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
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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 of consumption behaviors is crucial in accounting for cross-country variations in exports at the firm-product level. Compared to the trade literature, my model unifies the predictions of non-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 differentiated 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 differentiated 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 firm exports and income level, as shown in the empirical analysis in this paper, suggests differing consumption patterns across countries and necessitates a unified framework to study consumers' preferences for quality and variety.

My model differs 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 fixed investments in research and development. As such, firms' choices of output quality are independent of destination market size. In Antoniades (2015), a larger market size leads firms to upgrade quality since the average costs of producing quality decline as firms scale up, which provides a supply side explanation of market size effect on product quality. By assuming quasi-linear preferences, the income effect 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 profitable for firms to produce and sell higher quality goods in rich countries. In other words, firms producing high-quality goods have higher market shares because of consumers' tastes for quality, rather than because of lower costs of quality production. The firm selection resulting from the model is a pure demand side explanation.

This paper documents stylized facts on differential 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 find a positive relationship between export price and consumer income, especially for products of high quality. Controlling for aggregate income, consumers in a rich country (high income per capita) not only pay more for, but also demand more high-quality goods. However, GDP per capita has a negative effect on sales of low-quality goods, which is mainly driven by the decline in quantity demanded. The empirical evidence shows that, in addition to the market size effect, GDP per capita plays a separate role in shaping cross-country variations in exports of products at different quality levels.

Specifically, I conduct an empirical analysis by using disaggregate Chinese custom data in the Household Audio & Video Equipment industry in 2005. The processing firms in this industry are chosen as the sample for three main reasons. First, the Household Audio & Video Equipment industry is a typical Chinese manufacturing sector which relies heavily on imports of sophisticated intermediate inputs from a limited number of developed countries and exports to a wide set of destinations around the world after processing and assembly. This ensures enough within firm-product variations in exports and also allows me to infer product quality from the sources and prices of the imported inputs that a firm employs. Second, the products in this industry are quality differentiated, supported by the empirical evidence that more productive firms produce high-quality goods and charge higher fob export prices. Third, processing firms in this industry choose to upgrade quality via importing better intermediate inputs, rather than via undertaking fixed investment in product designs and innovations. There is no evidence showing that large scale firms produce high-quality goods. Instead, firms that export to rich countries tend to produce high-quality products, implying that firms' quality choices are demand-driven. These three characteristics together fit the industry well in the model set-up and facilitate my empirical study.

Guided by the model's predictions, I further investigate within-firm-product variation in exports across destinations. Taking advantage of highly concentrated origins of inputs in the sample, I construct a quality index based on the import price ranking of an input originating from a certain country. I then calculate the average ranking of multiple inputs within firms, weighted by import value and source country's export unit value index. According to the quality index, I categorize exporting products into five quality groups, and then test the differential impacts of income per capita on export sales of goods in different quality groups across countries. Given that only a subset of firms export to a particular destination, the disaggregate data contain many non-random zero export values. Thus, the standard OLS estimates may be biased by firm selection to exporting. To address this problem, I adapt the two stage estimation procedure proposed in Helpman et al. (2008), with a lagged participation index as the exclusion restriction. The results show that, conditional on entry, individual low-quality exporters make fewer export sales in richer countries when controlling for market size, gravity variables, and other destination characteristics. In contrast, the relationship between high-quality export value and the destination's GDP per capita exhibits an inverted-U shape, which is consistent with the taste for quality mechanism discussed in the theoretical model. The nonlinear relationship is generated from the fact that consumers prefer quality upgrading over more varieties in low and middle income countries while variety effect dominates in rich countries.

I carry out robustness checks in five aspects. An alternative explanation of the cross-country variations in prices and sales is that firms export different quality versions of a product to rich and poor countries. In order to rule out within firm-product quality differentiation, I restrict the data sample to the firms that import an input from a single source country. The results remain robust and consistent, suggesting that the identified per-capita income effects stem from consumers' tastes, rather than the production side. The second robustness check concerns the estimation approach. I run censored Tobit regressions, an alternative way to control for selection, by picking the minimum export value among Chinese firm exports as the censoring point for each destination-product, as in Eaton and Kortum (2001). The results are consistent with the two stage estimation. I also check that the results are robust to alternative measures of product quality, and can be generalized to other years (e.g. 2006) and to other industries (e.g. Women's, Misses', and Juniors' Outerwear industry, SIC 233).

My paper contributes to a growing literature on the relationship between quality and trade. It rationalizes and documents the differential impacts of a destination's GDP per capita on exports of high- and low-quality goods at the firm-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 offsetting amount such that higher quality firms sell more. At the firm level, Manova and Zhang (2012) establishes the fact that across destinations within a firm-product, firms set higher prices in richer and larger countries. Verhoogen (2008) and Kugler and Verhoogen (2012) find 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 firm-product level differs by product quality, which, to my best knowledge, has not been examined in the literature. The observed decline in exports of low-quality goods with destination's GDP per capita implies that the negative income effect on quantity outweighs the positive effect on price.

This paper also adds to the literature on the quality evaluation mechanism. Verhoogen (2008), Fajgelbaum et al. (2011), and Handbury (2014) incorporate a positive correlation between consumers willingness to pay for quality and income into utility functions. Consistent with these studies and inspired by the urban economics literature, I interpret consumers' quality of life as a reflection of their preferences for product quality in terms of both willingness-to-pay and quantity demanded. This is because people living in a rich country have a higher standard of living, and consider product quality as a more important determining factor of consumption decisions than product price. Moreover, the increase of taste for quality with income per capita is not sufficient to characterize the model equilibrium. The effects depend on the elasticity of taste for quality with respect to income. Consequently, the cross-country differences in income elasticity of taste for quality account for within firm-product variations in exports across countries.

The results presented in this paper suggest the need to tread carefully when attempting to infer quality by using information on prices and quantities sold in a market. The market share approach of estimating product quality (Khandelwal, 2010) is widely used in the trade literature. It argues that controlling for price, the product that has a larger market share is of higher quality. This approach fails to take into account that rich and poor consumers possess different quality valuations and therefore would like to pay for and demand high-quality goods in different manners. As a result, the market share approach would overestimate the degree of quality differentiation in a low-income country and underestimate it in a high-income country.

The remainder of the paper is organized as follows. Section 2 presents empirical evidence on the differential impacts of income per capita on export prices and sales of products by quality. Section 3 describes the theoretical model in a closed economy and discuss the role of tastes for quality in determining market equilibrium. Section 4 extends the model to an open economy setting and derives the implications on firm-product export sales across countries that can be empirically tested. The empirical analysis is given in Section 5. Section 6 provides robustness check. Section 7 concludes.

2 Empirical Evidence

This section aims to show the empirical evidence on differential impacts of income per capita on export prices and values by quality at the HS 8-digit level. I find that high-quality products are sold at higher prices in richer countries, which is consistent with the results in Manova and Zhang (2012) and Simonovska (2015), and there are no significant effects of income per capita on prices of low-quality products. The export quantities and values of high-quality products increase with importing country's GDP per capita, controlling for market size, distance, and other gravity variables, and a strong positive change in income effect takes place at lower levels of GDP per capita and tails off at high GDPs per capita. However, low-quality goods sell less and make less sales in richer countries. This differential patterns emphasize the roles of GDP per capita in shaping consumers' tastes for quality and product exports across countries.

2.1 Data

My main data source is the Chinese Custom database which reports the free-on-board value of firm exports and imports in U.S. dollars at the 8-digit HS level. The data also record the quantity traded, the type of shipment, and the destination/origin of each transaction. Unit price is calculated as the ratio of value to quantity based on yearly frequency data. According to the types of trade regimes, Chinese Custom Office classifies trade into 19 categories in which ordinary and processing using imported inputs regimes account for the two largest proportions. The data on GDP and GDP per capita across countries come from the Penn World Tables (version 6.2). I obtain the country level export and import unit value index from WITS.

2.2 The Household Audio & Video Equipment Industry

In order to investigate variations in export prices and revenues across destinations within a product, I choose the data on processing firms in the industry of Household Audio & Video Equipment (SIC 365) in 2005 for study for essentially three reasons. First, the prices and the sources of the intermediate inputs employed by the processing firms in the industry are a reasonable proxy for output quality. The Household Audio & Video Equipment industry is a typical Chinese manufacturing industry which imports intermediate inputs from a limited number of developed countries but exports to a wide set of destinations worldwide. Processing exporters obtain sophisticated intermediate inputs from abroad under zero import tariffs and export final goods after processing the inputs locally. The cheaper access to high-quality foreign intermediate inputs promises processing firms a success in the international market compared to ordinary exporters. Moreover, since processing firms are not allowed to sell their products in the domestic market, the imported inputs are only used in the production of goods for foreign markets. For these reasons, the quality of imported inputs plays an essential role in determining export quality. In the spirit of Manova and Zhang (2012), Kugler and Verhoogen (2012), and Bastos et. al (2014), I construct quality index for exports according to the prices of imported inputs that the producers use. In the Household

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:

$$\log p_{fpd} = \beta_0 + \beta_1 \log revenue_{fp} + \delta_{pd} + \varepsilon_{fpd}, \tag{1}$$

where p_{fpd} represents the export price of product p charged by firm f in destination d. $revenue_{fp}$ denotes firm f's worldwide export sales of product p, which captures firm's ability of producing and selling product p. δ_{pd}, product-destination fixed effects, are used to control for product specific features of the importing country that affect all firms selling there, such as market size, per-capita income, legal institutions, and exchange rates. Error terms ε_{fpd} are clustered at product-country level. Table 2 column (1) presents robust evidence on a positive and significant correlation between price and revenue at firm-product level. Firms earning more from selling a product tend to charge higher prices for the product in a given market. Similarly, the results of the firm-level regression is given in Table 2 column (2). Firm's average export price in a destination weighted by sales of products it sells is positively correlated with its worldwide revenues. All in all, large firms produce high-quality products and sell them at higher prices across markets.

Third, processing firms in the Household Audio & Video Equipment industry improve quality through using better imported inputs, rather than through doing fixed investments. In other words, there is no evidence suggesting scales of economy in quality production. Thanks to the duty free treatment, it is a less costly and time saving way for processing firms to source better key parts and intermediate inputs from abroad in order to cater rich consumers' picky tastes for quality. This is thought of as an important feature in the theoretical model in characterizing impacts of per-capita income on consumers' tastes and on market outcomes, since it rules out alternative explanations from the supply side. A larger market size does not induce firms to improve product quality. Instead, the level of per-capita GDP in the destination country and firms' own productivities are positively related to export quality. Empirical evidence in this regard will be given in the next section after quality index is defined.

2.3 Quality index

I adopt a new method to construct firm level quality index. Different from the common way of inferring product quality from weighted average prices of imported inputs across source countries, I exploit the information on the rankings of import prices of a given input from a certain source country and calculate the average rankings of the inputs weighted by import value and export unit value index of the source country. Directly comparing prices of imported inputs across countries cannot generate solid inferences about input quality, because it ignores some factors, such as exchange rates and trade costs, that also affect the prices firms pay for imported inputs but are unrelated to input quality, which makes prices of inputs originating from different countries incomparable.

