Does quality differentiation matter in exporters' pricing behaviour? Comparing China and India

Sushanta Mallick
Queen Mary University of London, UK
Email: s.k.mallick@qmul.ac.uk

Helena Marques
University of the Balearic Islands, Spain
Email: helena.ferreira-marques@uib.es

ABSTRACT

The studies of exchange-rate pass-through (ERPT) at a disaggregated level rarely mention product quality as an explanatory factor of pricing strategies across products and destination markets. Failing to do this may result in underestimation of ERPT. This paper investigates the role of quality differentiation using data for China and India exports disaggregated at the 6-digit product level. The paper adopts an empirical approach that incorporates gravity model explanatory factors and allows disentangling the effect of quality on trade prices and volumes from that of other sources of price variation. After excluding short duration export spells, China's export prices denominated in foreign currency terms increase with the yuan's depreciation, implying an increase in exporters' mark-ups, but they decrease as expected in the case of India. However, mark-up increases decline with product quality and destination market income, as the elasticity of demand perceived by exporters increases. These findings remain robust to different measures of quality, samples, specifications, and to the potential endogeneity of quality.

Keywords: *exchange-rate pass-through, pricing-to-market, quality, India, China*
JEL Classifications: *F14, F41, O11*

1. Introduction

A growing body of theoretical research on international trade predicts that product quality plays an important role as a determinant of the global patterns of bilateral trade (see Hallak, 2006; Kugler and Verhoogen, 2012). In this paper we undertake an empirical analysis that integrates this type of firm heterogeneity into the pricing framework that is often used in the exchange rate pass-through literature, controlling for destination market per capita income as an indicator of external demand and gravity-related variables for bilateral flows. It is already known that rich countries tend to import relatively more from countries that produce high-quality goods (Hallak, 2006; Bastos and Silva, 2010). We test this hypothesis in the case of rapidly growing emerging economies such as China and India so as to examine their exporters' pricing strategies conditional on a measure of product quality.

The paper examines the role of quality differentiation in determining how prices of Chinese and Indian exports (bilateral product-level unit-values) respond to bilateral exchange rate fluctuations in order to infer exchange rate pass-through (ERPT) and pricing-to-market (PTM) via a pricing equation. In other words, the paper explores whether the level of ERPT changes with the quality of the product, distinguishing between mark-up and quality adjustments. While product quality is unobservable in the data, we follow an approach recently proposed by Henn *et al* (2013) to estimate it based on observed trade patterns and country attributes. As export prices with destination/source country characteristics can reveal quality heterogeneity, a residual estimate from such a standard pricing equation could be used as a measure of quality.

Besides, China's adjustable currency peg policy and India’s relatively flexible exchange rate policy provide an appropriate contrast to compare the impact of exchange rate changes on the price setting behaviour of exporters in both countries. China's central bank has been widening the yuan's trading band against the dollar – a shift that signals continued commitment to reform in the recent years. In this context, it is important to understand first, how has the pricing behaviour of Chinese and Indian exporters changed since the early 1990s? Second, how much of the currency fluctuations, has been passed on driven by mark-up adjustment based on product quality variations? These questions can be important in the context of China with a large current account surplus and also in the context of India with a large current account deficit, requiring currency adjustments in different directions leading to heterogeneous responses in exporters’ pricing behaviour with different levels of mark-up adjustment on the basis of their product quality. To the best of our knowledge, the use of product quality as a measure of exporters’ pricing power can shed new light into this literature on imperfect exchange rate pass-through (ERPT).

In this paper we provide a disaggregated analysis of the pass-through to export prices in two countries—China and India, considering the product quality variations. ERPT refers to the transmission of exchange rate changes to import or export prices of goods in the currency of the destination market. The incompleteness of ERPT occurs when the change in the price is less than the change in the exchange rate. When the currency of an exporting country, for instance, appreciates against the currency of an importing country and the exporting country absorbs part of the exchange rate change by lowering the export price denominated in the exporting currency, then ERPT is incomplete. The consumer price in the importing currency increases by less than the change in the exchange rate and the exporters absorb some of the change in the exchange rate. The incompleteness of ERPT opens up the possibility of Pricing-to-Market (PTM) behaviour, whereby ERPT varies across destination markets, depending on the exchange rate regime, trade barriers and the inflation regime. Such an analysis is typically done at the industry level in which the average price change of all firms in an industry is seen to respond to exchange rate changes. At this level, the reason for the change in the price of the product can be due to intra-industry reallocation between firms caused by changes in the trade environment.

