	**46%**	**46%**	**52%**	**3**	**3.16**	**3.46**	**3.46**	**3.05**
4	**40**	**30**	**29**	**25**	**52**	**23%**	**42%**	**44%**	**52%**	**4**	**4.63**	**5.03**	**5.00**	**4.20**
5	14	13	12	10	20	30%	35%	40%	50%	5	4.86	4.85	4.08	6.00
6	9	8	8	6	12	25%	33%	33%	50%	6	4.89	6.25	5.00	5.83
7	8	5	4	3	9	11%	44%	56%	67%	7	6.88	6.00	6.25	4.33
8	1	1	1	1	1	0%	0%	0%	0%	8	8.00	4.00	10.00	11.00
9	1	0	0	0	1	0%	100%	100%	100%	9	1.00	.	.	.
10	1	1	1	0	1	0%	0%	0%	100%	10	5.00	3.00	1.00	.
11	1	0	0	0	1	0%	100%	100%	100%	11	8.00	.	.	.

Table 11: Product status 2002 and 2006

Panel A:Pairs started in 2002 - product status in 2006

	Total #	# keeping the top product	# with the same top product	# keeping the No. 2 product	# keeping the No. 3 product	# keeping the No. 4 product
single product pairs	1909	1348	1124			
≥ 2 product pairs	568	345	246	261		
≥ 3 products pair	197	121		91	83	
≥ 4 products pair	83	50		28	38	28
single product pair		71%	59%			
≥ 2 products pair		61%	43%	46%		
≥ 3 products pair		61%		46%	42%	
≥ 4 products pair		60%		34%	46%	34%

Panel B:Pairs active in 2002 - product status in 2006

	Total #	# keeping the top product	# with the same top product	# keeping the No. 2 product	# keeping the No. 3 product	# keeping the No. 4 product
single product pair	4311	3085	2486			
≥ 2 products pair	1799	1153	790	880		
≥ 3 products pair	811	490		407	349	
≥ 4 products pair	436	251		203	190	159
single product pair		72%	58%			
≥ 2 products pair		64%	44%	49%		
≥ 3 products pair		60%		50%	43%	
≥ 4 products pair		58%		47%	44%	36%

Table 12: Summary statistics of a balanced panel of firm and country pairs

Panel A: pairs started in 2002(1000)

		SP in 2006		MP in 2006	
		2002	2006	2002	2006
SP in 2002	# of pairs	450		249	
	total exp. value	36	133	33	306
	average exp. value	79	297	131	1230
	median exp. value	14	53	14	210
MP in 2002	# of pairs	106		195	
	total exp. value	10	17	35	396
	average exp. value	92	161	179	2029
	median exp. value	33	17	52	207

Panel B: pairs active in 2002(1909)

		SP in 2006		MP in 2006	
		2002	2006	2002	2006
SP in 2002	# of pairs	826		515	
	total exp. value	48	203	43	390
	average exp. value	59	245	84	758
	median exp. value	11	36	12	125
MP in 2002	# of pairs	207		361	
	total exp. value	18	41	72	494
	average exp. value	88	200	200	1367
	median exp. value	28	21	41	123

Total export values are in million USD. Average and median export values are in thousand USD.

Table 13: Jump in perceived quality and switch to multi-product status

Panel A: Average of perceived quality by year of becoming MP

	2002	2003	2004	2005	2006
switch in 2003	0.42	1.94	2.85	2.76	3.17
switch in 2004	0.59	1.52	2.33	2.29	2.68
switch in 2005	0.44	1.72	1.42	2.17	2.60
switch in 2006	0.37	1.35	2.06	2.01	2.59
Never switch	0.53	1.36	1.73	1.71	1.69

Panel B: Deviation from the "Never switch" group

	2002	2003	2004	2005	2006
switch in 2003	-0.11	**0.58**	**1.12**	**1.05**	**1.48**
switch in 2004	0.06	0.16	**0.60**	**0.58**	**1.00**
switch in 2005	-0.09	0.36	-0.31	**0.47**	**0.91**
switch in 2006	-0.16	-0.01	0.33	0.31	**0.90**

Panel C: Within-group year-to-year difference in deviations

	2003	2004	2005	2006
switch in 2003	**0.68**	0.54	-0.06	0.43
switch in 2004	0.10	**0.44**	-0.02	0.41
switch in 2005	0.45	-0.67	**0.78**	0.44
switch in 2006	0.15	0.34	-0.02	**0.60**

Table 14: Switch to multi-product exporter and the perceived quality of top product