Taking advantage of highly concentrated origins of inputs in the sample, I first calculate the average import prices by origin-product and compare the price of each transaction to the average. The difference generates a certain reference value. The higher the price is above the average, a larger value is assigned, indicating a higher quality level of the input among the same type of inputs imported from the same origin. Since firms import multiple inputs, I then calculate the weighted average quality reference value at the firm level, called quality index, by incorporating two more factors. One is the value share of each input in a firm's total imports which captures the importance of the input in firm's production. The other is the source country's export unit value index, as it generally represents a country's manufacturing productivity. In particular, the firm level quality index is constructed as follows:

$$qualityindex_f = \sum_m Ref_{mo} * imsh_m * EI_o,$$

where f, m, o stand for firm, intermediate input, and origin. Ref_{mo} is the assigned reference value according to price ranking at the origin-product level, $imsh_m$ is the share of input m in a firm's import value, and EI_o is the unit value index of exports of origin country o. If a firm has a large expenditure share on the inputs which originates from a country with high export price and possess 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:

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

where $wgdp_f = \frac{\Sigma_d revenue_{fd} GDP_d}{\Sigma_d revenue_{fd}}$ and $wgdppc_f = \frac{\Sigma_d revenue_{fd} GDPpc_d}{\Sigma_d revenue_{fd}}$ are export sales weighted average GDP and GDP per capita over destinations the firm exports to, and $revenue_f$ denotes firm level total export revenues. The results are reported in Table 3. In Column (1), the dependent variable is quality index constructed above. The coefficient on weighted GDP per capita is positive and statistically significant, suggesting that firms those sell to rich countries produce high-quality products on average, conditional on firm size and destination market sizes. However, the coefficients on weighted GDP and firm revenue are both insignificant. The results support the argument that product quality of processing firms is essentially determined by the income levels, rather than the market sizes, of the countries they serve. In column (2), I use weighted prices of imported inputs as the dependent variable for further check. The results confirm the positive and significant correlation between per-capita income and product quality, and even show a negative sign to the weighted GDP term. Thus, all else equal, market size is not a determinant of firm choices of product quality, which in turn implies that the main means of upgrading quality of processing firms is employing better intermediate inputs.

2.4 Effects of income per capita on export prices and sales across countries within product

I equally divide the products in the sample into five groups according to quality index, with group 1 as the lowest quality group and group 5 as the highest quality group. Since the data do not allow me to distinguish the use of inputs for different outputs within a firm, the most disaggregate level I can calculate quality index for is at the firm level. In the sample, a processing firm focuses on producing few types of products. The average number of products that each firm produces is about 3, which mitigates the seriousness of treating all products produced by a firm as of the same quality level.

Similarly, destination countries are also cut into five groups by GDP per capita, and country group 1 contains the poorest countries and country group 5 includes the richest ones. In order to investigate the potential differential impacts of income per capita on export price by quality, I run the following specification:

$$\log y_{fpd} = \beta_0 + \beta_{GDP} \log GDP_d + \sum_l \sum_k \beta_{kl} Q_l \times D_k + \beta_g X_d + \beta_{im} Imsh_d + \delta_p + \varepsilon_{fpd}, \qquad (3)$$

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. δ_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 effect gets larger as importing country's GDP per capita rises.

The differential 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, income effects on export values decrease with GDP per capita within the two lowest quality categories (groups 1 and 2) and increase within the high-quality categories (groups 3, 4, and 5). The decline is due to the fact that low-quality products are demanded less in rich countries and firms cannot charge higher prices. The rising income effects for high-quality goods can be explained by the higher prices charged and larger quantities sold (except group 5) in rich countries. Moreover, within each relatively high quality group, there is a strong change in income effect at lower levels of GDP per capita and not much improvement at higher GDP per capita.

3 The Model: a closed economy

3.1 Consumers

I first consider a closed economy in which L identical consumers have preferences over varieties of a good. Consumers are also workers, and each supplies one unit of labor and is paid by identical wage. The utility function follows Simonovska (2015) in featuring non-homothetic preferences, but deviates from it by introducing endogenous product quality. In particular, varieties enter in a consumer's utility function as follows:

$$U^c = \int_{\varphi \in \Omega} \log \left[z\left(\varphi\right) q^c\left(\varphi\right) + \bar{q}\left(w\right) \right] d\varphi, \tag{4}$$

where $z(\varphi)$ and $q^c(\varphi)$ are the quality and individual consumption of variety φ. Ω denotes the endogenous subset of varieties which are actually consumed. As in Verhoogen (2008) and Brambilla and Porto (2016), the parameter $\bar{q}(w)$ captures quality evaluation. Consumers in rich countries value product quality more than those in poor countries. Thus, $\bar{q}$ is increasing in income w. An alternative interpretation of $\bar{q}(w)$ is that it represents the provision of public goods per person that consumers would enjoy with no private consumption, and Deacon (2009) records that public goods provision is strongly and positively related to per-capita income. [2]

Given the utility function in (4), the marginal utility of variety φ increases in its quality level $z(\varphi)$ and decreases in quantity consumed $q^c(\varphi)$ and consumer's taste for quality $\bar{q}(w)$. Not only the product intrinsic characteristics but consumer's subjective tastes for quality determine consumption decisions. Also, individual quality-adjusted consumption of varieties and public goods are assumed to be substitutes in (4), which is consistent with the studies on the interaction between provision of public goods and individual private consumption. This is an appropriate assumption given that the model aims to investigate the impacts of per-capita income on product quality choice, rather than to evaluate the effectiveness of fiscal policies. A fast and convenient public transportation system provides consumers easier access to places where they intend to go, which in turn substitutes away

[2] Detailed discussion on quality of life, public goods, and income per capita can be found in Appendix A1.

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 φ can be derived as[3]:

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

where $p(\varphi)$ and $\tilde{p}(\varphi) = \frac{p(\varphi)}{z(\varphi)}$ stand for price and quality-adjusted price of variety φ, N is the number of varieties actually consumed, and w is each consumer's income. $\bar{\tilde{p}}$ 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

$$\bar{\tilde{p}} = \frac{P}{N}, \quad where\ P = \int_{\varphi \in \Omega} \frac{p(\varphi)}{z(\varphi)} d\varphi. \tag{6}$$

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

$$\tilde{p}(\varphi) < \tilde{p}_{max} = \frac{w + \bar{q}P}{N\bar{q}}. \tag{7}$$

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:

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

where $\bar{q}'(w)$ refers to the first derivative of $\bar{q}(w)$ 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 $\bar{q}$ positively and elastically correlated with income, rich consumers demand more (less) than poorer consumers for varieties of below (above) average quality-adjusted prices. As will be shown in the firm section, high-quality goods are characterized by low quality-adjusted prices.

[3] See Appendix A2 for derivation.

[4] This case is in accordance with several urban economics papers, like Brueckner, Thisse, and Zenou (1999), which argue that the marginal valuation of urban amenities rises sharply with income.

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:

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

The sign and the magnitude of income elasticity of demand depends on a variety's quality-adjusted price as well as income elasticity of tastes for quality. When $\varepsilon_t(w) > 1(< 1)$, income elasticities of demand are greater than 1 (between 0 and 1) for the varieties with below-average quality adjusted prices (as shown in the next section, theses varieties are of higher qualities and produced by more productive firms), are between 0 and 1 (greater than 1) for the varieties with above average quality-adjusted prices but not close to the choke one, and are smaller than 0 (greater than 1) for the varieties close to the choke quality-adjusted price. The results are summarized as below.

$$\kappa_{iw}(\varphi)\begin{cases} > 1\,(< 1) & if\;\tilde{p}(\varphi) < \bar{\tilde{p}}, \\ [0,1]\,(> 1) & if\;\bar{\tilde{p}} \leqslant \tilde{p}(\varphi) \leqslant \bar{\tilde{p}} + \left(N\bar{q}'(w)\right)^{-1}, \\ < 0\,(> 1) & if\;\bar{\tilde{p}} + \left(N\bar{q}'(w)\right)^{-1} < \tilde{p}(\varphi) < \tilde{p}_{max}. \end{cases}$$

In the case of elastic taste for quality, income growth induces consumers to demand disproportionately more high-quality varieties (low quality-adjusted price), to purchase more relatively low-quality varieties in a less proportionate amount, and to drop the low end varieties out of their consumption bundles. In the opposite case where consumers' tastes for quality is inelastic to income, individuals consume a broader set of varieties and the demand for low price varieties increases more in percentage than high price ones as individual income goes up. Hence, income elasticity of demand depends on not only variety's price and quality, but also on consumers' tastes for quality.

Another possible channel through which national income rises is population growth. The demand function shifts upwards in the same proportion for all types of varieties under an increase in L. The income elasticity of demand driven by population growth is equal to 1 and independent of

[5] See Appendix A3 for discussions on two sepecific function forms of tastes for quality.

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. $G(\varphi) = 1 - \left(\frac{\varphi}{\varphi_0}\right)^{-\gamma}$, where $\varphi \geqslant \varphi_0$. 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.

To characterize the production of product quality, I assume a complementary relationship between productivity and input quality such that

$$z(\varphi)^{\theta} = \frac{1}{2}\varphi^{b\theta} + \frac{1}{2}c(\varphi)^{2\theta}, \tag{10}$$

where $z(\varphi)$ and $c(\varphi)$ denote the endogenous output and input quality of a firm with productivity φ respectively, the parameter $\theta < 0$ captures the degree of complementarity between productivity and input quality, and the parameter $b > 0$ represents the scope for quality differentiation. The larger b is, the more incentives firms have to upgrade quality.

Final good producers are assumed to be price takers in the intermediate input markets, and face the same price schedule $p_I(c)$. Since there is a continuum of entrants operating in the market and consumers' utility is assumed to be additive, each firm is assumed to be small relative to the economy as a whole and hence takes aggregate price index as given. In the final product sector, firms produce and sell differentiated varieties under monopolistic competition and maximize their profits by choosing price and input quality simultaneously. The profit optimization problem is described as

$$\pi(\varphi) = \max_{p,c}\left[p(\varphi) - \frac{p_I(c)}{\varphi}\right]q(\varphi). \tag{11}$$

The first order conditions give the optimal solutions to price and input quality. Using (10), output quality is uniquely determined.

3.3 Market Equilibrium

Following models characterized by heterogeneous firms and variable elasticity of substitution preferences, all equilibrium expressions can be written in terms of a firm's productivity and the competition environment which is reflected in the market productivity threshold. Therefore, in order to pin down firms' performances and market outcomes in equilibrium, the first step is to solve for the productivity threshold under which a firm would exit. Formally, it is defined by

$$\varphi^* = \sup_{\varphi \geqslant \varphi_0}\{\pi(\varphi) = 0\}.$$

A firm with the productivity draw φ^* faces zero market demand and the price it charges barely covers variable cost. Plugging the demand equation (5) into the maximized profit function (11) yields the expression for the productivity cutoff[6]:

$$\varphi^* = \left(\frac{w}{a}\frac{N\bar{q}}{w + \bar{q}P}\right)^{\frac{2}{b+2}}. \tag{12}$$

The cutoff measures the degree of difficulty of entering the market. The higher the cutoff is, the more difficult for entrants to survive. φ^* increases in per-capita income w and number of varieties

[6]See detailed derivations in Appendix A4.

