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Per-capita Income, Taste for Quality, and Exports Across Countries

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Abstract

This paper studies how per-capita income affects trade patterns of quality-differentiated goods across countries. A product's perceived quality depends on intrinsic characteristics of the product as well as consumers' tastes for quality. In addition to aggregate income, this paper features a taste for quality channel through which a destination's income per capita causes the variety-quality tradeoff in product exports. I build a model combining non-homothetic preferences and product quality heterogeneity in which rich consumers demand more high-quality varieties than poor consumers. In equilibrium, holding market size constant, the elasticity of consumer taste for quality with respect to income per capita determines the differences between rich and poor countries in productivity thresholds, firm market shares, and number of varieties produced. To assess the evidence, I construct a quality index and examine cross-country variation in prices and export sales at the firm-product level with Chinese disaggregate trade data from the Household Audio and Video Equipment industry. In line with the model's predictions, the results show that firms charge higher prices in richer countries, and the effects of GDP per capita on export sales differ by product quality. Conditional on entry, low-quality export sales are decreasing in the destination country's GDP per capita, controlling for other country characteristics. The relationship between high-quality export sales and income per capita exhibits an inverted-U shape, which reflects the varying preferences for quality versus variety across consumers at different income levels.

Keywords: non-homothetic preference, income per-capita, taste for quality, exports across countries
JEL Classification: C34, F10, F12, F19, O14

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1 Introduction

Disaggregate data on exporters, their products, and their destinations facilitate empirical research on firm level export activity across foreign destinations. It is well established in the literature that a firm's exporting performance depends not only on its productivity, but on importing countries' characteristics, such as market size, income level, and remoteness. As product quality becomes an important dimension of international competition, variety margin and quality margin are both considered as important channels through which trade improves welfare. However, it remains unclear on the role of income per capita in shaping consumers' preferences for quality upgrading versus more varieties. Consequently, the relationship between cross-country exports of quality differentiated goods and destinations' GDP per capita has not been well explained. Motivated by the fact that consumers' tastes for quality vary considerably across countries and its relations to income and firm exports are rarely examined in the literature, this paper features income per capita as a demand base determinant of trade in that it affects consumers' valuations on product quality. Empirically, this paper shows that the cross-country variation in GDP per capita succeeds in explaining the differential patterns of export entry and sales of high- and low-quality goods across destinations.

Quality-augmented Melitz models rationalize the empirical findings that more productive firms produce high-quality goods and charge higher prices. The profitability of producing and exporting high-quality goods is jointly determined by supply and demand. On the supply side, producing better quality goods incurs additional production costs, as it requires advanced technology, functional designs and high-quality intermediate inputs. On the demand side, consumers' perceptions of a product's intrinsic features and qualities affect markups and market demands, and the perceptions vary with income levels. In this paper, I focus on the demand side and argue that the elasticity of taste for quality with respect to income per capita is crucial in predicting whether consumers prefer quality upgrading or more varieties as they get richer. To this end, I use a model combining quality evaluation mechanism and non-homothetic preferences over quality differentiated varieties which allows rich consumers to demand more high-quality goods. As such, a higher income per capita gives rise to a larger market size as well as a stronger taste for product quality which affect market demands for high- and low-quality goods in a disproportionate way. In equilibrium, when consumers' tastes for quality are income-elastic, a higher income leads to a higher average product quality and a smaller number of varieties in consumption bundles, with market shares shifting from low- towards high-quality varieties. When tastes for quality are inelastic to income, rich consumers prefer variety more than quality, resulting in a greater number of varieties and shrinking market shares of individual products.

An important feature of my model is that it does not predetermine whether consumers prefer quality upgrading or more varieties when they get richer. It allows for both cases and emphasizes the role of elasticity of taste for quality in determining which way it goes. Such a flexibility homothetic preference models. There are two main strands of research aimed at exploring the roles of per-capita income in shaping exports. One is built on the assumption that consumers purchase a single vertically di erentiated product, like Fajgelbaum et al (2011) and Brambilla and Porto (2016), and predicts a positive correlation between quality and price of consumption goods and income per capita. The other strand of literature utilizes models in which consumers purchase a range of horizontally di erentiated products, with rich individuals consuming a wider set of varieties, and concludes that the extensive margin of imports is positively related to income per capita, such as Foellmi et al (2010) and Simonovska (2015). The non-linear relationship between rm exports and income level, as shown in the empirical analysis in this paper, suggests di ering consumption patterns across countries and necessitates a uni ed framework to study consumers' preferences for quality and variety.

My model di ers from Antoniades (2015) on the supply side in the sense that quality upgrading is assumed to be through the use of higher quality inputs, rather than through xed investments in research and development. As such, rms' choices of output quality are independent of destination market size. In Antoniades (2015), a larger market size leads rms to upgrade quality since the average costs of producing quality decline as rms scale up, which provides a supply side explanation of market size e ect on product quality. By assuming quasi-linear preferences, the income e ect on consumers' perception of quality is ignored in that paper. In my model, the non-homothetic preferences allow consumers with high income to demand more high-quality goods than the ones with low income, which makes it more pro table for rms to produce and sell higher quality goods in rich countries. In other words, rms producing high-quality goods have higher market shares because of consumers' tastes for quality, rather than because of lower costs of quality production. The rm selection resulting from the model is a pure demand side explanation.

This paper documents stylized facts on di erential impacts of GDP per capita of importing country on export prices and sales by quality at the product level, which motivates an explanation based on tastes for quality. Consistent with Simonovska (2015), I nd a positive relationship between export price and consumer income, especially for products of -309celity. Controlling for

of high- and low-quality goods at the rm-product level. In the existing literature, at the product level, Baldwin and Harrigan (2011) and Johnson (2012) show that export prices increase with distance and decrease with destination's GDP and GDP per capita. Quality raises prices by a more than o setting amount such that higher quality rms sell more. At the rm level, Manova and Zhang (2012) establishes the fact that across destinations within a rm-product, rms set higher prices in richer and larger countries. Verhoogen (2008) and Kugler and Verhoogen (2012) nd the empirical evidence that larger plants pay more for their material inputs and charge more for their outputs. My work is consistent with the previous studies in that it presents evidence on the increase of export prices with importing country's GDP per capita, especially for the products of high quality. However, the separate role of GDP per capita in shaping quantity demanded at the rm-product level di ers by product quality, which, to

2 Empirical Evidence

Audio & Video Equipment industry, the firms engaged in the regime of processing using imported inputs obtain imported inputs from 22 countries and export their products to 108 countries. Table 1 lists the names and GDP per capita of countries from which firms import inputs as well as the total import value by origin country. The fact that input sources concentrate on a few developed countries gives an advantage in inferring input quality from import prices at the origin-product level, which serves as the basis of constructing firm level quality index. The detailed discussion on quality index is given in the following section. In contrast to the concentration of input source countries, firms export to a wide range of destinations, which ensures enough variations of price and revenue across markets within a firm. In the data, each firm exports to 13.37 foreign countries on average. The distribution at the firm-product level shows a similar pattern as at the firm level, and each firm-product on average exports to 9.68 destinations.

The second reason for choosing the Household Audio & Video Equipment industry as the sample is that products are quality differentiated in the industry and export prices increase in quality and in firm productivity. The key difference between the standard and the quality augmented Melitz models lies in how prices change in physical productivity. When taking into account product quality in an industry with a large scope for quality differentiation, more productive firms tend to produce high-quality goods and charge higher market prices. As such, quality serves as an innegligible dimension of firm heterogeneity. Empirically, an indicator of the scope of quality differentiation is the Rauch (1999) dummy which is recorded for SITC-4 digit categories. By matching it to the Chinese HS-8 digit classification, I find the products traded in the sample are all differentiated goods that are not traded on an organized exchange or listed in reference manuals. Furthermore, among the 451 processing firms considered, the weighted average price each firm pays for imported inputs spreads out widely, with a large proportion of firms standing in the middle and fewer firms paying more than or less than the average. Therefore, firms export products at different quality levels. This provides the ground for the study on differential impacts of per-capita GDP on products of different qualities across markets. The relationship between price and productivity can be examined by running the following specification:

$$\log p_{fpd} = {}_0 + {}_1 \log revenue_{fp} + {}_{pd} + \varepsilon_{fpd}; \quad (1)$$

where p_{fpd} represents the export price of product p charged by firm f in destination d. $revenue_{fp}$ denotes firm f r2(index.)-406(exp)-27(ex.)saldenotes or pro uctd high-quality products and sell them at higher prices across markets.

Third, processing rms in the Household Audio & Video Equipment industry improve quality a higher ranking of import price within the origin-product group, it ends up with a large quality index. The distribution of quality indexes of the 451 firms in the sample can be seen in Figure 1, varying from 0 to 10.15.

The relationship between quality and destination market conditions can be tested by looking into the following estimating equation:

$$qualityindex_f = \beta_0 + \beta_1 \log wgdp_f + \beta_2 \log wgdppc_f + \beta_3 \log revenue_f + \varepsilon_f; \quad (2)$$

where $wgdp_f$

where y_{fpd} represents firm f's export outcomes of product p in country d. GDP_d denotes country d's GDP. Q_l is a quality index dummy which equals 1 if product p produced by firm f belongs to the corresponding quality category l and equals 0 otherwise, where $l \in \{1;2;3;4;5\}$. D_k denotes a destination income dummy which takes a value of 1 if product p is exported to a country belonging to category k, where $k \in \{1;2;3;4;5\}$. I include all the interactions of quality dummy and country income dummy to fully pin down the pattern of price and exports variations across countries by quality, with term Q_1D_1 omitted to avoid collinearity. X_d contains distance to destination country and standard gravity controls[1]. $Imsh_d$ denotes the share of Chinese exports in country d's total imports of products HS85 and it captures the overall competitiveness of Chinese exports in that country. $_p$ is product fixed effects and aims to control for the differences across products in units of measure and other product characteristics that affect producers equally. Standard errors are clustered at the product level.