Firm-level analysis of ERPT takes into account not only the country-specific factors but heterogeneity of firms and the type of the product as well. If exporters, for instance, do not face much competition, mark-ups may be less responsive to fluctuations in the value of the exporter's currency against the buyers. In this situation, exchange-rate changes are passed in full in terms of the buyers' currency. Conversely, if the destination market is highly competitive, firms may try to guard their market share by absorbing exchange-rate changes and accepting lower mark-ups. In this paper, we study how pass-through differs across different varieties of products in order to reflect on the pricing-to-market decision of firms, considering the quality variations at product-level in the absence of firm-level data. The pricing of the product depends on gravity variables that proxy for transport costs, on GDP per capita and product quality. The exporter's average per capita income is used as a proxy for average production costs, whilst the importer's GDP per capita is a measure of the average income level of consumers in the destination market. In both cases this variable captures time variation in the model, as opposed to gravity variables, which are time-invariant.

The main findings are that China's export prices in foreign currency terms increase in response to an exchange rate depreciation (possibly reflecting increases in markups), but decrease in India. Markup adjustments tend to be inversely related with product quality. Exporters significantly increase their markups in higher-quality products and when exporting to high income destination markets. Exporters adopting PTM strategies tend to adjust their mark-up in order to partially offset changes of the exchange rate, so as to keep the price level in the importer's currency relatively unchanged. Products with lower quality-adjusted prices may gain competitiveness and increase market shares, which could be critical in explaining ERPT. We find that quality competitiveness factors do play a role even after controlling for foreign demand conditions, size, export intensity, destination market shares and other unobservables. China's yuan export prices change more than the change in the exchange rate, such that the foreign export price increases when there is a depreciation. For India, there is foreign currency price absorption, implying incomplete ERPT, that is, the foreign export price decreases only to a fraction of the depreciation. By controlling for the per capita income of the exporting and importing country and trade costs, this paper shows that diverse strategies are utilized to price products and that ERPT should not be expected to be complete for developing countries since they are no longer assumed to be price takers in the international market.

An important variable in export pricing is the quality variations at product level. This paper presents evidence for the importance of quality in the pricing decisions of export firms. We start by using the whole sample with over 1 million observations to obtain quality estimates and then take a subsample of quality-differentiated products to look at the pricing strategies for each differentiation group using the Alessandria and Kaboski (2011) classification. In this subsample, India's pricing strategy changes according to quality variations; while China's strategy responds less with the product quality. This may be due to different product mix of the two countries or the share of the traded goods in the economy.

Section 2 discusses the literature and presents a structural-form theoretical setting following the recent advances in the quality and trade literature. Section 3 describes the empirical strategy. Section 4 presents the benchmark ERPT estimates in a panel framework. Section 5 provides several robustness checks, including the impact of several different sources of quality on pricing strategies in both countries. Section 6 concludes.

2. Theoretical background

It has been well established in the heterogeneous-firms trade literature that firms react differently to changes in market conditions.[1] This literature has found that only more productive firms export. It is possible that those firms also have higher product differentiation, and thereby firm-level pricing strategies could differ depending on the quality of their products.[2] Although the framework needs to be developed at the firm level, in the absence of consistent cross-country firm-level datasets, an alternative approach – that allows the use of product-level data whilst proxying for the unobservables – has been proposed by Helpman et al (2008). Firm heterogeneity in productivity can lead to product differentiation in quality – a phenomenon which we intend to capture using an extended version of the Melitz and Ottaviano (2008) model as exporters tend to absorb changes in exchange rate by adjusting both their markups and product quality, leading to an incomplete exchange rate pass-through.

[1] For comprehensive surveys on the exporting and investment decisions of heterogeneous firms see Helpman (2006), Greenaway and Kneller (2007), Bernard et al (2012) and Melitz and Redding (2014).

[2] The micro-foundations for the interpretation of the Melitz's (2003) model of firm heterogeneity in productivity as heterogeneity in product quality are provided in detail by Hallak (2006), Khandelwal (2010), Hallak and Schott (2011), and Feenstra and Romalis (2014), among other studies in the related literature.

On the other hand, many empirical studies have found evidence on both "self-selection into exporting" (productive firms becoming exporters) and on "learning by exporting" (exporters are able to increase their productivity) (see for example Mallick and Yang (2013)). Similar effects can be found for quality. Exporting firms tend to strive for upgrading their product quality via gaining access to foreign markets. Verhoogen (2008) finds that more productive Mexican firms export more and pay higher wages, suggesting that these firms produce higher quality for foreign markets. Higher quality standards in international markets relative to domestic markets could provide greater incentives for firms to upgrade production technologies (Verhoogen 2008).

We start from a simplified formulation following Feenstra and Romalis (2014) and related literature that also used product-level data as we do in this paper. A firm located in country x and exporting product k to country m in year t faces marginal and fixed costs in terms of domestic currency and sets prices in terms of domestic currency. The demand faced by the exporter in the overseas market is given by:

$$C_{mxkt} = \left(\frac{P^*_{mt}}{p^*_{mxkt}}\right)^{\lambda} C_{mt} \qquad [1]$$

where p^*_{mxkt} is the firm's price of its exports to the destination market given in foreign currency, P^*_{mt} is the composite price index for all foreign goods sold on the destination market, also given in foreign currency, C_{mt} is the expenditure level, or absorption, of the destination market; and with σ the mark-up, $\lambda = \sigma - 1$ is the price elasticity of external market demand, which is country-specific and a function of the exchange rate (see Corsetti and Dedola, 2005). This type of demand function is derived from the destination market's utility maximisation (see Betts and Devereux, 2000 or Helpman et al, 2008). As a result, the exporting firm gets a share of the destination market that depends on its price relative to the composite price index that includes the prices of all sellers.