N, but decreases in the aggregate quality-adjusted price statistic P. Intuitively, firm 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 first order conditions derived from (11), firm φ's market performances can be written as

$$c(\varphi) = \varphi^{\frac{b}{2}}, \tag{13}$$

$$z(\varphi) = \varphi^{b}, \tag{14}$$

$$p(\varphi) = \frac{w}{a}\varphi^{\frac{b-2}{2}}\left(\frac{\varphi}{\varphi^*}\right)^{\frac{b+2}{4}}, \tag{15}$$

$$\tilde{p}(\varphi) = \frac{p(\varphi)}{z(\varphi)} = \frac{w}{a}(\varphi\varphi^*)^{-\frac{b+2}{4}}, \tag{16}$$

$$q(\varphi) = \bar{q}(w)\,L\varphi^{-b}\left[\left(\frac{\varphi}{\varphi^*}\right)^{\frac{b+2}{4}} - 1\right], \tag{17}$$

$$r(\varphi) = p(\varphi)\,q(\varphi) = \frac{w}{a}\bar{q}(w)\,L(\varphi^*)^{-\frac{b+2}{4}}\left[(\varphi^*)^{-\frac{b+2}{4}} - \varphi^{-\frac{b+2}{4}}\right], \tag{18}$$

$$\pi(\varphi) = \frac{w}{a}\bar{q}(w)\,L\left[(\varphi^*)^{-\frac{b+2}{4}} - \varphi^{-\frac{b+2}{4}}\right]^2. \tag{19}$$

Equation (14) indicates that the optimal quality level is positively associated with the physical productivity of the firm and the scope for quality upgrading. In the price equation (15), the value of parameter b determines how marginal cost varies with productivity. While higher productivity directly drives down the marginal cost of production, higher productivity also induces firms to upgrade quality and pay for more expensive intermediate inputs. The overall effect of productivity on marginal costs depends on the strength of incentives to upgrade quality which is captured by b. In accordance to recent trade papers that uncover the fact that quality raises marginal costs in differentiated good sectors, I assume a firm's marginal production cost is strictly increasing in its productivity by imposing a lower bound on the scope of quality differentiation such that $b > 2$. As shown in the above equations (13) to (19), when serving a given market, firms endowed with higher productivities employ better quality inputs by paying higher marginal costs, produce better quality outputs, charge higher markups, sell their products at lower quality-adjusted prices, and, as a result, earn more revenues and profits.

In the price equation (15), firm φ's markup is negatively correlated with the productivity cutoff. As φ^* rises, producers of the lowest quality goods run out of business and the competition among remaining firms gets intensified. As a consequence, firms lose part of market power and decrease 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.

The free entry condition states that firms' expected profit covers the fixed entry cost they pay before their productivity draws. I assume each firm has to pay f_e units of effective labor to be entitled to enter. The free entry condition equates expected profit with entry cost:

$$\bar{\pi} = [1 - G(\varphi^*)] \int_{\varphi^*}^{\infty} \pi(\varphi) \mu(\varphi) d\varphi = \frac{w}{a} f_e, \tag{20}$$

where $\mu(\varphi)$ denotes the conditional density of firms operating in the economy

$$\mu(\varphi) = \begin{cases} \frac{g(\varphi)}{1-G(\varphi^*)} & if\ \varphi \geqslant \varphi^*, \\ 0 & otherwise. \end{cases}$$

Furthermore, consumers must run income balance in equilibrium, implying that total labor income equals total expenditure over differentiated varieties:

$$wL = N \int_{\varphi^*}^{\infty} r(\varphi) \mu(\varphi) d\varphi. \tag{21}$$

It is assumed that there are J potential entrants who pay entry costs, but only a subset of them N firms stay in the market after revealing productivity draws. Thus, the relationship between J and N can be described as

$$N = J [1 - G(\varphi^*)]. \tag{22}$$

The last condition aims to have labor market clear. The labor demand-equal-supply condition is given by

$$L = J\frac{f_e}{a} + N \int_{\varphi^*}^{\infty} \frac{q(\varphi)}{\varphi} \frac{c(\varphi)}{a} \mu(\varphi) d\varphi. \tag{23}$$

In a closed economy, I normalize the efficiency adjusted wage rate to be 1 for simplicity, that is $\frac{w}{a} = 1$. [7] Combining equations (15) to (23) yields explicit solutions to productivity threshold, number of active firms (varieties), and number of entrants[8]:

[7] In the following open economy section, I will show the restriction sufficing to build up a relationship between wage and labor efficiency.

[8] See Appendix A5 for detailed derivations.

$$\varphi^* = \left(\frac{D\bar{q}L}{f_e}\right)^{\frac{2}{2\gamma+b+2}}, \tag{24}$$

$$N = \frac{4\gamma+b+2}{b+2}\frac{w}{\bar{q}}\left(\varphi^*\right)^{\frac{b+2}{2}}, \tag{25}$$

$$J = \frac{b+2}{2\gamma+b+2}\frac{aL}{f_e}, \tag{26}$$

where $D = \frac{\varphi_0^{\gamma}(b+2)^2}{(4\gamma+b+2)(2\gamma+b+2)}$ is an expression composed of model parameters. In equilibrium, the productivity threshold is determined by population size, quality taste, and entry cost. A population growth is followed by an increase in the productivity cutoff, since more labor for production triggers the entry of new firms, which intensifies competition. Per capita income positively affects the cutoff through consumers' tastes for product quality. In a rich country where technology level and wage rate are high, consumers value not only the quantity but also the quality of the varieties they consume. Only high-quality products which are produced by more productive firms can survive in the market. Thus, a positive shock on consumers' tastes for quality drives up the productivity cutoff. Furthermore, fixed entry cost and the threshold move in opposite directions. A large entry cost serves as a big barrier to new entrants, which to some extent protects the least productive firms who are operating in the market from competition.

The positive relationship between population size and number of varieties can be seen by combining equations (24) and (25). A more intensified competition pushes the least productive firms out of market and encourages more productive firms to enter. However, it is not straightforward to conclude the effect of per-capita income on number of varieties, since the effects of income per capita on the ratio $\frac{w}{\bar{q}}$ and the productivity threshold φ^* act in the opposite directions, as shown in (25). The overall effect remains ambiguous. The detailed discussion on the role of income per capita in determining market equilibrium is given in the next section. Lastly, number of entrants rises with the supply of effective labor and declines with fixed entry cost. The more effective labor supplied and the less firms have to pay to enter, the more entrants would come into the market.

3.4 Effects of income per capita

To highlight a separate role of income per capita, aside from the aggregate income effect, in determining market outcomes, I compare the equilibira of a set of closed economies with equal market size, but differing in population sizes and incomes per capita. In a standard model with homothetic preferences, these economies are predicted equivalent. But non-homothetic preferences combined with variable taste for quality account for mixed impacts of income per capita on market equilibrium.

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:

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

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 $\bar{q} (w)$, $\varepsilon_t (w)$ could vary with the level of income per capita in two different ways:

$$\begin{cases} \frac{\partial \varepsilon_t(w)}{\partial w} \leqslant 0 & if\ \bar{q}'' \leqslant \frac{\bar{q}'}{w\bar{q}} (w\bar{q}' - \bar{q}), \\ \frac{\partial \varepsilon_t(w)}{\partial w} > 0 & otherwise. \end{cases}$$

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 $\bar{q} (w)$ 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 share to each of the varieties. As such, productivity threshold decreases as a result.

The value of elasticity of taste for quality captures consumers' preference over quality versus variety. When it is greater than 1, consumers tend to hold a stronger preference on quality than on variety, and income growth has a positive effect on the average quality of varieties they consume but a negative effect on number of varieties. When the elasticity of taste is smaller than 1, consumers care more about variety than quality, with more varieties coming into the consumption set following an income increase. In other words, firm selection caused by an increase in per-capita income is closely related to the sensitivity of consumers' tastes for quality in response to income growth.

3.4.2 Number of varieties

A great number of varieties being produced and consumed is considered as one of the welfare gains from trade. Thus, carefully evaluating the effects of income per capita on number of varieties is of great interest. Holding market size constant, taking derivate of equation (25) with respect to per-capita income gives:

$$\frac{\partial N}{\partial w} = \frac{2\gamma\left(b+2+4\gamma\right)}{\bar{q}\left(b+2\right)\left(b+2+2\gamma\right)}\left(\varphi^{*}\right)^{\frac{b+2}{2}}\left[1-\varepsilon_{t}\left(w\right)\right].$$

In contrast to productivity threshold, number of varieties decreases in income per capita under elastic taste for quality and increases under inelastic taste for quality, implying a U shape relationship between number of varieties and income per capita. Combing with the results on firm selection, there exists a quality-variety trade off caused by income growth. When consumers' pickiness for product quality is responsive to changes in income at lower income levels, the firm selection becomes strict and the productivity of the marginal surviving firm rises. In the meantime, the number of varieties gets lower in a low income economy as the most productive firms expand market shares and push out low-quality firms. The opposite case applies to rich countries where the average product quality is already high and consumers hold strong and inelastic preference for quality. A further increase in income in such economies leads taste for quality to change less, and the expenditure on above-average quality products would not change much. As a result, more firms which produce differentiated varieties start to enter and the market productivity cutoff goes down.

3.4.3 Market shares

Will high-quality products obtain more market shares when the economy gets richer and consumers value quality more? To address this question, I first write out the expression for variety φ's revenue in equilibrium using equations (18) and (24):

$$r\left(\varphi\right) = \frac{\bar{q}\left(w\right)}{w}\left(\varphi^{*}\right)^{-\frac{b+2}{4}}\left[\left(\varphi^{*}\right)^{-\frac{b+2}{4}} - \varphi^{-\frac{b+2}{4}}\right]. \tag{28}$$

Since the economies under consideration are assumed to be of equal market size, changes in firm's revenues also represents changes in market shares. The impact of per-capita income on firms' market shares is mixed under elastic taste for quality ($\varepsilon_t\left(w\right) > 1$). There are two opposing forces that take into effect simultaneously as income per capita rises. On the one hand, a higher level of income leads to a stronger preference for quality which turns to shift up the revenue curve, which is reflected by an increase in $\frac{\bar{q}(w)}{w}$ in equation (28). This effect serves as a positive and direct driving force. On the other hand, per-capita income influences market share through productivity cutoff. An economy with a high income per capita is characterized by a high cutoff, a low quality-adjusted price index and a intense competition environment, which drives down individual firms' market shares. This effect is a negative and indirect way that income per capita changes firms' market shares. Thus, the overall effect depends on which side dominates.

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), $\frac{\bar{q}(w)}{w}$ 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

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

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

the income effect can be decomposed into taste for quality effect and competition effect. The signs of the two effects run opposite and are both determined by income elasticity of taste for quality. Consistent with intuition, an elastic consumer taste gives rise to a positive taste for quality effect and a negative competition effect as per-capita income rises and market size is kept constant, while an inelastic taste leads to a negative taste for quality effect and a positive competition effect. In terms of magnitudes, all else equal, high-quality producers (more productive firms) are affected more by both types of effects than low-quality producers (less productive firms) supplying in the same market. For individual firms, the necessary and sufficient condition for the sign of the overall marginal effect of income per capita on market share can be expressed as

(i) $\quad elastic\,taste\,for\,quality\;(\varepsilon_t > 1,\; w < w^*)$

$$\frac{\partial s(\varphi)}{\partial w}\begin{cases} \geqslant 0 & if\;\varphi \geqslant K\varphi^*, \\ < 0 & if\;\varphi < K\varphi^*; \end{cases}$$

(ii) $\quad inelastic\,taste\,for\,quality\;(\varepsilon_t < 1,\; w > w^*)$

$$\frac{\partial s(\varphi)}{\partial w}\begin{cases} < 0 & if\;\varphi \geqslant K\varphi^*, \\ \geqslant 0 & if\;\varphi < K\varphi^*; \end{cases}$$

where $s(\varphi)$ stands for market share of firm φ and $K = \left(1 + \frac{b+2}{4\gamma}\right)^{\frac{4}{b+2}}$. Among poor countries where consumers' preferences for product quality are sensitive to income levels, only better quality goods are selected to survive and market competition gets intensified as a technological advance brings an increase in per capita income. Consequently, each productive firm obtains a larger market share, while the size of a less productive firm shrinks. Different from poor consumers, rich consumers do not alter their tastes for product quality much when their incomes change, therefore, instead of dropping low priced varieties, income growth among rich countries allows for entry of less productive firms 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 $K\varphi^*$, 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 effect and a negative competition effect. Given that consumers' preferences for quality are dramatically enhanced by income growth in low income economies, the positive taste effect on individual high-quality variety outweighs that on the price index. As a result, the firm'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 effect on individual demand and a positive effect of competition, with a stronger taste effect leading to a decrease in firm's sales.