The results on fob export prices are shown in columns (1) and (2) of Table 4. The coefficients on the low quality dummies (Q_1, Q_2) interacted with country income dummies (D_k) are statistically insignificant, suggesting that there are no effects of GDP per capita on export prices of low-quality goods. For the goods in quality groups 3, 4, and 5, the coefficients on the interactions are positive and significant and the magnitudes rises with destination country's income level. Thus, export prices of high-quality products increase in importing country's GDP per capita monotonically. Moreover, within each country group, the magnitudes of the income effect on export prices is positively related to the quality level of the product. Column (1) reports the results with HS8 level fixed effects, and the fixed effects in Column (2) are at the HS6 level. Both of them show the same pattern of price variations. In sum, the cross-country variations in export prices within a product is consistent with the results in Simonovska (2015): firms charge higher prices in richer countries. And my results also show that this positive effect gets magnified as the quality of the product rises.

Columns (3) and (4) report the results of regression (3) with log of quantity as dependent variable. Within the lowest quality group (group 1), the effect of GDP per capita on export quantity decreases from 57.7% down to -56.4%, implying that low-quality products are sold less in rich countries. Products in the second lowest quality group (group 2) also experience a decline in the income effect on quantity sold. However, the positive impacts of GDP per capita on quantities sold in quality groups 3 and 4 are significant and get stronger as destination country's income level rises. For the products at the highest quality level (in group 5), GDP per capita has a negative effect on export volume in the poorest countries (D_1), and there are no significant income effects when selling to richer countries. Hence, how export quantity of a product varies with importing country's GDP per capita depends on the quality of the product. The last two columns of Table 4 show the results for (3) with log of export values on the left hand side. The effects of GDP per capita on export sales differ by product quality. In the low-quality groups (groups 1 and 2), the income effect decreases with GDP per capita and it turns to be even negative for Q_1 products sold in countries D_5. In contrast, products in high-quality groups 3, 4, and 5 make more sales in richer

[1] Data on gravity variables are obtained from Head, Mayer, and J. Ries (2010).

countries, and the income e ect gets larger as importing country's GDP per capita rises.

The di erential impacts of income per capita on export prices, quantities, and sales across countries and qualities can be seen in Figures 2, 3, and 4. Moving along the destination income axis from D_1 to D_5

purchases of cheap brand cars. Similarly, consumers living in a country with a good heating system would not probably think of clothings barely as warm keepers, but care more about fabric and designs. In other words, in an economy with a relatively high level of amenities, consumers have stronger preferences for product quality and tend to consume more better quality varieties.

The market demand for variety $'$ can be derived as[3]:

$$q(') = \frac{L}{p(')}\left[\frac{w}{N} + q(w)\left(\tilde{p} - \tilde{p}(')\right)\right]; \tag{5}$$

where $p(')$ and $\tilde{p}(') = \frac{p(')}{z(')}$ stand for price and quality-adjusted price of variety $'$, N is the number of varieties actually consumed, and w is each consumer's income. $\tilde{p}$ is defined as the average quality-adjusted price in the market, which equals an aggregate quality-adjusted price statistic (P) divided by number of varieties. In particular, it is expressed as

$$\tilde{p} = \frac{P}{N}; \quad where\, P = \int_{'\in} \frac{p(')}{z(')} d': \tag{6}$$

A consumer does not have a positive demand for all varieties. The chock quality-adjusted price occurs where market demand equals 0. From equation (5), firms have positive demand as long as

$$\tilde{p}(') < \tilde{p}_{max} = \frac{w + qP}{Nq}: \tag{7}$$

The chock quality-adjusted price increases in the aggregate quality-adjusted price statistic and decreases in the total number of varieties, implying that only varieties with low quality-adjusted prices can survive in a more competitive market. To clarify the relationship between individual income and chock price, I first define the elasticity of taste for quality with respect to income as:

$$\varepsilon_t(w) \equiv \frac{wq'(w)}{q(w)} > 0; \tag{8}$$

where $q'(w)$ refers to the first derivative of $q(w)$ with respect to income per capita. The value of the elasticity of taste varies with income and plays an essential role in determining the relationship between choke price and per-capita income. If the elasticity is greater than 1[4], the quality-adjusted choke price declines as individual income goes up. That is, when consumers get wealthier, they become much pickier on product quality and select varieties with relatively low prices conditional on quality. In demand equation (5), with q positively and elastically correlated with income, rich consumers demand more (less) than poorer consumers for varieties of below (above) average quality-

If the elasticity of taste for quality is smaller than 1, the quality-adjusted choke price turns to increase in individual income, implying that consumers choose to enlarge their consumption bundles when they get richer by purchasing new and less productive varieties. This case is isomorphic to the model developed in Simonovska (2015). Thus, omitting product quality and consumers' preferences for quality results in a loss of explanatory power of the model, especially in explaining consumption patterns under elastic taste for quality. [5]

An expansion of market size could be driven by either per-capita income increase or population growth. The non-homotheticity of utility function allows market demand to shift disproportionately towards high-quality varieties following an increase in income per capita. The elasticity of demand with respect to income per capita varies with varieties. This can be seen from the expression below:

$$\eta_{iw}(\varphi) = \frac{\partial q(\varphi)}{\partial w}\frac{w}{q(\varphi)} = \frac{\frac{w}{N} + wq'(w)\left[\bar{p} - \bar{p}(\varphi)\right]}{\frac{w}{N} + q(w)\left[\bar{p} - \bar{p}(\varphi)\right]}. \tag{9}$$

The sign and the magnitude of income elasticity de variety's attributes and consumer's tastes:

$$\varepsilon_{iL}(\varphi) = \frac{\partial q(\varphi)}{\partial L}\frac{L}{q(\varphi)} = 1.$$

In sum, like in other non-homothetic preferences, income per capita and population size enter the demand function in two distinct ways. Changes in individual income impact both market size and taste for product quality which in turn generates differential responses in consumption patterns across consumers at different income levels. My model differs from others in an emphasis on the importance of income effect in determining market equilibrium in a quality differentiated sector.

3.2 Firms

Following Kugler and Verhoogen (2012), I assume a Melitz type production structure by adding an intermediate input sector. Labor is the only factor of production and its supply is inelastic. Workers are homogeneous and each one is paid equally by w. Quality of final products is jointly determined by a firm's productivity and the quality of intermediate inputs it employs.

3.2.1 Intermediate input sector

Intermediate input producers use labor to produce intermediate inputs of different qualities under constant returns to scale and sell them in a perfectly competitive market. The price of an intermediate input of quality c is given by

$$p_I(c) = \frac{cw}{a};$$

where c denotes the quality of the intermediate input and a is the country-specific labor efficiency parameter of producing intermediate inputs at a given level of quality.

3.2.2 Final product sector

Final product producers need to pay a one-time entry cost f_e in order to uncover their random productivity draws from a Pareto distribution with c.d.f. $G(\varphi) = 1 - \frac{\varphi}{\varphi_0}$, where $\varphi > \varphi_0$. Only the firms whose draws are high enough to at least break even will stay in the market and produce. All other firms exit immediately. In such a quality differentiation model, I assume product quality improvements can be achieved by employing better quality and more expensive intermediate inputs. Since firms are assumed to be heterogeneous in terms of productivity, they choose to incur different variable costs to produce varieties at different quality levels. Firms with relatively high productivity draws would be able to afford the additional costs of quality improvements and therefore produce high-quality varieties and sell them at low quality-adjusted prices. In equilibrium, the firms that stay in the market optimally decide not only price but product quality which in turn impacts their production costs and market demand.

N, but decreases in the aggregate quality-adjusted price statistic P. Intuitively, rm selection is relatively tough in a more competitive market where consumers are rich and care much more about product quality, more varieties are competing, and the quality-adjusted price index is lower. Using equation (12) and the rst order conditions derived from (11), rm $'$'s market performances can be written as

$$c(') = '^{\frac{b}{2}}; \tag{13}$$

$$z(') = '^{b}; \tag{14}$$

$$p(') = {}^{w}$$

their markups and prices. The quantity of outputs sold by each firm also decreases, and accordingly, both sales and profits shrink as well. The taste component does not affect price in a direct way, but raises the quantity demanded. All else equal, firms sell more in a market composed of consumers with high incomes and this taste effect becomes much stronger for high-quality varieties. Therefore, taste heterogeneity is expected to account for the different patterns of price and quantity across markets.

In order to fully pin down the market equilibrium, three more conditions are required: free entry, income balance, and labor market clearing conditions.

$$' = \left(\frac{DqL}{f_e}\right)^{\frac{2}{2 \quad + b+2}} ; \tag{24}$$

$$N = \frac{4 \quad + b + 2}{b + 2} \frac{w}{q} ('$$

3.4.1 Productivity threshold and firm selection

As equation (24) shows, per-capita income raises threshold by positively influencing taste for quality. Comparative static exercise yields how productivity cutoff responds to changes in income per capita:

$$\frac{\partial \varphi}{\partial w} = \frac{2}{2\ \ + b + 2\ }\frac{\varphi}{w}\left[\varepsilon_t(w) - 1\right]. \tag{27}$$

The sign of the derivative depends on the value of elasticity of tastes for quality. If $\varepsilon_t(w) > 1$, productivity cutoff turns to be higher in rich than poor economies. If $0 < \varepsilon_t(w) < 1$, however, rich economies have lower thresholds. With a general function of $q(w)$, $\varepsilon_t(w)$ could vary with the level of income per capita in two different ways:

$$\begin{cases} \frac{\partial \varepsilon_t(w)}{\partial w} \leq 0 & \text{if } q'' \leq \frac{q'}{wq}(wq' - q); \\ \frac{\partial \varepsilon_t(w)}{\partial w} > 0 & \text{otherwise.} \end{cases}$$

From now on, I stay with a negative relationship between elasticity of taste and income per capita, because this is the case which is empirically relevant and is consistent with the specific functional forms of $q(w)$ discussed in Appendix A3. That is, poor consumers have more elastic taste for quality relative to rich consumers. But the model itself does not exclude the other possibility that elasticity of taste increases in income per capita. I denote w^* as the critical value of w at which elasticity of taste equals 1. In particular, w^* satisfies $\varepsilon_t(w^*) = 1$.