$D_{t1} = 1$ if switch to MP in t_1	(1) D_{2003}	(2) D_{2004}	(3) D_{2005}	(4) D_{2006}	(5) D_{2003}	(6) D_{2004}	(7) D_{2005}	(8) D_{2006}	(9) D_{2003}	(10) D_{2004}	(11) D_{2005}	(12) D_{2006}
$\widehat{\xi}^{rank=1}_{fmt_1}$	0.0228**	0.0509***	0.0405***	0.00683	0.0210*	0.0495***	0.0403***	0.00726				
	(1.99)	(6.53)	(3.42)	(0.39)	(1.78)	(5.16)	(2.75)	(0.58)				
$\widehat{\xi}^{rank=1}_{fm2002}$	0.0111	-0.0100	-0.0209	0.00372	0.0116	-0.00902	-0.0206	0.00777				
	(0.77)	(-0.51)	(-1.48)	(0.31)	(0.71)	(-0.85)	(-1.46)	(0.49)				
$dlog(uv)^{rank=1}_{fmt_1}$	0.00253	-0.0865**	0.0211	0.0930					0.00318	-0.0463	0.0204	0.0964
	(0.06)	(-2.18)	(0.47)	(1.60)					(0.05)	(-1.09)	(0.47)	(1.31)
$dlog(uv)^{rank=1}_{fm2002}$	0.142***	0.0633	0.0245	0.0791*					0.132***	0.0834*	0.0178	0.0820
	(2.73)	(0.90)	(0.48)	(1.90)					(3.10)	(1.71)	(0.56)	(1.35)
destination m FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
firm f FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	1169	964	805	678	1169	964	805	678	1169	964	805	679

t statistics in parentheses. All standard errors are robust and clustered at the firm (f) level. All standard errors are calculated with bootstrapping. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Perceived quality, unit value and sales of later introduced products

	(1) SP $\widehat{\xi}_{fmht}$	(2) MP $\widehat{\xi}_{fmht}$	(3) SP $dlnuv_{fmht}$	(4) MP $dlnuv_{fmht}$	(5) SP $dlnq_{fmht}$	(6) MP $dlnq_{fmht}$
$New_{fm\widetilde{h}t}$	-0.298***		0.00248		-0.438***	
	(-7.02)		(0.48)		(-9.49)	
$I_{fmht}(rank=1) \times New_{fm\widetilde{h}t}$		0.0162		0.00498		-0.0927
		(0.25)		(0.90)		(-1.60)
$I_{fmht}(rank=2) \times New_{fm\widetilde{h}t}$		0.333***		0.00253		0.0819
		(5.48)		(0.46)		(1.49)
$I_{fmht}(rank=3) \times New_{fm\widetilde{h}t}$		0.389***		0.00124		0.0383
		(3.99)		(0.14)		(0.60)
$I_{fmht}(rank=4) \times New_{fm\widetilde{h}t}$		0.389***		0.00413		0.0824
		(2.88)		(0.31)		(0.90)
$I_{fmht}(rank=5) \times New_{fm\widetilde{h}t}$		0.0407		0.00454		-0.251***
		(0.38)		(0.42)		(-2.82)
destination-product-year *mht* triplet FE	Y	Y	Y	Y	Y	Y
N	86836	82780	86996	82882	86996	82882

t statistics in parentheses. All standard errors are robust and clustered at the destination (m) and year (t) level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Product choice for new markets

Panel A: Rank by export value

	No. 1	No. 2	No. 3	No. 4	No. 5	Top 5 in total
All later markets	31%	22%	13%	8%	6%	80%
First market after becoming MP	35%	24%	14%	8%	5%	85%

Panel B: Rank by perceived quality

	No. 1	No. 2	No. 3	No. 4	No. 5	Top 5 in total
All later markets	31%	21%	13%	9%	6%	80%
First market after becoming MP	34%	24%	13%	8%	5%	86%