However, the sales of a low-quality producer respond differently 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 effect dominates the positive taste for quality effect for low-quality varieties, which results in a decline in firm'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 firm start to market more revenues as consumers' individual incomes rise if it could successfully survive in the rich markets.

In sum, taste for quality effect and competition effect jointly determine how income per capita impacts market shares of individual varieties, and both effects are quality- and income per capita specific. 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 first 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 first and up afterwards as income per capita rises.

3.4.4 Elasticity of substitution

As an inverse measure of the degree of differentiation across varieties, elasticity of substitution serves an important factor in firms' pricing decisions and sales. The lower the elasticity of substitution, the more market power, and the higher mark-ups firms charge and the more revenues earned. The analysis on income effect 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 firm model, the elasticity of substitution varies across varieties. In this section, I first 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-φ firms is

$$\sigma(\varphi) = 1 + \frac{\bar{q}(w)}{\tilde{q}(\varphi)}, \tag{29}$$

where $\tilde{q}(\varphi) = z(\varphi) q(\varphi)$ represents the quality-adjusted output of variety φ. The elasticity of substitution between type-φ 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 strictly increasing in productivity, all else equal, the elasticity of substitution decreases in φ. The high-quality varieties produced by more productive firms are being considered less substitutable than low-quality varieties, which accounts for that more productive firms charge higher markups on their products. The second determinant of elasticity of substitution is income varying tastes for quality. Rich consumers tend to be pickier on product quality than poor consumers, in the sense that a stronger taste for quality raises the substitutability between varieties.

Income per capita affects the elasticity of substitution between type-φ varieties through two channels. On the one hand, a higher per-capita income leads to a pickier taste for quality, which raises elasticity of substitution. On the other hand, income growth gives rise to differential impacts on per variety quality-adjusted consumption of products at different quality levels. The quality-adjusted consumption of high-quality goods would increase if the elasticity of taste for quality is greater than 1, while the quality-adjusted consumption of low-quality goods would increase if the elasticity of taste is smaller than 1. As a result, the combining effect of income per capita on elasticity of substitution can be stated as

$$\frac{\partial \sigma(\varphi)}{\partial w} \begin{cases} \leqslant 0 & if\ \varphi \leqslant M\varphi^* \ and\ \varepsilon_t < 1 \\ > 0 & otherwise \end{cases},$$

where $M = \left[\frac{2(b+2+2\gamma)}{(b+2)\varepsilon_t + (b+2+4\gamma)}\right]^{\frac{4}{b+2}}$. When consumers hold elastic tastes for quality, $\bar{q}(w)$ plays a dominant role and hence all varieties would end up with higher elasticities of substitution in an economy with a higher income per capita. Regardless of quality levels, varieties are being perceived as less differentiated and market competition gets intensified. Also, the positive effect of income per capita is relatively weak on high-quality varieties compared to on low-quality varieties, as shown by:

$$\frac{\partial^2 \sigma(\varphi)}{\partial w \partial \varphi} < 0.$$

When taste for quality is inelastic to income changes, income growth does a favor to the pricing and consumption of less productive firms which makes it easier for them to survive, since it drives down the elasticity of substitution between the newly entered varieties. In this case, the increase 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

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

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 $\bar{q}\left(w\right) = \alpha w$, where α 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

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

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

$$\varphi_{ij}^* = \sup_{\varphi \geqslant \varphi_0} \{\pi_{ij}(\varphi) = 0\}.$$

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

$$\varphi_{ij}^{*}=\left(\frac{\tau w_i}{a_i}\frac{N_j\bar{q}_j}{w_j+\bar{q}_jP_j}\right)^{\frac{2}{b+2}}. \tag{31}$$

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

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

$$q_{ij}\left(\varphi\right)=\bar{q}_jL_j\varphi^{-b}\left[\left(\frac{\varphi}{\varphi_{ij}^{*}}\right)^{\frac{b+2}{4}}-1\right], \tag{33}$$

$$\pi_{ij}\left(\varphi\right)=\frac{\tau w_i}{a_i}\bar{q}_jL_j\left[\left(\varphi_{ij}^{*}\right)^{-\frac{b+2}{4}}-\varphi^{-\frac{b+2}{4}}\right]^2. \tag{34}$$

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

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

Free entry drives firms' expected profits down to zero. That is, the sum of the expected profits from sales in the domestic and the foreign markets is equal to fixed entry costs:

$$\left[1-G\left(\varphi_{jj}^{*}\right)\right]\int_{\varphi_{jj}^{*}}^{\infty}\pi_{jj}\left(\varphi\right)\mu\left(\varphi\right)d\varphi+\left[1-G\left(\varphi_{ji}^{*}\right)\right]\int_{\varphi_{ji}^{*}}^{\infty}\pi_{ji}\left(\varphi\right)\mu\left(\varphi\right)d\varphi=\frac{w_j}{a_j}f_e. \tag{36}$$

Income balance conditions suggest that consumers' total income barely covers their expenditure on differentiated varieties that are produced at home and abroad:

$$w_jL_j=N_{jj}\int_{\varphi_{jj}^{*}}^{\infty}r_{jj}\left(\varphi\right)\mu\left(\varphi\right)d\varphi+N_{ij}\int_{\varphi_{ij}^{*}}^{\infty}r_{ij}\left(\varphi\right)\mu\left(\varphi\right)d\varphi. \tag{37}$$

Lastly, labor market clears. The labor demanded for productions of intermediate inputs and final products is equal to labor endowment in that economy:

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

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

$$\varphi_{jj}^* = \left\{ \frac{L_j \bar{q}_j D \left(1 - \tau^{-\frac{4\gamma}{b+2}}\right)}{f_e \left[1 - \tau^{-\frac{2\gamma}{b+2}} \left(\frac{w_j a_i}{w_i a_j}\right)^{-1-\frac{2\gamma}{b+2}}\right]} \right\}^{\frac{2}{2\gamma+b+2}}, \tag{39}$$

$$\varphi_{ij}^* = \left(\frac{\tau w_i a_j}{w_j a_i}\right)^{\frac{2}{b+2}} \varphi_{jj}^*, \tag{40}$$

where $D = \frac{\varphi_0^{\gamma}(b+2)^2}{(4\gamma+b+2)(2\gamma+b+2)}$, 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 efficiency-adjusted income per capita of the two trading countries. It turns to be $\varphi_{jj}^* \geqslant \varphi^*$, where φ^* denotes the threshold in the closed economy, if and only if the home country's efficiency adjusted income per capita relative to its trade partner is lower such that $\frac{w_j a_i}{w_i a_j} \leqslant \tau^{\frac{2\gamma}{2\gamma+b+2}}$. Intuitively, if home country has the cost advantage in producing intermediate inputs and final products, exporters from foreign country find 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 firms have to exit.

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

$$N_j = \frac{4\gamma + b + 2}{b+2} \frac{a_j}{\bar{q}_j} \left(\varphi_{jj}^*\right)^{\frac{b+2}{2}}, \tag{41}$$

$$J_j = \frac{b+2}{2\gamma + b + 2} \frac{a_j L_j}{f_e}. \tag{42}$$

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 $\bar{q}_j$, suggesting an ambiguous effect 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 and decreases in fixed entry cost .

To insulate the separate role of income per capita from the one it plays in market size, I consider the equilibrium in which two trading countries have equal effective labor supply $a_i L_i = a_j L_j$ but differ in population $L_i < L_j$ and technology $a_i > a_j$. Following this assumption, I have:

$$J_i = J_j \qquad and \qquad \frac{w_i}{a_i} = \frac{w_j}{a_j}.$$

If two countries are endowed with the same amount of effective labor, they also share the same number of potential entrants and the same efficiency-adjusted income per capita. Accordingly, the solution to productivity thresholds in equations (39) and (40) boil down to

$$\varphi_{jj}^* = \left[\frac{L_j \bar{q}_j D}{f_e}\left(1 + \tau^{-\frac{2\gamma}{b+2}}\right)\right]^{\frac{2}{2\gamma+b+2}}, \tag{43}$$

$$\varphi_{ij}^* = \tau^{\frac{2}{b+2}} \varphi_{jj}^*. \tag{44}$$

The market specific productivity threshold of exporting reflects the degree of difficulty for foreign producers to enter. Firms from country$i$ are more likely to export to j if variable trade costs are small and the domestic productivity cutoff is low. Income per capita affects the thresholds through tastes for quality in the same way as in the autarky case. Conditional on market size, the productivity cutoffs increase in income per capita if the income elasticity of taste for quality is greater than 1, and decrease in income per capita if the income elasticity of taste for quality is smaller than 1.

Consider two destination countries with equal market size, under income elastic(inelastic) preference for quality, the one with a higher per-capita income ends up with greater(lower) productivity thresholds. Therefore, the average quality of products consumed in the rich country is higher(lower) than that in the poor country, while there are fewer(more) varieties sold in the rich than in the poor country. Since the assumption of equal labor supply rules out the cost variations across countries, the differences in market outcomes in equilibrium is explained by the demand side. It is consumers' taste for quality, which varies with per-capita income, that selects better quality varieties (or a wider range of varieties) into the rich country. Variations in threshold across destination markets generate variations in the number of exporting firms, the average quality of exports, and the price index.

4.4 Firm sales

Export sales of a firm with productivity φ originating from country i and selling in country j is

$$r_{ij}(\varphi) = \frac{\tau w_i}{a_i} L_j \bar{q}_j \left(\varphi_{ij}^*\right)^{-\frac{b+2}{4}} \left[\left(\varphi_{ij}^*\right)^{-\frac{b+2}{4}} - \varphi^{-\frac{b+2}{4}}\right]. \tag{45}$$

As shown in the above expression, a firm's export sales in country j are jointly determined by population size, tastes for quality, and the productivity of survival in the destination country. More revenues would be earned if the destination market is characterized by a large population size, a strong preference for quality, and a low productivity threshold of exporting. Consumer's preference for quality changes with income per capita, so does the productivity threshold. The overall effect 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

$$\frac{\partial r_{ij}(\varphi)}{\partial w_j} = \frac{2\gamma}{2\gamma + b + 2} \frac{\tau w_i}{a_i} \frac{\bar{q}_j}{w_j^2} (\varphi^*)^{-\frac{b+2}{2}} [\varepsilon_t(w_j) - 1] \left[1 - \left(1 + \frac{b+2}{4\gamma}\right) \left(\frac{\varphi_{ij}^*}{\varphi}\right)^{\frac{b+2}{4}}\right].$$

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 per capita spend more of their incomes on better quality varieties and drop low end varieties. As a result, a higher income per capita allows a high-quality exporter to expand its sales and obtain a larger market share due to consumers' enhanced tastes for quality, while a low-quality exporter makes shrinking revenues or even be pushed out of the market. Moreover, the market share shift from low- to high-quality goods drives down the quality-adjusted price index, and therefore intensifies market competition. In this case, trade improves welfare mainly by improving the average quality of products consumers purchase.