Equation (27) states that for a set of closed economies with equal market size and in an ascending order of income per capita, productivity threshold rises first and then declines. In poor countries (income per capita below w^*), consumers' tastes for quality are relatively low but sensitive to income, therefore, an income increase induces them to shift expenditure shares from low- towards high-quality varieties and drop low end varieties out of the consumption set, resulting in a higher productivity cutoff. On the other hand, when tastes for quality are at relatively strong levels but not responsive to income changes in rich countries (income per capita above w^*), a further increase in income allows consumers to consume a broader set of varieties and give a smaller expenditure

When it comes to inelastic taste for quality ($\varepsilon_t(w) < 1$), which is more likely to occur among rich countries, per-capita income tends to reduce competition intensity and mitigate the taste effect on firm revenue. As shown in equation (28), $\frac{q(w)}{w}$ and φ decrease in w, resulting in that following an increase in income the firm benefits less from stronger preference for quality but more from loose market competition as less productive firms start to be active in the economy. The combined impact of per-capita income remains ambiguous, depending on firm's productivity and the quality of the product it produces. In particular, given that

$$\frac{\partial r(\varphi)}{\partial w} = \underbrace{\frac{wq' - q}{w^2}(\varphi)^{\frac{b+2}{4}}\left[(\varphi)^{\frac{b+2}{4}} - \varphi^{\frac{b+2}{4}}\right]}_{\text{taste for quality effect}} + \underbrace{\frac{(b+2)\,q}{2w}(\varphi)^{\frac{b+2}{4}-1}\left[(\varphi)^{\frac{b+2}{4}} + \frac{1}{2}\varphi^{\frac{b+2}{4}}\right]\frac{\partial\varphi}{\partial w}}_{\text{selection effect (CE)}}$$

$$= \frac{2\,q}{(2 + b + 2)\,w^2}(\varphi)^{\frac{b+2}{2}}\left[\varepsilon_t(w) - 1\right]\left[1 - \left(1 + \frac{b+2}{4}\right)\right]$$

therefore, instead of dropping low priced varieties, income growth among rich countries allows for entry of less productive rms which were not active before and drives down the incumbents' market shares. Resource reallocation following an increase per-capita in income depends on the elasticities of consumers' preferences for product quality.

Consider a set of closed economies with equal market size and a ascendingly ranking by income per capita. For a high-quality producer whose productivity draw is above K' , its revenues exhibit an inverted-U relationship with the economy's income per capita. At the low levels of income per capita, an increase in income per capita triggers a positive taste for quality e ect and a negative competition e ect. Given that consumers' preferences for quality are dramatically enhanced by income growth in low income economies, the positive taste e ect on individual high-quality variety outweighs that on the price index. As a result, the rm's sales increase in per-capita income. At the high levels of income per capita, consumers tend to hold a relatively stable preference for product quality and prefer to spend the increased income over a wide range of varieties. Hence, income growth generates a negative taste e ect on individual demand and a positive e ect of competition, with a stronger taste e ect leading to a decrease in rm's sales.

However, the sales of a low-quality producer respond di erently to changes in economy's income per capita. When there is a slight increase in income per capita among poor countries, the associated negative competition e ect dominates the positive taste for quality e ect for low-quality varieties, which results in a decline in rm's sales. As moving from the poor to rich country group, consumers turn to alter their tastes for quality less and less following an income growth. Therefore, the market share gains due to a loose competition environment are more than the market share loss caused by picky tastes for quality, and the rm start to market more revenues as consumers' individual incomes rise if it could successfully survive in the rich markets.

In sum, taste for quality e ect and competition e ect jointly determine how income per capita impacts market shares of individual varieties, and both e ects are quality- and income per capita speci c. Conditional on aggregate income, individual high-quality varieties develop an inverted-U relationship with income per capita in the economy, as a stronger preference for quality associated with a higher income per capita rst rewards high-quality producers, while a further pickier taste on product quality pushes down the market quality-adjusted price index and therefore lowers the probability of successful entry. Low quality varieties experience the opposite to high-quality varieties, with sales going down rst and up afterwards as income per capita rises.

3.4.4 Elasticity of substitution

As an inverse measure of the degree of di erentiation across varieties, elasticity of substitution serves an important factor in rms' pricing decisions and sales. The lower the elasticity of substitution, the more market power, and the higher mark-ups rms charge and the more revenues earned. The analysis on income e ect cannot be complete without looking into how elasticity of substitution responses to changes in income per capita and hence in tastes for quality. In a heterogeneous rm model, the elasticity of substitution varies across varieties. In this section, I rst show the elasticities of substitution between varieties of the same quality, and then generalize the results to varieties of different qualities.

As equation (14) says, the firms who get the same productivity draw produce outputs at the same quality level. The elasticity of substitution between varieties produced by type-$'$ firms is

$$(') = 1 + \frac{q(w)}{\tilde{q}(')}; \tag{29}$$

where $\tilde{q}(') = z(')\,q(')$ represents the quality-adjusted output of variety $'$. The elasticity of substitution between type-$'$ varieties is jointly determined by per variety quality-adjusted consumption and consumers' tastes for quality at the income level w. Given that the quality-adjusted output is in per variety quality-adjusted consumption more than offsets the change in consumers' taste for quality.

Similarly, the elasticity of substitution between varieties of different quality depends on the quality adjusted consumption of each variety as well as taste for quality. In particular, for any pair of varieties φ and φ', I have

$$\sigma_{\varphi\varphi'} = 1 + \frac{1}{2} q(w) \left[\frac{1}{\tilde{q}(\varphi)} + \frac{1}{\tilde{q}(\varphi')} \right].$$

All in all, under elastic taste for quality, a higher per-capita income exposes low-quality varieties to a stronger competition pressure by raising elasticity of substitution and lowering markups, while high-quality varieties are also, to a smaller extent, being perceived as less differentiated as per-capita income moves up. However, under inelastic taste for quality, following an increase in income per capita and a constant aggregate income, less productive firms have a lower elasticity of substitution and it is more likely to have new varieties enter than to have each high-quality variety expand sales.

3.4.5 Homothetic preference

The utility function in equation (4) can be set as a homothetic one by assuming taste for quality is proportional to income per capita. That is $q(w) = \lambda w$, where λ is a positive constant. As such, all varieties have a unit income elasticity of demand. Consistent with other models with homothetic preferences, any two economies with equal aggregate income are predicted equivalent, and population size and income per capita play exactly the same role in determining the market equilibrium. As a result, the model with such a preference fails to account for the differential effects of income per capita on sales of high- and low-quality varieties in each economy as well as the mixed impacts of income per capita on firm entry and sales across economies in a heterogeneous firm model with free entry, which is observed in the data. In the next section of open economy, a homothetic preference would predict two countries to end up with the same market performances in every aspect as long as they have the same market size. Taking into account changes in consumers' tastes for quality associated with income growth generate differential responses of demand for quality differentiated varieties, which features the important and separate role of income per capita in a quality differentiation model.

4 Open Economy

I extend the closed economy model to a two-country setting. Consider a world comprised of two countries, Home and Foreign, which trade varieties of a final good. Each country $i = H; F$ has an inelastic labor endowment L_i and the labor efficiency of production is given by a_i. Labor is mobile within a country but immobile across countries.

4.1 Consumers

As in the closed economy model, the demand for variety φ originating from country i in country j is

$$q_{ij}(\varphi) = \frac{L_j}{p_{ij}(\varphi)}\left[\frac{w_j}{N_j} + q(w_j)\left(\bar{p}_j - \tilde{p}_{ij}(\varphi)\right)\right]; \tag{30}$$

where $p_{ij}(\varphi)$, $\tilde{p}_{ij}(\varphi)$, and $q_{ij}(\varphi)$ are the price, quality-adjusted price, and quantity of variety produced in country i demanded in country j respectively. Country j's labor endowment and per-capita income are given by L_j and w_j. N_j represents the total number of varieties available to consumers in country j, including both domestically produced and imported goods.

4.2 Firms

The basic setup for the production sectors is as described in the closed economy. When open to trade, firms have the option to export. Iceberg trade costs are assumed to be symmetric such that $\tau_{ij} = \tau_{ji} = \tau > 1$ and $\tau_{ii} = \tau_{jj} = 1$. Since markets are segmented under the assumption of constant marginal production costs, firms independently choose prices and qualities for each market in order to maximize profits. Countries trade varieties of final products, and there is no trade in intermediate inputs. The production costs and prices of intermediate inputs may differ across countries due to different production efficiencies and labor endowments, but the equilibrium analysis below considers a case of two countries with the same supply of effective labor and therefore the costs of producing intermediate inputs are equal in both countries. By suppressing the variations in production costs across countries, the trade pattern in equilibrium is purely driven by demand side.