Table Appendix 1: HS4 Description

HS4	Description
8501	Electric motors and generators (excluding generating sets)
8502	Electric generating sets and rotary converters Generating sets with compression-ignition internal combustion piston engines (diesel or semi diesel engines):
8503	Parts suitable for use solely or principally with the machines of heading 8501 or 8502
8504	Electrical transformers, static converters (for example, rectifiers) and inductors
8505	Electro/magnets; permanent magnets and articles intended to become permanent magnets after magnetisation; Electro-magnetic or permanent magnet chucks, clamps and similar holding devices; Electro-magnetic couplings, clutches and brakes; Electro-magnetic li
8506	Primary cells and primary batteries
8507	Electric accumulators, including separators therefore, whether or not rectangular (including square)
8509	Electro-mechanical domestic appliances, with self-contained electric motor
8510	Shavers, hair clippers and hair-removing appliances, with self-contained electric motor
8511	Electrical ignition or starting equipment of a kind used for spark-ignition or compression-ignition internal combustion engines (for example, ignition magnetos, magneto-dynamos, ignition coils, sparking plugs and glow plugs, starter motors); Generators (f
8512	Electrical lighting or signalling equipment (excluding articles of heading 8539), windscreen wipers, defrosters and demisters, of a kind used for cycles or motor vehicles
8513	Portable electric lamps designed to function by their own source of energy (for example, dry batteries, accumulators, magnetos), other than lighting equipment of heading 8512
8514	Industrial or laboratory electric(including induction or dielectric) furnaces and ovens (including those functioning by induction or dielectric loss); Other industrial or laboratory equipment for the heat treatment of materials by induction or dielectric
8515	Electric (including electrically heated gas), laser or other light or photo beam, ultrasonic, electron beam, magnetic pulse or plasma arc soldering, brazing or welding machines and apparatus, whether or not capable of cutting; Electric machines and appara
8516	Electric instantaneous or storage water heaters and immersion heaters; Electric space heating apparatus and soil heating apparatus; Electro-thermic hair-dressing apparatus (for example hair dryers, hair curlers, curling tong heaters) and hand dryers, Elec
8517	Electrical apparatus for line telephony or line telegraphy, including line telephone sets with cordless handsets and telecommunication apparatus for carrier-current line system or for digital line systems; Videophones Telephone sets; Videophones:
8518	Microphones and stands therefor; Loudspeakers, whether or not mounted in their enclosures; Headphones and earphones, whether or not combined with microphone, and sets consisting of a microphone and one or more loudspeakers; Audio-frequency electric amplif
8519	Turntables (record-decks), record-players, cassette-players and other sound reproducing apparatus, not incorporating a sound recording device
8520	Magnetic tape recorders and other sound recording apparatus, whether or not incorporating a sound reproducing device
8521	Video recording or reproducing apparatus, whether or not incorporating a video tuner
8522	Parts and accessories suitable for use solely or principally with the apparatus of headings 8519 to 8521
8523	Prepared unrecorded media for sound recording or similar recording of other phenomena, other than products of Chapter 37 Magnetic tapes:

8524	Records, tapes and other recorded media for sound or other similarly recorded phenomena, including matrices and masters for the production of records, but excluding products of chapter 37
8525	Transmission apparatus for radio-telephony, radio-telegraph, radio-broadcasting or television, whether or not incorporating reception apparatus or sound recording or reproducing apparatus; Television cameras; still-mage video cameras and other video camer
8526	Radar apparatus, radio navigational aid apparatus and radio remote control apparatus
8527	Reception apparatus for radio-telephony or radio-broadcasting, whether or not combined, in the same housing, with sound recording apparatus or a clock
8528	Reception apparatus for television, whether or not incorporating radio-broadcast receivers or sound or video recording or reproducing apparatus; Video monitors and video projectors Reception apparatus for television, whether or not incorporating radio-bro
8529	Parts suitable for use solely or principally with the apparatus of headings 8525 to 8528
8530	Electrical signaling, safety or traffic control equipment of railways, tramways, roads, inland waterways, parking facilities, port installations or airfields (other than those of heading 8608)
8531	Electric-sound or visual signalling apparatus (for example, bells, sirens, indicator panels, burglar or fire alarms), other than those of heading 8512 or 8530
8532	Electrical capacitors, fixed, variable or adjustable (pre-set)
8533	Electrical resistors (including rheostats and potentiometers), other than heating resistors
8534	Printed circuits
8535	Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (for example, switches, fuses, lighting arresters, voltage limiters, surge suppressors, plugs, junction boxes), for a voltage exce
8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections to or om electrical circuits (for example, switches, relays, fuses, surge suppressors, plugs, sockets. Lamp-holders, junction boxes), for a voltage not exceedi
8537	Boards, panels, consoles desks, caninets and other bases, equipped with two or more apparatus of heading 8535 or 8536, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of Chapter 90, and numer
8538	Parts suitable for use solely or principally with the apparatus of headings 8535, 8536 or 8237
8539	Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; Arc-lamps
8540	Thermionic, cold cathode or photocathode valves and tubes (for example, vacuum or vapour or gas filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes) Cathode-ray television picture tubes, including v
8541	Diodes, transistors and similar semi-conductor devices; Photosensitive semi-conductor devices, including photovoltaic cells whether or not assembled in modules or made-up into panels; Light emitting diodes; Mounted piezo-electric crystal
8542	Electronic Integrated circuits and microassemblies
8543	Electrical machianes and apparatua having individual functions, not specified or included elsewhere in this Chapter Particle accelerators:
8544	Insulated (including enamelled or anodised) wire, cable (including co-axial cable) and other insulated electric conductors, whether or not fitted with connectors; Optical fibre cables, made up of individually sheathed fibres, whether or not assembled with
8545	Carbon electrodes, carbon brushes, lamp carbons, battery carbons and other articles of graphite or other carbon, with or without metal, of a kind used for electrical purposes Electrodes:
8546	Electrical insulators of any material

8547	Insulating fittings for electrical machines, appliances or equipment, being fittings wholly of insulating material apart from any minor components of metal (For example, threaded sockets) incorporated during moulding solely for purposed of assembly, other
8548	Waste and scrap of primary cells, primary batteries and electric accumulators; Spent primary cells, spent primary batteries and spent electric accumulators; Electrical parts of machinery or apparatus, not specified or included elsewhere in this Chapter