When it comes to developed countries, where consumers already keep a strong taste for quality and tend not to alter their tastes much as income increases, a higher income per capita induces consumers to broaden their consumption sets. As more differentiated varieties enter, the market share of each variety declines. In the meantime, the quality-adjusted price index goes up and the existing firms therefore charge higher markups. The gains from trade in this cases is mainly through a greater number of varieties.

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:

$$\begin{aligned}\log x_{fpd} = \beta_0 + \beta_1 \log GDP_d + \beta_2 \log GDPpc_d + \sum_l \zeta_l \log GDPpc_d * Q_l \\ + \beta_3 \log GDPpc_d^2 + \sum_l \gamma_l \log GDPpc_d^2 * Q_l + \beta_4 X_d + \beta_5 Imsh_d + \delta_{fp} + \varepsilon_{fpd}.\end{aligned} \tag{46}$$

As in section 2, products are divided into five groups according to quality. Q_l is a quality dummy which equals 1 if product p produced by firm f belongs to quality category l and equals 0 otherwise, where $l \in \{1, 2, 3, 4\}$. The quality dummy enters interacted with destination's GDP per capita, which allows for testing differential impacts of per-capita income by quality. A polynomial in log of GDP per capita as well as its interaction with quality dummies are also added into the regression as so to examine if there are non-monotonic relationships between income per capita and exports of high- and low-quality products. Considering the potential collinearity between $\log GDPpc_d$ and $\log GDPpc_d^2$, I run a regression of $\log GDPpc_d^2$ on $\log GDPpc_d$, $\log GDP_d$, and gravity controls X_d, and save the residuals for $\log GDPpc_d^2$ in estimating specification (46). I incorporate firm-product fixed effects so that the identification stems from variations of export sales across countries within a firm and a product. Standard errors are clustered at the firm product level, and the results remain robust when clustering at other different levels. $Imsh_d$ 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.

In specification (46), β_1 captures market size effect and is expected to be positive, since a bigger market raises the sales of all firms selling there in a proportional way. With an interaction term of per-capita income and quality dummy, β_2 reflects the impact of per-capita income on export revenues of low-quality products. The theoretical model predicts that rich consumers hold stronger preferences over quality and spend less of their incomes on low end products. Therefore, I expect β_2 to be negative. ζ_l should be positive as it reflects a positive role of per-capita income in shaping consumers' tastes for product quality as well as sales of high-quality products in rich countries. The significance of β_3 and γ_l would indicate non-linear relationships between income and export values for products in each quality group, and their magnitudes describe the curvatures of the relationships. The model predicts high-quality varieties to expand their export sales as income per capita rises at lower levels and shrink at higher levels, and the lower the quality is, the faster its sales would drop in richer countries. Hence, β_3 is expected to be negative and γ_l to be positive. Lastly, rich countries import more expensive goods and may switch their preferences away from Chinese exports, which in turn affects export sales of Chinese products at all quality levels. Hence, I expect β_5 to be positive in the sense that firms make more sales in the country where Chinese 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:

$$\Pr\left(T_{fpd}=1\right)=\Pr\left(\log x_{fpd}>0\right)=\mathbf{\Phi}\left(\delta_{fp}+\eta_{\mathbf{d}}Z_d+\eta_{LT}LT_{fpd}\right), \tag{47}$$

where T_{fpd} is a binary variable that takes the value one when the firm-product makes positive sales in destination d, δ_{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 μ_{fpd}, running the Probit at the firm-product-destination level yields the estimated inverse Mills ratio $\hat{\lambda}_{fpd}$.

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

$$\boldsymbol{E}\left[x_{fpd} \mid T_{fpd}=1\right] = \delta_{fp} + \beta_{\mathbf{d}} Z_d + \boldsymbol{E}\left[\varepsilon_{fpd} \mid \mu_{fpd} > -\left(\delta_{fp} + \eta_{\mathbf{d}} Z_d + \eta_{LT} LT_{fpd}\right)\right]$$
$$= \delta_{fp} + \beta_{\mathbf{d}} Z_d + \rho \hat{\lambda}_{fpd}.$$

The selection bias arises from the non-zero correlation between the error terms ε_{fpd} and μ_{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 $\hat{\lambda}_{fpd}$ as an additional regressor:

$$\log x_{fpd} = \beta_0 + \beta_{\mathbf{d}} Z_d + \rho \hat{\lambda}_{fpd} + \delta_{fp} + \varepsilon_{fpd}, \tag{48}$$

where coefficient ρ 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), $\hat{\lambda}_{fpd}$ controls for firm-product selection to exporting, and the estimates of $\beta_{\mathbf{d}}$ 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 ($\hat{\lambda}_{fpd}$) 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, $\hat{\lambda}_{fpd}$ and Z_d in the export value equation would be less correlated, facilitating identification and reducing multicollinearity among regressors as well as the correlation between error terms. I incorporate lagged participation in product exporting (LT_{fpd}) in the Probit as the exclusion restriction. The firms that successfully developed trading relations to a destination in the previous year have lower fixed exporting costs this year compared to new exporters. Hence, lagged participation is a proxy for firm current exporting fixed costs, which increases the probability of entering a foreign market but does not directly affect the levels of exports.

5.2.1 Results

Table 5 reports the results of standard OLS estimations of specification (46) with standard errors clustered at the firm-product level. Without differentiating products by quality, as shown in column (3), the regression successfully identifies a positive and significant effect of market size (log GDP) at the 1% significance level, while the coefficient on log GDP per capita is insignificant. In column (6), the inclusion of the interaction term of quality dummies and log of GDP per capita reveals the differential effects of income per capita on export sales of high- and low-quality products. Controlling for market size and other related variables, 1% increase in GDP per capita of importing country reduces a low-quality product's sales by 24.1% on average and raises the sales of a high-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 $\hat{\lambda}_{fpd}$ 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 β_2 and β_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. ζ_l are positive and their magnitudes exceed the absolute value of β_2 and increase with quality levels. γ_l are also positive and roughly increase with quality, but they are smaller than the absolute value of β_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 over a wider range of income levels and decrease at a slower rate in very rich countries. Consumers' income inelastic tastes for quality and the corresponding intensified market competition gives rise to a drop in individual export sales in countries at higher income levels. Moreover, the estimates of β_5 are positive and statistically significant in both the trade participation equation and the export value equation. This implies that if Chinese exports are popular in a country in the sense that the share of Chinese products in its total imports is relatively large, individual firm-products are more 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 inverse Mills ratio from the first stage as an additional regressor. As can be seen in column (4), high-quality products tend to make more sales in richer countries and low-quality products have shrinking export values when selling to countries with higher GDP per capita. In particular, all else equal, 1% higher GDP per capita is associated with a 20.7% less export sales of low-quality firm-products and a 10.7% more export sales of high-quality firm-products.

6.2 Censored Tobit Regression

An alternative way to deal with selection bias is running censored Tobit regressions. Given that the trade data contain many zeros and the minimum export revenue from selling a product in a country is strictly positive, the maximum likelihood estimate of the censoring point of exports can be obtained from the value of minimum destination exports in the data, as Eaton and Kortum (2001) suggests. The model presented in Eaton and Kortum (2001) builds on fixed export costs that could be covered by more productive producers, whereas the firm selection to exporting in my model is through market competition. However, fixed exporting costs are non-negligible in reality and the censoring method helps to check the robustness of the results obtained from the two stage estimation. I pool the HS8 level export data on all Chinese exporters, including both ordinary and processing firms, in the Household Audio & Video Equipment industry, and pick the minimum export value as the censoring point for each destination-product. The corresponding estimates indicate the effects of market characteristics on export sales of the firm-products that are actually active in the foreign markets.

The results for Tobit regressions can be found in Table 5 column (4) and in Table 6 columns (5) and (6). They are consistent with the results from two stage correction approach. the estimates indicate a positive effect of GDP on firm-product export sales as well as a negative effect of GDP per capita on sales of low-quality products and a positive effect on sales of high-quality products. Holding other variables constant, within a low-quality firm-product, 1% increase of the importing country's GDP per capita leads to a 20.8% drop in export values. On the other hand, within a high-quality firm-product, 1% increase of the importing country's GDP per capita is associated with a 18.5% increase of export values from that destination country. Thus, categorizing products by quality is essential to disentangle the differential impacts of per-capita income on export sales across markets at the firm-product level. In column (6), the regression incorporates a polynomial in GDP per capita and its interaction with high quality dummy. The non-monotonicity of income impact on high-quality product sales is significant at the 5% significance level, with exports going up first and down afterwards as GDP per capita rises. Also, the negative coefficient on the GDP per capita squared suggests that export values of low end products decrease with GDP per capita at a faster rate.

6.3 Alternative quality indexes

In the main regression, I construct quality index based on the import price ranking of inputs in the same HS6 product category. The method takes advantage of the concentration of source countries that firms import inputs from in the Household Audio & Video Equipment industry. To make sure the results are not sensitive to quality index, I adapt Manova and Yu (2012)'s approach to calculate firm'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 five quality groups according to firm 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 first 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 point. The Tobit estimates in column (6) provide similar evidence.

6.4 Other year

To check if the above results are specific to year 2005, I examine the relationship between exports and destination characteristics at the firm-product level by using Chinese custom data on the Household Audio and Video Equipment industry in 2006. The estimation procedure is exactly the same as stated in the previous section. Table 10 reports the results. The export pattern is consistent with that in 2005. Column (1) shows a significant and positive effect of GDP per capita on fob export price regardless of product quality. In column (2), the OLS estimates suggest that a 1% higher GDP per capita reduces export value of low-quality product by 15.4% and raises export value of products in quality groups 1 to 4 by 11.4%, 18.8%, 15.8%, and 6.4% respectively. The two stage estimate of the coefficient on GDP per capita is negative and statistically significant, as shown in column (4), implying that, controlling for selection, low-quality products make less sales in richer countries. As for high-quality products (in quality groups 1 to 4), their export values increases and then decreases in destination country's GDP per capita. A higher income level first raises individual sales of high-quality firm-products due to the associated change of consumers' tastes for quality and then drives it down due to more intensified competition. Also, the coefficient on $Imsh_d$ is positive, meaning that all else equal firm makes more export sales in countries where Chinese products have a large market share in total imports of HS85 products.

6.5 Other industry

The data used in the main regression focus on the Household Audio and Video Equipment industry. It remains unknown whether the above export pattern could be applied to other industries. As a robustness check, I use the data on the Women's, Misses', and Juniors' Outerwear industry (SIC

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 coefficient on $\log GDPpc_d$ is positive and statistically significant, but the coefficients on interactions of $\log GDPpc_d$ and quality dummies are insignificant, suggesting that GDP per capita has a positive effect 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 coefficients on $\log GDPpc_d$ and its second order are both significant. A higher income level first encourages product entry but turns to make it harder as market competition gets more intensified. After controlling for selection to exporting, the impacts of GDP per capita on active exporters differ 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 unified framework to account for the variety-quality tradeoff on exports across countries driven by income effect on tastes for quality. Aside from aggregate income, per capita income plays a separate role in shaping market demand in a quality differentiated sector. In equilibrium, income elasticity of taste for quality determines the effects of income per-capita on firm selection and market shares, since it reflects consumers' relative preferences for quality versus variety.