Following that product quality is improved by using better intermediate inputs rather than by fixed investments, there is no scales of economy in the production of quality and a firm's quality choice is independent of market size. After opening to trade, the optimal product quality that a firm sells is still determined by its productivity draw and the scope for quality differentiation of the product, as in the case of closed economy:

$$z_{ij}(\varphi) = \varphi^{b}.$$

Firm selection is through competition. Only the firms that charge low enough quality-adjusted prices can survive. The firm at the margin has zero market demand and earns zero profits. Thus, the productivity threshold, under which firms stop serving, for firms producing in i and selling to j is defined as

$$\varphi_{ij} = \sup_{\varphi > \varphi_0} \{\pi_{ij}(\varphi) = 0\}.$$

Using equations for demand and profits, the market specific productivity threshold can be expressed as

$$\varphi_{ij} = \left(\frac{w_i}{a_i} \frac{N_j q_j}{w_j + q_j P_j} \right)^{\frac{2}{b+2}} : \tag{31}$$

Substituting equation (31) into price, demand, and profits equations, the export performances of a firm φ originating from i selling to j are

$$p_{ij}(\varphi) = \frac{w_i}{a_i} \varphi^{\frac{b-2}{2}} \left(\frac{\varphi}{\varphi_{ij}} \right)^{\frac{b+2}{4}} ; \tag{32}$$

$$q_{ij}(\varphi) = q_j L_j \varphi^{b} \left[\left(\frac{\varphi}{\varphi_{ij}} \right)^{\frac{b+2}{4}} - 1 \right] ; \tag{33}$$

$$\pi_{ij}(\varphi) = \frac{w_i}{a_i} q_j L_j \left(\varphi_{ij}^{\frac{b+2}{4}} - \varphi^{\frac{b+2}{4}} \right)^2 : \tag{34}$$

In a differentiated goods sector, a firm's marginal cost increases with productivity, trade cost, and the efficiency adjusted wage rate in the production country. Markup is negatively related to the cutoff. The higher the cutoff, the more difficult to enter the market, implying a more competitive market and less market power of each firm. As before, the output of a firm depends on the market size of the destination country and the productivity cutoff. Controlling for market size, high-quality goods sell relatively more in richer countries.

4.3 Trade Equilibrium

There are J_h and J_f potential entrants in the two countries respectively. A fraction of entrants whose productivity draws are greater than the thresholds stay and serve the destination market. The number of active firms selling in market j is

$$N_j = N_{ij} + N_{jj} = J_i \left[1 - G(\varphi_{ij}) \right] + J_j \left[1 - G(\varphi_{jj}) \right] : \tag{35}$$

$$L_j = J_j \frac{f_e}{a_j} + N_{jj} \int_{\varphi_{jj}}^{\infty} \frac{q_{jj}(\varphi)}{\varphi} \frac{c_{jj}(\varphi)}{a_j} (\varphi)\, d\varphi + N_{ji} \int_{\varphi_{ji}}^{\infty} \frac{q_{ji}(\varphi)}{\varphi} \frac{c_{ji}(\varphi)}{a_j} (\varphi)\, d\varphi. \qquad (38)$$

Thus, the equilibrium productivity thresholds above which rms start producing and exporting to can be solved as

$$\varphi_{jj} = \left\{ \frac{L_j q_j D \quad 1 \quad \frac{4}{b+2}}{f_e \quad 1 \quad \frac{2}{b+2} \quad \frac{w_j a_i}{w_i a_j} \quad 1 \quad \frac{2}{b+2}} \right\}^{\frac{2}{2 + b+2}}, \qquad (39)$$

$$\varphi_{ij} = \frac{w_i a_j}{w_j a_i}^{\frac{2}{b+2}} \varphi_{jj}, \qquad (40)$$

where $D = \frac{\varphi_0 (b+2)^2}{(4 + b+2)(2 + b+2)}$, φ_{jj} denotes the threshold for domestic producers selling in j, and φ_{ji} represents the threshold for foreign producers to export to j. Comparing equations (24) and (39), opening to trade does not necessarily raise the productivity threshold, depending on trade costs and the relative e ciency-adjusted income per capita of the two trading countries. It turns to be $\varphi_{jj} > \varphi$, where φ denotes the threshold in the closed economy, if and only if the home country's e ciency adjusted income per capita relative to its trade partner is lower such that $\frac{w_j a_i}{w_i a_j} \leqslant \frac{2}{2 + b+2}$. Intuitively, if home country has the cost advantage in producing intermediate inputs and nal products, exporters from foreign country nd it hard to penetrate in. Hence, when opening to trade, the entry of foreign competitive producers drives down the quality adjusted price index and the least productive domestic rms have to exit.

The total number of varieties available to consumers and the number of entrants in country j are

$$N_j = \frac{4 + b + 2}{b + 2} \frac{a_j}{q_j} \varphi_{jj}^{\frac{b+2}{2}}, \qquad (41)$$

$$J_j = \frac{b + 2}{2 + b + 2} \frac{a_j L_j}{f_e}. \qquad (42)$$

Similar to the autarky case, the number of varieties available in country j is positively correlated to the domestic productivity threshold φ_{jj} and negatively to consumers' tastes for quality q_j, suggesting an ambiguous e ect of income per capita in country j on number of varieties. The number of potential entrants is proportional to the aggregate labor supply in country j

$$J_i = J_j \quad and \quad \frac{w_i}{a_i} = \frac{w_j}{a_j}:$$

of income per capita on a firm's sales is ambiguous, since the relationship between productivity threshold and income per capita is related to the value of income elasticity of taste for quality. Formally, holding aggregate income constant ($w_j L_j$), I have

$$\frac{\partial r_{ij}(\varphi)}{\partial w_j} = \frac{2}{2\;\; + b + 2}\frac{w_i}{a_i}\frac{q_j}{w_j^2}(\varphi)^{\frac{b+2}{2}}\left[\varepsilon_t(w_j) - 1\right]\left[1 - \left(1 + \frac{b+2}{4}\right)\left(\frac{\varphi_{ij}}{\varphi}\right)^{\frac{b+2}{4}}\right].$$

All else equal, how a firm's export revenue relates to the income per capita in the destination country depends on income elasticity of taste for quality and the firm's productivity (quality). A firm realizes higher sales in a richer country if it produces high-quality goods and consumers' tastes for quality are income elastic. If consumers' tastes for quality are not sensitive to income, a high-quality producer would not earn more revenues when selling to a richer country. On the other hand, for a less productive firm whose products are of low quality, its export sales in a rich country are smaller than that in a poor country when consumers care about quality more than variety, while are larger when consumers prefer variety to quality.

The empirical implication of the model is that within a firm that exports a single quality level product to multiple countries, the sales per destination vary with the destination country's income per capita, holding market size constant, and exports of high- and low-quality products display differential sales patterns across countries. Following the assumption that taste for quality increases in income per capita at a decreasing rate, consumers in poor countries are predicted to be more responsive to income growth than rich country consumers in terms of preferences for product quality. Therefore, among developing countries, consumers with a relatively higher income

5 Firm-product level Empirical Evidence

5.1 Export value equation

To investigate how export sales vary with market size and per-capita income at the firm-product level, I first estimate the following specification:

$$\log x_{fpd} = {}_0 + {}_1 \log GDP_d + {}_2$$

exports in total occupy a large market share. I also use destination country's import unit value index as an alternative proxy for the competitiveness of Chinese exports. Countries with a higher unit value index of import may tend to purchase more high-quality products produced by developed countries and reduces consumptions of Chinese exports. As such, the coefficient on the import unit value index is expected to be negative. Adding these controls into the regression does not change the pattern of export values with respect to GDP per capita.

A major concern regarding estimating export value by standard OLS method arises from firm selection bias. In the disaggregate data, only a subset of firms export to a certain destination and the presence of zero trade observations is pervasive. As Heckman (1979) points out, if the zeros are not random, deleting can lead to loss of information. There may exist unobservable firm or destination characteristics that affect both selection to exporting and export sales, such as productivity, skill intensity, and cultural similarity, which results in biased estimates of coefficients in linear OLS regressions. In order to control for selection bias, I investigate income effects on export participation and export values by employing a two stage estimation procedure proposed in Helpman et al. (2008). Then, as robustness check, I follow Eaton and Kortum (2001) and use product specific minimum destination exports as censoring points in Tobit regressions.

Another factor that may bias estimates is the potential quality differentiation within firm-product. It is observed in the data that a proportion of firms import an input from multiple source countries, so they may provide different quality versions of the product to different destination countries, which gives rise to cross-country variations in prices and sales. This would not bias the results in a serious way, since the standard deviation of input prices within firm-product is smaller than 5 and therefore the quality of the inputs originating from various countries used by a firm do not vary considerably. In the robustness check, I restrict the sample to the firms which source an input from a single source country and find the relationship between export value and GDP per capita by quality remain robust.

5.2 Export participation equation

Following the two stage estimation procedure, I first estimate the probability of entry using a reduced form Probit:

$$\Pr(T_{fpd} = 1) = \Pr(\log x_{fpd} > 0) = \ ({}_{fp} + {}_{d} Z_d + {}_{LT} LT_{fpd}); \quad (47)$$

where T_{fpd} is a binary variable that takes the value one when the firm-product makes positive sales in destination d, ${}_{fp}$ is firm-product fixed effects, Z_d includes the destination specific explanatory variables in the right hand side of specification (46), and LT_{fpd} is lagged participation index that equals one if the firm-product was sold in the market in the previous year (year 2004). By assuming a normally distributed error terms ${}_{fpd}$, running the Probit at the firm-product-destination level yields the estimated inverse Mills ratio $\hat{}_{fpd}$.

The expected value of exports conditional on observing positive trade flows is

$$E[x_{fpd} \mid T_{fpd} = 1] = {}_{fp} + {}_{d} Z_d + E[\varepsilon_{fpd} \mid {}_{fpd} > \; ({}_{fp} + {}_{d} Z_d + {}_{LT} LT_{fpd})]$$
$$= {}_{fp} + {}_{d} Z_d + \hat{}_{fpd}.$$

The selection bias arises from the non-zero correlation between the error terms ε_{fpd} and ${}_{fpd}$ in the export value and the participation equations. Thus, in the second stage, I estimate the export value equation for positive levels of exports by OLS, with the estimated inverse Mills ratio $\hat{}_{fpd}$ as an additional regressor:

$$\log x_{fpd} = {}_{0} + {}_{d} Z_d + \hat{}_{fpd} + {}_{fp} + \varepsilon_{fpd}, \qquad (48)$$

where coefficient on the estimated inverse Mills ratio captures the degree to which the error terms of the export value regression is correlated with the error term of the Probit. If it is significant, it indicates that sample selection is present. In (48), $\hat{}_{fpd}$ controls for firm-product selection to exporting, and the estimates of ${}_{d}$ reflects the effects of destination characteristics on operating firms whose export sales are strictly positive in a certain destination.