Consider two importing countries with equal market size but differing in income per capita. When consumers' tastes for quality are income elastic, the richer country tends to select better quality goods into the market and has a higher productivity threshold for firm survival. The much stronger preference for quality of consumers in the rich country induces high-quality producers to expand their market shares and low-quality producers to shrink. As a result, low end varieties are dropped off and the average quality of consumption goods is improved, as consumer expenditure gets more concentrated on high-quality varieties. In contrast, when consumers' tastes for quality are inelastic to income, rich consumers turn to prefer a broader set of varieties compared to poor consumers, which results in a loose firm selection and entry of less productive firms. Consequently, 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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Appendix: Theoretical Part

A1. Quality of life, public goods, and income per capita

Quality of life embraces multiple dimensions of human experience that affect well being. Much of urban economics literature examines the relationship between economic growth and quality of life, where GDP per capita is taken as a summary index of the level of economic development. Cross sectional studies show successfully causal relations from economic growth to quality of life, although it has been found mixed changes in quality of life based on time series evidence[9]. Supported by empirical results, I assume a positive relationship between quality of life $\bar{q}$ and per-capita income w, that is $\frac{d\bar{q}}{dw} > 0$. Consumers living in a rich country, on average, lead a life of better quality overall, since they are provided with more and better public goods and service, which are non-rival and non-excludable and consumers do not have to pay for[10][11].

Given the substantial differences across countries in the provision of public goods and service, ignoring the impacts of quality of life on consumers' utility would be an important omission. Since a comfortable and convenient living environment is attractive to workers, countries would be much better off redirecting their economic development efforts to improving amenities such as schools, transportation, and cultural venues. Thus, in the spirit of Albouy et al (2013) , in addition to quantity, quality, and number of varieties, I assume quality of life also raises a consumer's utility in a direct way. Consumers who keep a high standard of living are more likely to have a favorable taste for product quality. As shown below, income-related $\bar{q}$ also represents consumers' taste for product quality and plays an essential role in explaining the differential consumption patterns of consumers with different levels of income.

A2. Demand Function

A consumer's utility maximization problem can be stated as follows:

$$\max U^c = \int_{\varphi\in\Omega} \log\left[z\left(\varphi\right) q^c\left(\varphi\right) + \bar{q}\right] d\varphi$$

$$s.t. \quad \int_{\varphi\in\Omega} p\left(\varphi\right) q^c\left(\varphi\right) d\varphi \leqslant w.$$

Given income and prices of varieties, a consumer chooses $q^c\left(\varphi\right)$ to maximize utility. The first order conditions yield:

[9] See more details in Easterly (1999).

[10] Taxes system is assumed away in this model. Empirical studies point out that individual wellbeing is significantly enhanced in rich countries where consumers pay more taxes out of their income. Hence, taking taxes into account does not contradict the arguments stated in this paper.

[11] An alternative interpretation of $\bar{q}\left(w\right)$ in the utiltiy function is that it represents the individual consumption of outside goods which is excluded from the model but positively correlated with income.

$$\frac{z(\varphi)}{z(\varphi)\, q^c(\varphi) + \bar{q}} = \lambda p(\varphi),$$

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

$$p(\varphi)\, q^c(\varphi) + \frac{p(\varphi)}{z(\varphi)}\bar{q} = p(\varphi')\, q^c(\varphi') + \frac{p(\varphi')}{z(\varphi')}\bar{q}.$$

By summing over all varieties φ' that a consumer actually consume, I have

$$N\left[p(\varphi)\, q^c(\varphi) + \frac{p(\varphi)}{z(\varphi)}\bar{q}\right] = w + \bar{q}P,$$

where

$$P = \int_{\varphi' \in \Omega} \frac{p(\varphi')}{z(\varphi')} d\varphi \quad and \quad w = \int_{\varphi' \in \Omega} p(\varphi')\, q^c(\varphi')\, d\varphi.$$

Thus, the individual demand for variety φ can be derived as

$$q^c(\varphi) = \frac{1}{p(\varphi)}\left[\frac{w}{N} + \bar{q}\left(\frac{P}{N} - \frac{p(\varphi)}{z(\varphi)}\right)\right].$$

By the definition of quality adjusted price, the demand equation can be rewritten as

$$q^c(\varphi) = \frac{1}{p(\varphi)}\left[\frac{w}{N} + \bar{q}\left(\bar{\tilde{p}} - \tilde{p}(\varphi)\right)\right].$$

Therefore, the total demand for variety φ in an economy endowed with L identical consumers is

$$q(\varphi) = \frac{L}{p(\varphi)}\left[\frac{w}{N} + \bar{q}\left(\bar{\tilde{p}} - \tilde{p}(\varphi)\right)\right].$$

A3. Examples of taste for quality as a function of income

The function of $\bar{q}(w)$ is assumed to be general so far, and there are a wide range of functions which allows $\bar{q}$ and w positively correlated. Here I list two specific function forms of $\bar{q}(w)$ which satisfy the positive correlation assumption and are supported by empirical evidence. The first stems from a strand of literature which documents positive and diminishing impacts of GDP per capita on well-being in cross-sectional analysis.[12]Related studies establish a clear positive link between average levels of well-being and GDP per capita across countries, and find evidence of a satiation point beyond which wealthier countries have insignificant further increases in well-being. Hence, it

[12]Layard et al. (2008) regress several alternative measures of well-being on log income and its square, and find the quadratic term has a negative effect. Such results are also confirmed by Akay et al. (2012) and Easterlin and Angelescu (2007).

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

$$\bar{q}(w) = \eta \ln w,$$

where η is a positive parameter representing a positive and flexible effect 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 $\varepsilon_t(w) = (\ln w)^{-1}$, which shows a negative correlation between elasticity of taste for quality and per capita income. The value of $\varepsilon_t(w)$ ranges from positive infinity 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 fifths 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 off at high incomes. Relative income raises quality of life at variable rates in different aspects. [13] As such, I assume the following function form:

$$\bar{q}(w) = (w - \lambda)^{\alpha},$$

where λ stands for the world poverty line which is common across countries and α 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 $\bar{q}(w)$ 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 $\varepsilon_t(w) = \frac{\alpha w}{(w-\lambda)}$, where $\varepsilon_t(w) > 1$ if $w < \frac{\lambda}{(1-\alpha)}$ and $\alpha < 1$ while $\varepsilon_t(w) < 1$ otherwise.

A4. Profit Maximization and Productivity Threshold

The first order conditions derived from profit maximization problem stated in section 2.1.2 are:

$$\frac{\partial \pi(\varphi)}{\partial p(\varphi)} = q(\varphi) - L\left[p(\varphi) - \frac{cw}{a\varphi}\right]\frac{w + \bar{q}P}{N}p(\varphi)^{-2} = 0$$

$$\frac{\partial \pi(\varphi)}{\partial c(\varphi)} = L\left[p(\varphi) - \frac{cw}{a\varphi}\right]\bar{q}z(\varphi)^{-2}\frac{\partial z(\varphi)}{\partial c(\varphi)} - q(\varphi)\frac{w}{a\varphi} = 0.$$

[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 significantly.

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

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

$$p(\varphi) = \left(\frac{w}{\bar{q}}\frac{w+\bar{q}P}{N}\right)^{\frac{1}{2}} \varphi^{\frac{3b-2}{4}},$$

$$q(\varphi) = L\varphi^{-b}\left[\left(\frac{a\bar{q}}{w}\frac{w+\bar{q}P}{N}\right)^{\frac{1}{2}} \varphi^{\frac{b+2}{4}} - \bar{q}\right].$$

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

$$L\varphi^{-b}\left[\left(\frac{a\bar{q}}{w}\frac{w+\bar{q}P}{N}\right)^{\frac{1}{2}} (\varphi^{*})^{\frac{b+2}{4}} - \bar{q}\right] = 0.$$

Therefore,

$$\varphi^{*} = \left(\frac{w}{a}\frac{N\bar{q}}{w+\bar{q}P}\right)^{\frac{2}{b+2}}.$$

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:

$$P = \int_{\varphi\in\Omega} \frac{p(\varphi)}{z(\varphi)} d\varphi = \frac{4\gamma}{4\gamma+b+2}\frac{w}{a}N(\varphi^{*})^{-\frac{b+2}{2}}.$$

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

$$P = \frac{4\gamma}{b+2}\frac{w}{\bar{q}}.$$

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

$$(\varphi^{*})^{\frac{b+2}{2}} = \frac{b+2}{4\gamma+b+2}\frac{N}{a}\bar{q}.$$

Equivalently, that is

$$N = \frac{4\gamma+b+2}{b+2}\frac{a}{\bar{q}}(\varphi^{*})^{\frac{b+2}{2}}.$$

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:

$$\left(\varphi^*\right)^{\frac{2\gamma+b+2}{2}} = \frac{b+2}{4\gamma+b+2}\frac{\bar{q}}{a}\varphi_0^{\gamma}J. \tag{A.1}$$

From the free entry condition, I have

$$\left(\frac{\varphi^*}{\varphi_0}\right)^{-\gamma}\int_{\varphi^*}^{\infty}\frac{w}{a}\bar{q}L\left[\left(\varphi^*\right)^{-\frac{b+2}{4}}-\varphi^{-\frac{b+2}{4}}\right]^2\gamma\left(\varphi^*\right)^{\gamma}\varphi^{-\gamma-1}d\varphi = \frac{w}{a}f_e,$$

$$\gamma\varphi_0^{\gamma}\frac{w}{a}\bar{q}L\frac{(b+2)^2}{\gamma\left(4\gamma+b+2\right)\left(2\gamma+b+2\right)}\left(\varphi^*\right)^{-\gamma-\frac{b+2}{2}} = \frac{w}{a}f_e,$$

$$\left(\varphi^*\right)^{\frac{2\gamma+b+2}{2}} = \frac{D\bar{q}L}{f_e},\ where\ D = \frac{\varphi_0^{\gamma}\left(b+2\right)^2}{\left(4\gamma+b+2\right)\left(2\gamma+b+2\right)}.$$

Plugging 7 back to **??** yields the equilibrium number of entrants:

$$J = \frac{b+2}{2\gamma+b+2}\frac{aL}{f_e}.$$

A6. Elasticities of Substitution Between Varieties

In general, the elasticity of substitution between varieties i and j can be written as

$$\sigma_{ij} = -\frac{D_i D_j\left(q_i D_j + q_j D_i\right)}{q_i q_j\left(D_i' D_j^2 + D_j' D_i^2\right)},$$

where q_i is the consumption of variety i, $D_i = MU_{q_i}$ denotes marginal utility of consuming q_i, and D_i' stands for first derivative of marginal utility with respect to consumption.

For two varieties with the same quality level, the elasticity between them is

$$\sigma\left(\varphi\right) = 1 + \frac{\bar{q}}{\tilde{q}\left(\varphi\right)},$$

where both varieties are assumed to be produced by firms with productivity φ and $\tilde{q}\left(\varphi\right) = z\left(\varphi\right)q\left(\varphi\right)$ is the quality-adjusted consumption of each variety. Thus,

$$\frac{\partial\sigma\left(\varphi\right)}{\partial w} = \frac{b+2}{2\left(b+2+2\gamma\right)}\frac{L\bar{q}\bar{q}'}{\tilde{q}\left(\varphi\right)^2}\left(\frac{\varphi}{\varphi*}\right)^{\frac{b+2}{4}} > 0$$

and

$$\frac{\partial^2\sigma\left(\varphi\right)}{\partial w\partial\varphi} < 0.$$

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

$$\sigma_{\varphi\varphi'} = 1 + \frac{1}{2}\bar{q}\left(\frac{1}{\tilde{q}_{\varphi}} + \frac{1}{\tilde{q}_{\varphi'}}\right).$$

Accordingly,

$$\frac{\partial \sigma_{\varphi\varphi'}}{\partial w} = \frac{\bar{q}'}{2}\left\{\frac{1}{\tilde{q}_{\varphi}}\left[1 - \frac{L\bar{q}}{\tilde{q}_{\varphi}}\left(A\left(\frac{\varphi}{\varphi*}\right)^{\frac{b+2}{4}} - 1\right)\right] + \frac{1}{\tilde{q}_{\varphi'}}\left[1 - \frac{L\bar{q}}{\tilde{q}_{\varphi'}}\left(A\left(\frac{\varphi'}{\varphi*}\right)^{\frac{b+2}{4}} - 1\right)\right]\right\},$$

where $A = 1 - \frac{b+2}{2(b+2+2\gamma)}$.

Figure 1: Distribution of product quality index

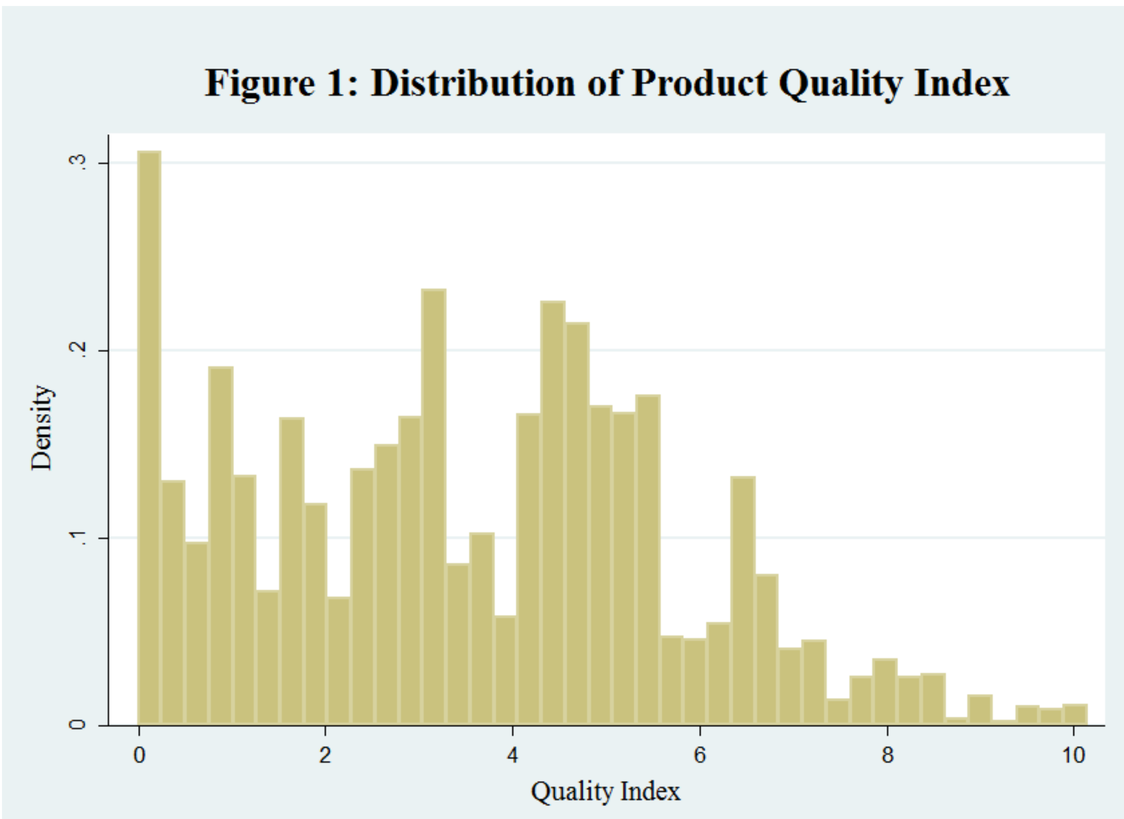

Figure 2: Effects of GDP per capita on export price by quality (HS8 level)

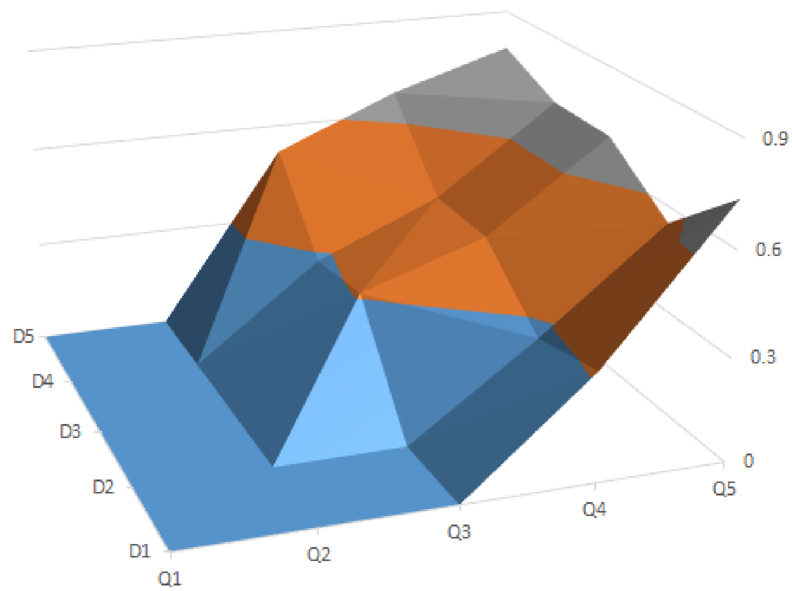

Figure 3: Effects of GDP per capita on export volume by quality (HS8 level)

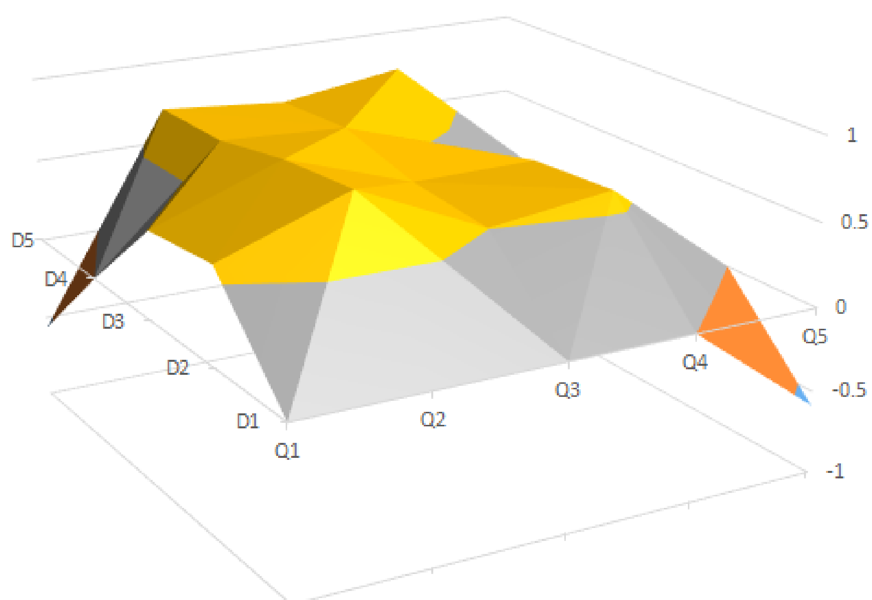

Figure 4: Effects of GDP per capita on export value by quality (HS8 level)

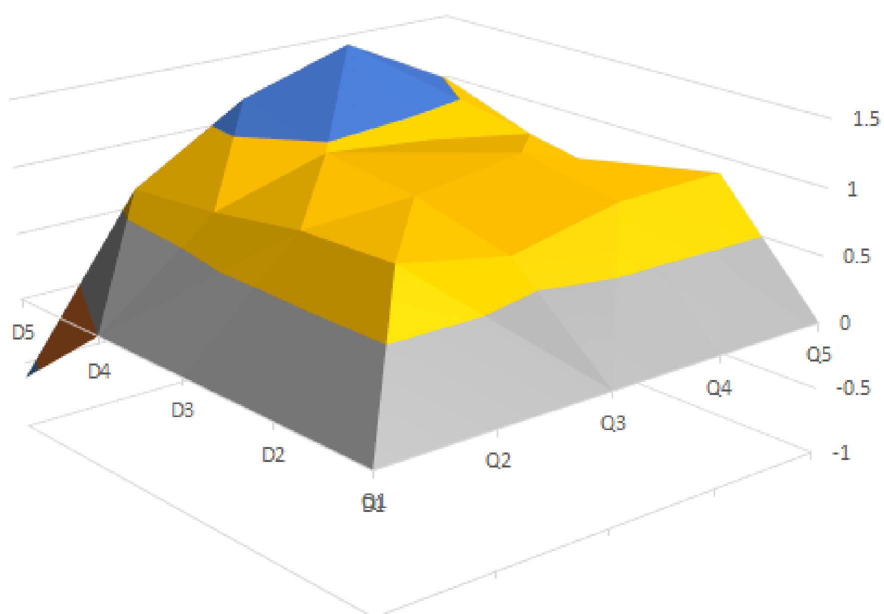

Table 1: Source countries of imported inputs

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 firms 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 2: Variations in export prices across firms

	(1) $logp_{fpd}$	(2) $logp_{fd}$
$logrevenue_{f(p)}$	0.166***	0.111***
	(0.062)	(0.034)
Product-Destination FE	Yes	
Destination FE		Yes
Observations	1,211	956
R-squared	0.797	0.107

Notes: $logp_{fd}$ are calculated as firm's average export price in a destination weighted by products' sales. Standard errors are clusted at the product-importing country level for regression (1) and are at the importing country level for regression (2). The value of standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Variations in product quality across firms

	(1) *Quality Index*	(2) *Avg Input Price* $logp_{fim}$
$logwGDPpc_f$	0.269***	0.562***
	(0.104)	(0.093)
$logwGDP_f$	0.091	-0.265***
	(0.075)	(0.057)
$logrevenue_f$	0.011	-0.074*
	(0.047)	(0.040)
Observations	956	956
R-squared	0.029	0.056