Exclusion restriction Although the inverse Mills ratio is estimated by the non-linear Probit model, the collinearity between the selection correction term ($\hat{}_{fpd}$) and the included independent variables (Z_d) in the export value regression can inflate standard errors, since the Probit model is approximately linear for the mid-range values of exports and is truly non-linear only when exports take on extreme values. Effectively addressing this problem requires at least one variable that uniquely determines the participation choice of exporting but not the value of exports. With such a valid exclusion variable, $\hat{}_{fpd}$ and Z_d in the export value equation would be less correlated, facilitating identification and reducing multicollinearity among regressors as well as the correlation quality product in group 1, 2, 3, and 4 by 9%, 10.1%, 21%, and 15.8% respectively. These results are statistically significant and economically important. It is worth noting that the coefficient on the import unit value index is negative and significant, suggesting that Chinese exports account for a small market share in a country with high price imports. Table 5 also reports the OLS regressions of firm-product price and quantity on the explanatory variables on the right hand side of (46). Columns (1) and (4) show that GDP per capita raises export price regardless of product quality: a 1% higher GDP per capita leads to a 2.5% higher price. The income effects on export quantity differ by product quality, as given in columns (2) and (5): as GDP per capita increases by 1 percent, low-quality products sell 26.7% less, and high-quality goods are demanded 7.6%, 7.3%, 17.7%, and 13.5% more respectively.

Considering the OLS estimates may be biased by selection to exporting, Table 6 shows the results of two stage estimation and censored Tobit regression. Column (1) reports Probit estimates in the first stage. A larger GDP (market size) improves the likelihood of a firm-product entry, and a higher GDP per capita encourages entry at lower income levels and suppresses entry at higher incomes, given that the coefficient on GDP per capita is positive and statistically significant and the polynomial in GDP per capita has a negative estimate. The negative role of income per capita can be explained by the fact that the degree of market competition increases with GDP per capita which makes it more difficult for exporters to survive. Also, all else equal, products are more likely to be exported to the countries that share the same language or a geographical border with China.

Column (3) displays the key results of my empirical study. The estimated inverse Mills ratio obtained from the Probit is included as an additional regressor in the second stage OLS estimation of export values. The significance of the coefficient on $\hat{}_{fpd}$ confirms the necessity of correcting selection bias. Conditional on entry, market size (GDP) has a positive effect on individual firm-product sales, and GDP per capita differ its roles by product quality. In particular, all else equal, 1% higher GDP is associated with a 60% more export sales. The estimates of $_2$ and $_3$ are both negative, implying that low-quality products earn less revenues in richer countries and the revenues drop even more quickly as GDP per capita goes up. $_l$ are positive and their magnitudes exceed the absolute value of $_2$ and increase with quality levels. $_l$ are also positive and roughly increase with quality, but they are smaller than the absolute value of $_3$. This suggests that high-quality products makes more sales as GDP per capita rises at lower levels and start to decline as income rises further. The relationships between export value and GDP per capita for products in quality groups 1 to 4 display similar patterns, but differ in curvature and turning point. The higher the quality, the larger turning point and the less curvature. In other words, high-quality products' sales keep increasing

o(Prob)1e2-364()]TJ 0 bm[(o(Prob)1e22h)-310(qualit)28(y)-30n.ds,en(and)8ct

likely to export to and make more sales in that country.

An alternative explanation of the results is that the roles of GDP per capita in shaping firm-product level exports across countries work through market size. Such an argument can be ruled out by replacing GDP per capita with population size or market size of the destination country in specification (46). The corresponding regression results show that neither the population term nor the interaction of population and high quality dummy is statistically significant, suggesting that the differential impacts of per-capita income on export values by quality category are independent of market size effect.

6 Robustness Check

6.1 Quality differentiation within firm-product

An alternative explanation for the increase of export prices and sales with GDP per capita is that firms export different quality versions of a product to different countries. To exclude quality differentiation across markets within a firm-product, I restrict the data sample to the firms which import an input from a single country. The quality of sophisticated intermediate inputs is the most important determinant of output quality produced by processing firms, and as stated above, processing firms upgrade product quality mainly through importing better inputs. Therefore, it is less likely for a processing exporter to produce a product at different quality levels if it sources each input from barely one country. As such, the observed variations in export prices and sales within a firm-product are driven by consumers' tastes for the quality of a given product.

There are 189 firms satisfying the single-source restriction in the data. The restricted sample consists of 1,208 observations. I run regression (46) for this subsample using OLS, two-stage estimation, and Tobit approaches. Considering the small sample size, I classify products into two quality groups: high and low and denote Q_H a dummy variable which takes a value of 1 if the product belongs to the high-quality group and 0 otherwise. The results are given in Table 6 and confirms the conclusions discussed in the previous section. Comparing column (1) and (2), it is found that GDP per capita does not have a significant effect on export values of all products, but the effects become significant when products are differentiated by quality: a higher GDP per capita leads to fewer export sales of low-quality products and more sales of high-quality ones. To control for firm-product selection to exporting, two stage approach is adapted and the results for each step are reported in column (3) and (4). Destination country's GDP per capita influences firm-products' exports' market entry in the opposite directions: a 1% higher GDP per capita lowers the probability of a low-quality product entry by 0.5% but raises the probability of a high-quality product entry by 0.4%. Also, the relationship between export participation and GDP per capita is non-linear for high-quality products, given that the coefficient on the interaction term of GDP per capita and quality dummy is negative and significant. The second stage is OLS regression with the estimated

rm's input price the weighted average of import prices for inputs, using import values as weights, and it is based on imports in the same HS3 product category. Then, products are equally divided into ve quality groups according to rm level input price: higher input prices infer better quality of inputs and outputs.

The regression results with the alternative quality index are displayed in Table 9. The key estimates remain as robust and consistent as in the main regressions. The change of quality measure does not alter conclusions. The rst three columns report OLS estimations of export price, quantity, and value. Per capita GDP raises export prices regardless of product quality. Rich consumers demand more high-quality goods, and high-quality goods make more export revenues as destination country's GDP per capita rises, controlling for market size, distance, and other related variables. In terms of entry, a higher GDP per capita increases the probability of entry of high-quality goods and a larger import unit value index defers product entry. After correcting selection bias, in column (5), export values of low-quality products drop dramatically following an increase in GDP per capita. The relationship between export values of products in quality groups 1 to 4 and GDP per capita display an inverted-U shape, with better quality goods having a larger turning

233) in 2005 for study. Table 11 reports the results. The estimates of interest remain as consistent and robust as in the above analysis. In column (1), the coe cient on $\log GDPpc_d$ is positive and statistically signi cant, but the coe cients on interactions of $\log GDPpc_d$ and quality dummies are insigni cant, suggesting that GDP per capita has a positive e ect on price of all products regardless of quality levels: 1 percent increase in GDP per capita leads to a 1.9% increase in export price. Column (2) corresponds to OLS estimation of export value equation. For the products in the lowest, group 1 and group 2 quality categories, their export values decrease with GDP per capita: 1 percent higher GDP per capita drives down product export sales by 15.7%, 15.7%, and 0.9%. In contrast, for products belonging to quality groups 3 and 4, export sales increase by 2.5% and 3.8% respectively.

Columns (3) and (4) show the results of two stage estimation of export values. The relationship between probability of successful entry and destination's GDP per capita is non-linear: the coe cients on $\log GDPpc_d$ and its second order are both signi cant. A higher income level rst encourages product entry but turns to make it harder as market competition gets more intensi ed. After controlling for selection to exporting, the impacts of GDP per capita on active exporters di er by product quality. The products in the lowest quality group and group 1 make less sales in richer countries, holding other variables constant. The export value of high-quality products in groups 3 and 4 increases with importing country's income level and then slightly decreases, indicating that richer consumers demand more high-quality products and a further increase in income induce them to buy more varieties. Also, exporters earn less revenue in a distant country and more in a similar country in terms of language and geographical border.

7 Conclusions

This paper provides a uni ed framework to account for the variety-quality tradeo on exports across countries driven by income e ect on tastes for quality. Aside from aggregate income, per capita income plays a separate role in shaping market demand in a quality di erentiated sector. In equilibrium, income elasticity of taste for quality determines the e ects of income per-capita on rm selection and market shares, since it re ects consumers' relative preferences for quality versus variety.

Consider two importing countries with equal market size but di ering in income rder.

the richer country comes with a greater number of varieties and each producer selling in the market has a smaller market share. If it is further assumed that the elasticity of taste is negatively correlated with income per-capita, the model predicts that at the early stage of development, consumers benefit from economic growth and trade mainly through quality margins, while variety effect becomes the main source of gains at higher levels of per-capita income. If the elasticity of taste rises as income goes up, the opposite case applies.

In the empirical analysis, I construct firm level quality indexes for processing firms in the Household Audio and Video Equipment industry by using trade data collected by Chinese Custom Office. In line with the model's predictions, I find that, controlling for market size and other destination characteristics, there is a negative impact of per-capita income on export sales of low-quality products but a mixed impact on sales of high-quality products. There is an inverted-U shape relationship between high-quality export sales and a destination's income per-capita at the firm-product level, which reflects differing preferences for quality and variety across consumers at different income levels.