Notes: $logwGDPpc_f$ denotes sales weighted average of destination GDPs per capita at the firm level. $logwGDP_f$ denotes sales weighted average of destination GDPs at the firm level. Robust standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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_{fpd}	(4) log q_{fpd}	(5) log x_{fpd}	(6) log x_{fpd}
$Q_1 \times D_2$	-0.119	-0.155	0.576**	0.654***	0.457*	0.498**
	(0.112)	(0.138)	(0.245)	(0.253)	(0.239)	(0.244)
$Q_1 \times D_3$	-0.113	-0.040	0.526**	0.497**	0.412*	0.457**
	(0.099)	(0.123)	(0.218)	(0.225)	(0.212)	(0.217)
$Q_1 \times D_4$	-0.069	-0.029	0.408*	0.402*	0.338	0.372*
	(0.096)	(0.119)	(0.211)	(0.218)	(0.206)	(0.210)
$Q_1 \times D_5$	-0.050	-0.069	-0.564***	-0.541***	-0.614***	-0.610***
	(0.092)	(0.114)	(0.203)	(0.210)	(0.198)	(0.202)
$Q_2 \times D_1$	0.038	-0.067	0.219	0.348	0.258	0.281
	(0.122)	(0.151)	(0.268)	(0.276)	(0.261)	(0.266)
$Q_2 \times D_2$	-0.007	-0.041	0.852***	0.883***	0.845***	0.841***
	(0.108)	(0.133)	(0.237)	(0.244)	(0.231)	(0.236)
$Q_2 \times D_3$	0.011	0.097	0.808***	0.782***	0.819***	0.879***
	(0.099)	(0.122)	(0.217)	(0.224)	(0.211)	(0.216)
$Q_2 \times D_4$	-0.009	0.085	0.711***	0.659***	0.702***	0.744***
	(0.096)	(0.119)	(0.212)	(0.218)	(0.206)	(0.210)
$Q_2 \times D_5$	0.107	0.176	0.728***	0.656***	0.635***	0.633***
	(0.093)	(0.114)	(0.204)	(0.210)	(0.199)	(0.203)
$Q_3 \times D_1$	0.284**	0.074	0.033	0.251	0.318	0.325
	(0.119)	(0.146)	(0.262)	(0.269)	(0.255)	(0.260)
$Q_3 \times D_2$	0.173	0.055	0.504**	0.675***	0.678***	0.731***
	(0.111)	(0.136)	(0.244)	(0.251)	(0.237)	(0.242)
$Q_3 \times D_3$	0.311***	0.396***	0.551**	0.544**	0.863***	0.941***
	(0.101)	(0.124)	(0.221)	(0.228)	(0.216)	(0.220)
$Q_3 \times D_4$	0.281***	0.415***	0.675***	0.651***	0.956***	1.067***
	(0.098)	(0.121)	(0.216)	(0.222)	(0.210)	(0.214)
$Q_3 \times D_5$	0.516***	0.724***	0.642***	0.512**	1.158***	1.236***
	(0.093)	(0.115)	(0.205)	(0.211)	(0.200)	(0.203)
$Q_4 \times D_1$	0.316***	0.257*	0.025	0.083	0.341	0.340
	(0.116)	(0.143)	(0.255)	(0.263)	(0.249)	(0.254)
$Q_4 \times D_2$	0.264**	0.223*	0.594**	0.681***	0.859***	0.904***
	(0.108)	(0.133)	(0.237)	(0.245)	(0.231)	(0.236)
$Q_4 \times D_3$	0.435***	0.498***	0.559**	0.553**	0.994***	1.052***
	(0.099)	(0.123)	(0.219)	(0.226)	(0.213)	(0.217)
$Q_4 \times D_4$	0.439***	0.574***	0.431**	0.363*	0.870***	0.937***
	(0.097)	(0.119)	(0.213)	(0.220)	(0.207)	(0.212)
$Q_4 \times D_5$	0.670***	0.826***	0.753***	0.634***	1.424***	1.461***
	(0.093)	(0.114)	(0.204)	(0.210)	(0.199)	(0.203)

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}
$Q_5 \times D_1$	0.737***	0.666***	-0.586**	-0.504*	0.151	0.161
	(0.134)	(0.165)	(0.295)	(0.304)	(0.287)	(0.293)
$Q_5 \times D_2$	0.552***	0.641***	0.326	0.341	0.879***	0.983***
	(0.116)	(0.143)	(0.254)	(0.262)	(0.248)	(0.253)
$Q_5 \times D_3$	0.696***	0.888***	-0.110	-0.144	0.585***	0.744***
	(0.105)	(0.130)	(0.231)	(0.238)	(0.225)	(0.230)
$Q_5 \times D_4$	0.700***	0.986***	0.032	-0.034	0.732***	0.951***
	(0.101)	(0.123)	(0.219)	(0.226)	(0.214)	(0.218)
$Q_5 \times D_5$	0.783***	1.010***	0.199	0.116	0.982***	1.126***
	(0.094)	(0.115)	(0.205)	(0.211)	(0.200)	(0.204)
log GDP_d	0.002	0.026***	0.319***	0.305***	0.321***	0.331***
	(0.006)	(0.007)	(0.013)	(0.013)	(0.012)	(0.013)
$Imsh_d$	-0.041	-0.121*	3.772***	3.663***	3.813***	3.785***
	(0.058)	(0.071)	(0.292)	(0.310)	(0.324)	(0.327)
log $distance_d$	-0.010	0.006	-0.115**	-0.148***	-0.125**	-0.142***
	(0.025)	(0.031)	(0.055)	(0.057)	(0.054)	(0.055)
comlang	0.073*	-0.001	0.466***	0.458***	0.386***	0.457***
	(0.038)	(0.049)	(0.087)	(0.091)	(0.085)	(0.087)
border	0.080**	0.068	0.503***	0.484***	0.429***	0.416***
	(0.040)	(0.047)	(0.085)	(0.088)	(0.083)	(0.084)
timediff	-0.013***	-0.019***	0.070***	0.076***	0.056***	0.057***
	(0.004)	(0.005)	(0.010)	(0.011)	(0.010)	(0.010)
Gatt	-0.046	0.054	-0.017	-0.076	-0.064	-0.022
	(0.038)	(0.047)	(0.084)	(0.087)	(0.082)	(0.084)
Product FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,812	11,812	11,812	11,812	11,812	11,812
R^2	0.77	0.65	0.23	0.18	0.41	0.37

Notes: The dependent variables are: (1)(2) log fob export price, (3)(4) log quantity, and (5)(6) log export value. The product fixed effects are at the HS8 level in columns (1)(3)(5) and are at the HS6 level in columns (2)(4)(6). Standard errors are reported in parentheses and are clustered at the HS8 level in (1)(3)(5) and at the HS6 level in (2)(4)(6). Results remain robust when standard errors are clustered at the country level. The coefficients 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 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 $GDPpc_d \times Q_1$				-0.012	0.343***	0.331***
				(0.011)	(0.048)	(0.047)
log $GDPpc_d \times Q_2$				0.002	0.340***	0.342***
				(0.010)	(0.050)	(0.048)
log $GDPpc_d \times Q_3$				0.007	0.444***	0.451***
				(0.010)	(0.055)	(0.054)
log $GDPpc_d \times Q_4$				-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)
timediff	-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 firm-product-destination level. Standard errors are clustered at the firm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the firm level. The coefficients 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)
$\log GDPpc_d \times Q_1$	-0.046**	0.207***	0.197***	0.259***
	(0.020)	(0.046)	(0.045)	(0.053)
$\log GDPpc_d \times Q_2$	-0.069***	0.214***	0.219***	0.291***
	(0.020)	(0.047)	(0.046)	(0.062)
$\log GDPpc_d \times Q_3$	-0.031	0.347***	0.355***	0.363***
	(0.021)	(0.044)	(0.043)	(0.059)
$\log GDPpc_d \times Q_4$	-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)
$\log GDPpc_d^2 \times Q_1$	-0.018	0.119***	0.118***	0.101**
	(0.011)	(0.033)	(0.033)	(0.042)
$\log GDPpc_d^2 \times Q_2$	-0.001	0.149***	0.150***	0.100**
	(0.010)	(0.032)	(0.032)	(0.047)
$\log GDPpc_d^2 \times Q_3$	-0.009	0.198***	0.203***	0.112***
	(0.011)	(0.034)	(0.033)	(0.036)
$\log GDPpc_d^2 \times Q_4$	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)
timediff	-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)
$\hat{\lambda}_{fpd}$		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 firm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the firm level. The coefficients 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 differentiation within firm-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)
$logGDPpc_d * Q_H$		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)
$logGDPpc_d^2 * Q_H$			-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)
$\hat{\lambda}_{fpd}$				-0.596***		
				(0.065)		
firm-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 firm-product level, and are reported in parentheses. Results remain robust if standard erros are clustered at the importing country level. The coefficients on comlang, border, and Gatt are for discrete changes of dummy variables from 0 to 1. Column (3) reports the marginal effects 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 $GDPpc_d \times Q_1$	-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 $GDPpc_d \times Q_2$	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 $GDPpc_d \times Q_3$	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 $GDPpc_d \times Q_4$	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 $GDPpc_d^2 \times Q_1$				-0.014	0.052*	0.143***
				(0.008)	(0.030)	(0.037)
log $GDPpc_d^2 \times Q_2$				-0.047***	-0.058**	0.018
				(0.008)	(0.029)	(0.033)
log $GDPpc_d^2 \times Q_3$				-0.042***	0.023	0.121***
				(0.010)	(0.034)	(0.034)
log $GDPpc_d^2 \times Q_4$				-0.059***	-0.028	0.082**
				(0.012)	(0.041)	(0.040)

Notes: Standard errors are clustered at the firm-product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the firm level. The coefficients 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)
timediff	-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)
$\hat{\lambda}_{fpd}$					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 firm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the firm level. The coefficients 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 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)	(0.032)
log $GDPpc_d \times Q_1$	0.001	0.268***	0.144***	0.475***
	(0.011)	(0.055)	(0.016)	(0.052)
log $GDPpc_d \times Q_2$	-0.005	0.342***	0.102***	0.489***
	(0.012)	(0.053)	(0.016)	(0.049)
log $GDPpc_d \times Q_3$	0.005	0.312***	0.165***	0.537***
	(0.013)	(0.056)	(0.017)	(0.053)
log $GDPpc_d \times Q_4$	-0.019	0.218***	0.120***	0.405***
	(0.012)	(0.055)	(0.016)	(0.051)
$\log GDPpc_d{}^2$			-0.070***	-0.157***
			(0.008)	(0.031)
log $GDPpc_d^2 \times Q_1$			0.025***	0.051
			(0.010)	(0.037)
log $GDPpc_d^2 \times Q_2$			0.032***	0.052
			(0.010)	(0.037)
log $GDPpc_d^2 \times Q_3$			0.022***	0.062*
			(0.011)	(0.036)
log $GDPpc_d^2 \times Q_4$			0.034***	0.085**
			(0.011)	(0.037)
log $distance_d$	-0.007	-0.039	-0.070***	0.086*
	(0.013)	(0.049)	(0.012)	(0.052)
comlang	0.051**	0.597***	0.881***	1.983***
	(0.021)	(0.075)	(0.030)	(0.162)
border	-0.011	0.060	0.059	0.153*
	(0.019)	(0.073)	(0.056)	(0.081)
timediff	-0.001	0.062***	-0.151***	0.061***
	(0.002)	(0.008)	(0.026)	(0.008)
Gatt	0.003	0.121*	0.194***	0.191**
	(0.013)	(0.062)	(0.022)	(0.077)
$Imsh_d$	0.073	3.630***	2.266***	6.976***
	(0.067)	(0.251)	(0.096)	(0.440)
$\hat{\lambda}_{fpd}$				2.224***
				(0.217)
Firm-product FE	Yes	Yes	Yes	Yes
Observations	12,097	12,097	102,726	102,726

Notes: Standard errors are clustered at the firm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the firm level. The coefficients 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 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 $GDPpc_d \times Q_1$	-0.003	0.022	-0.032***	-0.085**
	(0.006)	(0.041)	(0.011)	(0.043)
log $GDPpc_d \times Q_2$	0.002	0.148***	-0.018	0.108**
	(0.007)	(0.041)	(0.013)	(0.045)
log $GDPpc_d \times Q_3$	-0.012	0.182***	-0.024**	0.112***
	(0.007)	(0.038)	(0.012)	(0.043)
log $GDPpc_d \times Q_4$	-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 $GDPpc_d^2 \times Q_1$			0.026***	0.112***
			(0.007)	(0.032)
log $GDPpc_d^2 \times Q_2$			0.035***	0.203***
			(0.008)	(0.033)
log $GDPpc_d^2 \times Q_3$			0.018**	0.151***
			(0.008)	(0.032)
log $GDPpc_d^2 \times Q_4$			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)
timediff	-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)
$\hat{\lambda}_{fpd}$				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 firm -product level, and are reported in parentheses. Results remain robust when standard errors are clustered at the product level and at the firm level. The coefficients 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.