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$$\frac{z(')}{z(')\,q^c(') + q} = \quad p(');$$

where is the Lagrange multiplier, indicating the marginal utility of income. Hence, for two distinct varieties $'$ and $'^0$, the following equation must hold:

$$p(')\,q^c(') + \frac{p(')}{z(')}q = p \quad '^0 \quad q^c \quad '^0 \quad + \frac{p('^0)}{z('^0)}q:$$

By summing over all varieties $'^0$ that a consumer actually consume, I have

$$N \quad p(')\,q^c(') + \frac{p(')}{z(')}q \quad = w + qP;$$

where

$$P = \int$$

is reasonable to assume $q(w)$ takes a natural log of income per capita:

$$q(w) = \quad \ln w;$$

where   is a positive parameter representing a positive and exible e ect of per-capita income on quality of life as well as on tastes for product quality. The corresponding elasticity of taste with respect to income can be expressed as $"_t(w) = (\ln w)\ ^{1}$, which shows a negative correlation between elasticity of taste for quality and per capita income. The value of $"_t(w)$ ranges from positive in nity to zero as individual income rises from 1 to extremely high, with poor consumers holding elastic tastes for quality and rich consumers being relatively inelastic.

The second example is inspired by the work of Easterly (1999) and Prados (2010) which emphasize the role of a country's relative income level compared to the world average. Easterly (1999) studies the rate of changes of quality of life as relative income hikes by adding a quadratic term of per-capita income into regressions. The results turn out that two fths of the indicators of quality of life, such as mail per capita and health and nutrition, exhibit a relationship in which there is not much improvement at low incomes but there is much more at higher incomes, and the rest of indicators show a relationship to income in which there is a strong change at lower levels of income that tails o at high incomes. Relative income raises quality of life at variable rates in di erent aspects.[13] As such, I assume the following function form:

$$q(w) = (w \quad) \ ;$$

where   stands for the world poverty line which is common across countries and   is a positive parameter which indicates the degree of concavity or convexity of the function. The more a country's per-capita income exceeds the world poverty line, the higher quality of life consumers enjoy by living in that country. Such a function form ensures that consumers' tastes for quality $q(w)$ increase with per-capita income and gives rise to a negative relationship between elasticity of taste and income. The value of elasticity of taste varies considerably, given $"_t(w) = \frac{w}{(w \quad)}$, where $"_t(w) > 1$ if $w < \frac{}{(1 \quad)}$ and < 1 while $"_t(w) < 1$ otherwise.

A4. Pro t Maximization and Productivity Threshold

The rst order conditions derived from pro t maximization problem stated in section 2.1.2 are:

$$\frac{@ \ (\ ')}{@p(\ ')} = q(\ ') \quad L \quad p(\ ') \quad \frac{cw}{a\ '} \quad \frac{w + qP}{N} p(\ ') \ ^{2} = 0$$

$$\frac{@ \ (\ ')}{@c(\ ')} = L \quad p(\ ') \quad \frac{cw}{a\ '} \quad qz(\ ') \ ^{2} \frac{@z(\ ')}{@c(\ ')} \quad q(\ ') \frac{w}{a\ '} = 0:$$

[13] Similar arguments can be found in Prados (2010). The Kuznets curve is widely used to pin down the relationship between environmental quality and economic growth: early stage economic development is accompanied by deterioration of environmental quality, but further increases of income levels start to improve environmental quality signi cantly.

Combining with $z(\varphi) = \frac{1}{2}\varphi^{b} + \frac{1}{2}c(\varphi)^2$, the optimal choices of quality, price, and output are

$$c(\varphi) = \varphi^{\frac{b}{2}}; \qquad z(\varphi) = \varphi^{b};$$

$$p(\varphi) = \left(\frac{w}{q}\frac{w+qP}{N}\right)^{\frac{1}{2}} \varphi^{\frac{3b\ \ 2}{4}};$$

$$q(\varphi) = L\varphi^{\ b}\left[\left(\frac{aq}{w}\frac{w+qP}{N}\right)^{\frac{1}{2}}\varphi^{\frac{b+2}{4}} \quad q\right]:$$

To derive the productivity threshold, setting the market demand equation equal to 0 yields

$$L\varphi^{\ b}\left[\left(\frac{aq}{w}\frac{w+qP}{N}\right)^{\frac{1}{2}}(\varphi\ )^{\frac{b+2}{4}} \quad q\right] = 0:$$

Therefore,

$$\varphi \ = \left(\frac{w}{a}\frac{Nq}{w+qP}\right)^{\frac{2}{b+2}}:$$

A5. Market Equilibrium Solutions in a Closed Economy

In equilibrium, plug firms' optimal choices of quality and price (equations (6) and (7)) into the aggregate quality-adjusted price statistic:

$$P = \int_{\varphi \in} \frac{p(\varphi)}{z(\varphi)}d\varphi = \frac{4}{4\ \ + b + 2}\frac{w}{a}N(\varphi\ )^{\frac{b+2}{2}}:$$

Then, substituting the expression of productivity threshold given by equation (4) into the price statistic yields:

$$P = \frac{4}{b+2}\frac{w}{q}:$$

Next, plugging the new expression of the price statistic back to equation (4) gives

$$(\varphi\ )^{\frac{b+2}{2}} = \frac{b+2}{4\ \ + b + 2}\frac{N}{a}q:$$

Equivalently, that is

$$N = \frac{4\ \ + b + 2}{b+2}\frac{a}{q}(\varphi\ )^{\frac{b+2}{2}}:$$

The quality-adjusted price statistic is negatively correlated with per-capita income. This implies that consumers would like to purchase more high-quality goods whose quality-adjusted prices are relatively low as their income rises. Also, the increase in productivity threshold raises the number of varieties that consumers actually consume.

Substituting (13) into (16) gives an equation which links the threshold and number of potential entrants:

$$(\,'\,)^{\frac{2\ \ +b+2}{2}}$$

For two varieties with different quality levels, the elasticity between them equals

$$\sigma_{\varphi\varphi'} = 1 + \frac{1}{2}q\left(\frac{1}{\hat{q}_{\varphi}} + \frac{1}{\hat{q}_{\varphi'}}\right):$$

Accordingly,

$$\frac{\partial \sigma_{\varphi\varphi'}}{\partial w} = \frac{q'}{2}\left\{\frac{1}{\hat{q}_{\varphi}}\left[1 - \frac{Lq}{\hat{q}_{\varphi}} - A\left(\frac{\varphi}{\varphi}\right)^{\frac{b+2}{4}} - 1\right] + \frac{1}{\hat{q}_{\varphi'}}\left[1 - \frac{Lq}{\hat{q}_{\varphi'}} - A\left(\frac{\varphi'}{\varphi}\right)^{\frac{b+2}{4}} - 1\right]\right\};$$

where $A = 1 - \frac{b+2}{2(b+2+2\sigma)}:$

Figure 1: Distribution of product quality index

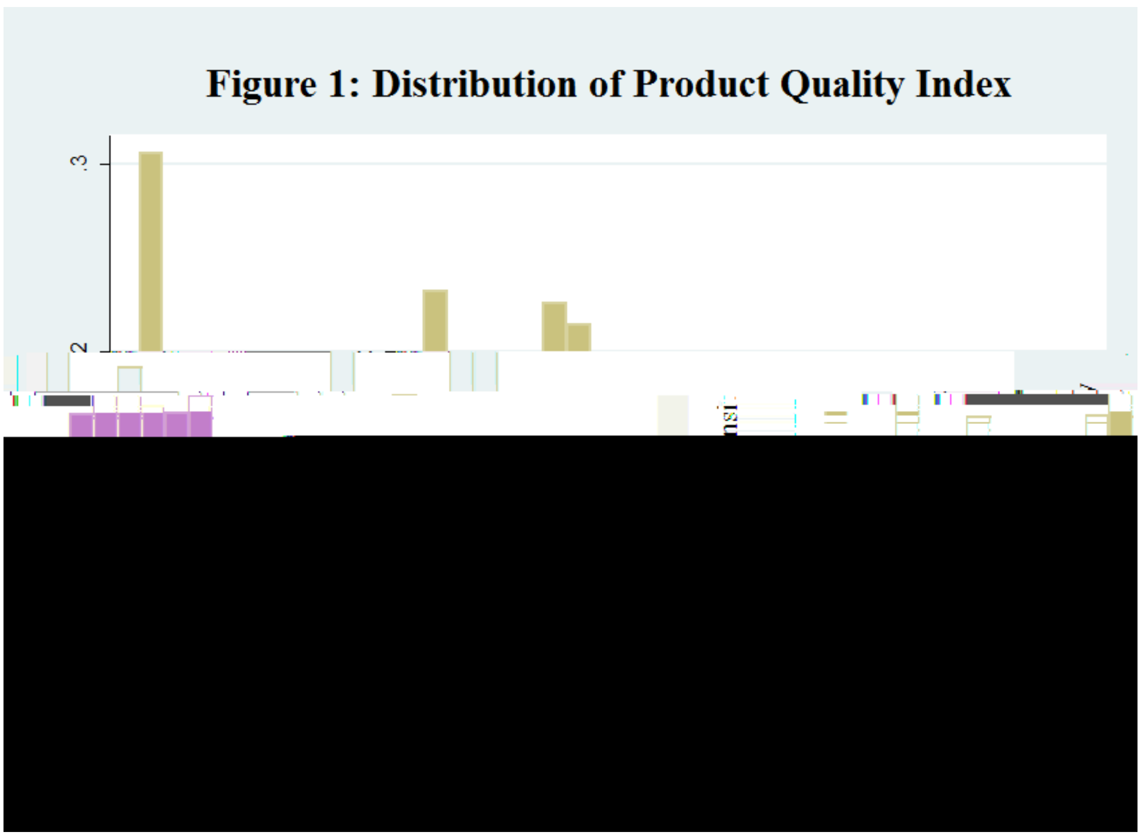

Figure 4: E ects of GDP per capita on export value by quality (HS8 level)

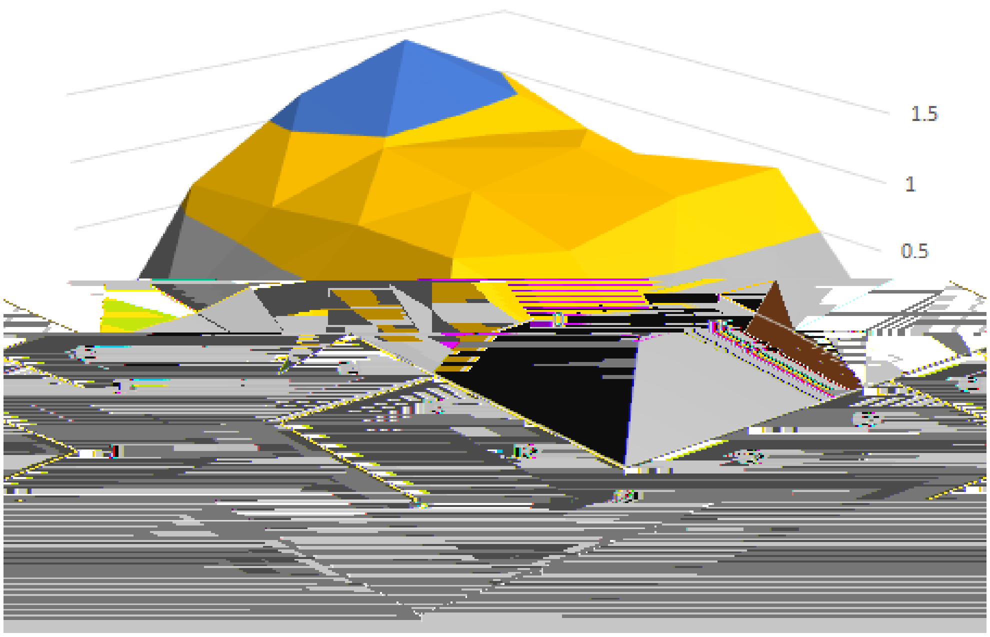

Table 1: Source countries of imported inputs

Source Country	Import Value	GDP per capita
Norway	13,566	63,918
Switzerland	213,292	49,351
United States	32,823,009	41,889
Sweden	332,856	39,637
Netherlands	21,298	38,248
Austria	79,018	37,175
United Kingdom	1,604,985	36,555
Australia	15,491,701	36,046
Japan	36,464,883	35,484
France	115,421	34,936
Canada	753,012	34,484
Germany	694,601	33,890
Italy	1,125,100	30,074
Singapore	6,944,778	26,877
Hong Kong	45,195,732	25,604
Korea	62,898,447	16,388
Russia	17,119	5,342
Malaysia	1,167,951	5,159
Brazil	1,267,450	4,734
Thailand	4,056,536	2,743
Indonesia	1,696,999	1,301
India	116,769	736

Notes: The import value column reports total import value of inputs sourced by rms in the sample in 2005. The GDP per capita column lists GDP per capita in 2005 by source country. For reference, GDP per capita of China is 1,730 US dollars in 2005. Both import value and GDP per capita are reported in 2005 US dollars.

Table 4: Variations in export prices, quantities, and sales by destination and quality within product

	(1) log p_{fpd}	(2) log p_{fpd}	(3) log q	p

Table 4 (Cont'd): Variations in export prices, quantities, and sales by destination and quality within product

		(1) log p_{fpd}	(2) log p_{fpd}	(3) log q_{fpd}	(4) log q_{fpd}	(5) log x_{fpd}	(6) log x_{fpd}
Q_5	D_1	0.737***	0.666***	-0.586**	-0.504*	0.151	0.161
		(0.134)	(0.165)	(0.295)	(0.304)	(0.287)	(0.293)
Q_5	D_2	0.552***	0.641***	0.326	0.341	0.879***	0.983***
		(0.116)	(0.143)	(0.254)	(0.262)	(0.248)	(0.253)
Q_5	D_3	0.696***	0.888***	-0.110	-0.144	0.585***	0.744***
		(0.105)	(0.130)	(0.231)	(0.238)	(0.225)	(0.230)
Q_5	D_4	0.700***	0.986***	0.032	-0.034	0.732***	0.951***
		(0.101)	(0.123)	(0.219)	(0.226)	(0.214)	(0.218)
Q_5	D_5	0.783***	1.010***	0.199	0.116	0.982***	1.126***
		(0.094)	(0.115)	(0.205)	(0.211 0 0 m 493.84982***5		

Table 5: Firm-products' export outcomes and destination charateristics: OLS

	(1) log p_{fpd}	(2) log q_{fpd}	(3) log x_{fpd}	(4) log p_{fpd}	(5) log q_{fpd}	(6) log x_{fpd}
log GDP_d	-0.002	0.326***	0.337***	-0.001	0.326***	0.325***
	(0.002)	(0.013)	(0.013)	(0.002)	(0.013)	(0.012)
log $GDPpc_d$	0.025***	0.036*	0.033*	0.026***	-0.267***	-0.241***
	(0.004)	(0.021)	(0.020)	(0.007)	(0.035)	(0.033)
log $GDPpc_d$ Q_1				-0.012	0.343***	0.331***
				(0.011)	(0.048)	(0.047)
log $GDPpc_d$ Q_2				0.002	0.340***	0.342***
				(0.010)	(0.050)	(0.048)
log $GDPpc_d$ Q_3				0.007	0.444***	0.451***
				(0.010)	(0.055)	(0.054)
log $GDPpc_d$ Q_4				-0.005	0.404***	0.399***
				(0.012)	(0.046)	(0.045)
log $distance_d$	0.013	-0.083	-0.086	0.012	-0.102*	-0.089*
	(0.014)	(0.052)	(0.053)	(0.014)	(0.052)	(0.053)
comlang	-0.012	0.529***	0.728***	-0.012	0.527***	0.515***
	(0.019)	(0.078)	(0.074)	(0.019)	(0.078)	(0.076)
border	0.015	0.338***	0.381***	0.015	0.338***	0.354***
	(0.017)	(0.074)	(0.072)	(0.017)	(0.074)	(0.072)
timedi	-0.004*	0.066***	0.063***	-0.003*	0.068***	0.064***
	(0.002)	(0.008)	(0.009)	(0.002)	(0.008)	(0.008)
Gatt	0.014	-0.126*	-0.092	0.014	-0.121	-0.107
	(0.013)	(0.074)	(0.073)	(0.013)	(0.074)	(0.072)
Im_d	-0.061	3.144***	3.082***	-0.062	3.025***	2.963***
	(0.064)	(0.281)	(0.270)	(0.063)	(0.281)	(0.271)
Firm-product FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,812	11,812	11,812	11,812	11,812	11,812

Notes: Dependent variables are measured at the rm-product-destination level. Standard errors are clustered at the rm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the rm level. The coe cients on comlang, border, and Gatt are for discrete changes of dummy variables from 0 to 1. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Firm-products' export outcomes and destination charateristics

Two stage correction and Tobit regressions

	(1) Probit	(2) 2nd stage	(3) 2nd stage	(4) Tobit
Dependent Var	T_{fpd}	log q_{fpd}	log x_{fpd}	log x_{fpd}
log GDP_d	0.367***	0.613***	0.600***	0.345***
	(0.004)	(0.065)	(0.064)	(0.015)
log $GDPpc_d$	0.125***	-0.119***	-0.094***	-0.159***
	(0.015)	(0.036)	(0.035)	(0.037)
log $GDPpc_d$ Q_1	-0.046**	0.207***	0.197***	0.259***
	(0.020)	(0.046)	(0.045)	(0.053)
log $GDPpc_d$ Q_2	-0.069***	0.214***	0.219***	0.291***
	(0.020)	(0.047)	(0.046)	(0.062)
log $GDPpc_d$ Q_3	-0.031	0.347***	0.355***	0.363***
	(0.021)	(0.044)	(0.043)	(0.059)
log $GDPpc_d$ Q_4	-0.030	0.365***	0.361***	0.299***
	(0.022)	(0.047)	(0.046)	(0.052)
log $GDPpc_d{}^2$	-0.028***	-0.218***	-0.214***	-0.133***
	(0.007)	(0.025)	(0.024)	(0.033)
log $GDPpc_d^2$ Q_1	-0.018	0.119***	0.118***	0.101**
	(0.011)	(0.033)	(0.033)	(0.042)
log $GDPpc_d^2$ Q_2	-0.001	0.149***	0.150***	0.100**
	(0.010)	(0.032)	(0.032)	(0.047)
log $GDPpc_d^2$ Q_3	-0.009	0.198***	0.203***	0.112***
	(0.011)	(0.034)	(0.033)	(0.036)
log $GDPpc_d^2$ Q_4	0.001	0.185***	0.182***	0.133***
	(0.011)	(0.036)	(0.035)	(0.042)
log $distance_d$	-0.009	-0.105**	-0.092*	-0.065
	(0.012)	(0.051)	(0.050)	(0.061)
comlang	0.837***	1.962***	1.921***	0.532***
	(0.032)	(0.179)	(0.176)	(0.087)
border	0.092***	0.158*	0.177**	0.398***
	(0.027)	(0.082)	(0.080)	(0.078)
timedi	-0.631*	0.061***	0.058***	0.057***
	(0.328)	(0.008)	(0.008)	(0.010)
Gatt	0.204***	0.265***	0.271***	-0.069
	(0.024)	(0.087)	(0.085)	(0.081)
$Imsh_d$	2.191***	4.582***	5.803***	4.829***
	(0.109)	(0.531)	(0.440)	(0.342)
$\hat{}_{fpd}$		2.286***	2.242***	
		(0.243)	(0.238)	
Firm-product FE	Yes	Yes	Yes	Yes
Observations	110,970	110,970	110,970	11,629

Notes: Standard errors are clustered at the rm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the rm level. The coe cients on comlang, border, and Gatt are for discrete changes of dummy variables from 0 to 1. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Export values and destination charateristics

Quality di erentiation within rm-product

	(1) OLS	(2) OLS	(3) Probit	(4) 2nd Stage	(5) Tobit	(6) Tobit
Dependent Var	$logx_{fpd}$	$logx_{fpd}$	T_{fpd}	$logx_{fpd}$	$logx_{fpd}$	$logx_{fpd}$
$logGDP_d$	0.271***	0.274***	0.014***	0.172***	0.310***	0.319***
	(0.057)	(0.055)	(0.001)	(0.044)	(0.057)	(0.056)
$logGDPpc_d$	-0.047	-0.214***	-0.005***	-0.207***	-0.208***	-0.218***
	(0.075)	(0.079)	(0.001)	(0.073)	(0.079)	(0.084)
$logGDPpc_d \quad Q_H$		0.361***	0.009***	0.314***	0.392***	0.375***
		(0.113)	(0.002)	(0.090)	(0.111)	(0.112)
$logGDPpc_d^2$			0.001			-0.113**
			(0.000)			(0.051)
$logGDPpc_d^2 \quad Q_H$			-0.005***			0.167
			(0.001)			(0.193)
$logdistance_d$	-0.111	-0.163	-0.007***	-0.053	-0.260	-0.254
	(0.208)	(0.209)	(0.002)	(0.162)	(0.196)	(0.193)
comlang	0.717**	0.785***	0.042***	0.466**	0.912***	0.917***
	(0.287)	(0.293)	(0.005)	(0.235)	(0.277)	(0.280)
border	0.717**	0.682**	0.004	0.633***	0.616**	0.621**
	(0.283)	(0.283)	(0.010)	(0.218)	(0.258)	(0.258)
Gatt	0.328	0.232	0.004	0.101	0.038	0.087
	(0.243)	(0.248)	(0.004)	(0.267)	(0.264)	(0.280)
$\hat{\ }_{fpd}$				-0.596***		
				(0.065)		
rm-product FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,208	1,208	1,208	1,208	1,157	1,157

Notes: Standard errors are clustered at the rm-product level, and are reported in parentheses. Results remain robust if standard errros are clustered at the importing country level. The coe cients on comlang, border, and Gatt are for discrete changes of dummy variables from 0 to 1. Column (3) reports the marginal e ects of regressors on probability of exporting. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Firm-products' export outcomes and destination charateristics: alternative quality index

	(1)log p_{fpd} (OLS)	(2) log q_{fpd} (OLS)	(3) log x_{fpd} (OLS)	(4) Probit	(5) log x_{fpd} (2nd Stage)	(6) log x_{fpd} (Tobit)
log GDP_d	-0.001	0.325***	0.324***	0.369***	0.641***	0.345***
	(0.002)	(0.013)	(0.013)	(0.004)	(0.064)	(0.013)
log $GDPpc_d$	0.020***	-0.071**	-0.051*	-0.016*	-0.123***	0.002
	(0.005)	(0.029)	(0.028)	(0.008)	(0.026)	(0.028)
log $GDPpc_d$ Q_1	-0.009	0.130***	0.121**	0.162***	0.365***	0.074
	(0.010)	(0.050)	(0.048)	(0.013)	(0.048)	(0.049)
log $GDPpc_d$ Q_2	0.009	0.089*	0.098**	0.115***	0.152***	0.053
	(0.009)	(0.048)	(0.047)	(0.010)	(0.039)	(0.052)
log $GDPpc_d$ Q_3	0.012	0.246***	0.258***	0.239***	0.540***	0.176***
	(0.010)	(0.055)	(0.055)	(0.019)	(0.053)	(0.052)
log $GDPpc_d$ Q_4	0.023	0.292***	0.315***	0.309***	0.684***	0.236***
	(0.014)	(0.054)	(0.053)	(0.025)	(0.061)	(0.048)
log $GDPpc_d{}^2$				-0.018***	-0.117***	-0.169***
				(0.004)	(0.017)	(0.047)
log $GDPpc_d^2$ Q_1				-0.014	0.052*	0.143***
				(0.008)	(0.030)	(0.037)
log $GDPpc_d^2$ Q_2				-0.047***	-0.058**	0.018
				(0.008)	(0.029)	(0.033)
log $GDPpc_d^2$ Q_3				-0.042***	0.023	0.121***
				(0.010)	(0.034)	(0.034)
log $GDPpc_d^2$ Q_4				-0.059***	-0.028	0.082**
				(0.012)	(0.041)	(0.040)

Notes: Standard errors are clustered at the rm-product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the rm level. The coe cients on comlang, border, and Gatt are for discrete changes of dummy variables from 0 to 1. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Firm-products' export outcomes and destination charateristics: alternative quality index (Cont'd)

	(1)log p_{fpd} (OLS)	(2) log q_{fpd} (OLS)	(3) log x_{fpd} (OLS)	(4) Probit	(5) log x_{fpd} (2nd Stage)	(6) log x_{fpd} (Tobit)
log $distance_d$	0.012	-0.079	-0.066	-0.008	-0.062	-0.052
	(0.014)	(0.052)	(0.053)	(0.013)	(0.051)	(0.053)
comlang	-0.011	0.535***	0.523***	0.833***	2.050***	0.543***
	(0.019)	(0.078)	(0.076)	(0.033)	(0.177)	(0.074)
border	0.014	0.330***	0.345	0.091***	0.146*	0.394***
	(0.017)	(0.074)	(0.072)	(0.028)	(0.082)	(0.073)
timedi	-0.003*	0.065***	0.062***	-1.061***	0.052***	0.055***
	(0.002)	(0.009)	(0.008)	(0.356)	(0.008)	(0.008)
Gatt	0.015	0.123*	0.108	0.206***	0.308***	0.077
	(0.013)	(0.074)	(0.073)	(0.024)	(0.086)	(0.079)
$Imsh_d$	-0.051	3.979***	3.921***	2.489***	4.571***	4.856***
	(0.058)	(0.225)	(0.222)	(0.147)	(0.349)	(0.325)
$\hat{}_{fpd}$					2.401***	
					(0.236)	
Firm-product FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,812	11,812	11,812	110,970	110,970	11,629

Notes: Standard errors are clustered at the rm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at rm23 6.r ate rm cl

Table 10: Firm-products' export outcomes and destination charateristics: Year 2006

	(1)log p_{fpd} (OLS)	(2) log x_{fpd} (OLS)	(3) Probit	(4) log x_{fpd} (2nd Stage)
log GDP_d	-0.007**	0.292***	0.304***	0.772***
	(0.003)	(0.013)	(0.004)	(0.050)
log $GDPpc_d$	0.026***	-0.154***	0.025***	-0.098***
	(0.010)	(0.039)	(0.006-110(pd)]TJ/F8 10.4l21 Tf 17.701 1.777 Td	

Table 11: Firm-products' export outcomes and destination charateristics

SIC233: Women's, Misses', and Juniors' Outerwear

	(1)log p_{fpd} (OLS)	(2) log x_{fpd} (OLS)	(3) Probit	(4) log x_{fpd} (2nd Stage)
log GDP_d	-0.002	0.351***	0.390***	0.895***
	(0.002)	(0.009)	(0.003)	(0.071)
log $GDPpc_d$	0.019***	-0.157***	0.038***	-0.030
	(0.005)	(0.029)	(0.004)	(0.026)
log $GDPpc_d$ Q_1	-0.003	0.022	-0.032***	-0.085**
	(0.006)	(0.041)	(0.011)	(0.043)
log $GDPpc_d$ Q_2	0.002	0.148***	-0.018	0.108**
	(0.007)	(0.041)	(0.013)	(0.045)
log $GDPpc_d$ Q_3	-0.012	0.182***	-0.024**	0.112***
	(0.007)	(0.038)	(0.012)	(0.043)
log $GDPpc_d$ Q_4	-0.000	0.195***	-0.014	0.145***
	(0.007)	(0.038)	(0.010)	(0.039)
log $GDPpc_d{}^2$			-0.031***	-0.158***
			(0.005)	(0.023)
log $GDPpc_d^2$ Q_1			0.026***	0.112***
			(0.007)	(0.032)
log $GDPpc_d^2$ Q_2			0.035***	0.203***
			(0.008)	(0.033)
log $GDPpc_d^2$ Q_3			0.018**	0.151***
			(0.008)	(0.032)
log $GDPpc_d^2$ Q_4			0.019***	0.146***
			(0.007)	(0.031)
log $distance_d$	0.001	-0.011	-0.089***	-0.243***
	(0.007)	(0.038)	(0.010)	(0.049)
comlang	0.039***	0.341***	0.513***	1.787***
	(0.011)	(0.063)	(0.025)	(0.136)
border	0.001	0.297***	0.221***	0.602***
	(0.010)	(0.055)	(0.021)	(0.083)
timedi	-0.002*	0.050***	-0.057*	0.038***
	(0.001)	(0.006)	(0.029)	(0.007)
Gatt	-0.000	-0.343***	0.215***	0.304***
	(0.010)	(0.054)	(0.018)	(0.085)
$Imsh_d$	-0.054	5.053***	1.737***	7.195***
	(0.051)	(0.309)	(0.119)	(0.452)
$\hat{}_{fpd}$				3.358***
				(0.240)
Firm-product FE	Yes	Yes	Yes	Yes
Observations	22,786	22,786	183,296	183,296

Notes: Standard errors are clustered at the rm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the rm level. The coe cients on comlang, border, and Gatt are for discrete changes of dummy variables from 0 to 1. *** p<0.01, ** p<0.05, * p<0.1.