The final price paid by the consumer is the price denominated in the currency of the importing country p^*_{mxkt}, for each importer m, exporter x, product k, and year t. By definition, $p^*_{mxkt} = \frac{p_{mxkt}}{e_{mxt}}$, where e_{mxt} is the bilateral exchange rate defined as the units of domestic currency per unit of foreign currency, such that an increase in the exchange rate means a depreciation. The composite price index in the foreign market can also be converted to domestic currency by the same means.

Following the formulation in Feenstra and Romalis (2014), the exporting firm's profit in terms of domestic currency is given by:

$$\pi_{mxkt} = \left(p_{mxkt} - y_{xt}\theta^{1/\delta}_{mxkt}\tau_{mxk}\right)C_{mxkt} - F_{mx} \qquad [2]$$

where $y_{xt}\theta^{1/\delta}_{mxkt}$ is the quality-adjusted labour cost at the producer's location, with $0 < \delta < 1$ a production function parameter indicating diminishing returns to quality to an extent that depends on the firm's productivity,[3] τ_{mxk} is the composite trade cost including iceberg transport cost, which depends on distance and other gravity related variables, and F_{mx} is the fixed cost of exporting, which is country-specific but not firm-specific.

Thus the profit-maximization problem faced by a firm in an imperfectly competitive industry can be derived by maximizing profit with respect to the two choice variables price p_{mxkt} and quality θ_{mxkt}. This formulation gives rise to two first order conditions with respect to price and quality, respectively. The first-order condition with respect to price can be written as:

[3] The production structure of the model is described in detail in Feenstra and Romalis (2014).

$$f'(C_{mxkt})\left(p_{mxkt} - y_{xt}\theta_{mxkt}^{1/\delta}\tau_{mxk}\right) = -C_{mxkt} \qquad [3]$$

Substituting the demand function [1] in this first order condition and assuming that the exporting firm could adjust its price at any time through mark-up adjustment, the equilibrium export price can be derived as:

$$p_{mxkt}^{*} = \frac{\lambda}{\lambda-1}\frac{y_{xt}\theta_{mxkt}^{1/\delta}\tau_{mxk}}{e_{mxt}} \qquad [4]$$

This pricing equation is a mark-up equation modified to reflect the existence of transport costs and heterogeneous product quality, where p_{mxkt}^{*} is the price in terms of the destination country's currency and e_{mxt} is the exchange rate defined as units of the exporter's currency per unit of the importer's currency. Hence, an increase in e means that the exporter's currency becomes weaker (it depreciates).

The second first-order condition with respect to quality is defined where its marginal cost equals its average cost since, as stated by Feenstra and Romalis (2014), the firm chooses quality in order to minimize its average variable cost per quality unit. Assuming increasing marginal costs of improving quality and diminishing returns to quality, this condition has a finite solution which is given by:

$$\theta_{mxkt}^{1/\delta} = \frac{\delta}{\delta-1}\frac{F_{mx}}{y_{xt}\tau_{mxk}} \qquad [5]$$

Prices, quality and volumes can be simultaneously estimated to derive consistent estimates. By introducing a measure of quality, we are able to disentangle the unobservable quality and mark-up differences that remain fixed across markets as commonly understood in the literature.

Some of the previous research used firm-level data to estimate equations (4) and (5), as has been done by Chaney (2008) for the US, Berman et al (2012) for France, Manova and Zhang (2012) for China, Chatterjee et al (2013) for Brazil, among others. However, Cadot et al (2013) make a case for the use of product-level data in the absence of firm-level data. Furthermore, Costinot et al (2011) show that firms in high routine sectors are necessarily less innovative and thus less productive due to the routine nature of the tasks they perform. Kugler and Verhoogen (2012) suggest that quality differences of both inputs and outputs play an important role in generating the price-plant size correlations, while Manova and Zhang (2012) find that more successful exporters use higher quality inputs to produce higher quality goods, and firms vary the quality of their products across destinations by using inputs of different quality levels.

Hallak and Sivadasan (2013) developed a model of international trade with two dimensions of firm heterogeneity: 'process productivity' as the commonly understood standard definition of productivity, and 'product productivity' defined as firms' ability to develop high-quality products spending small fixed outlays. These two sources of productivity become evident in the case of exporters. Using manufacturing establishment data for India, the U.S., Chile, and Colombia, they show that exporters sell higher quality products, charge higher prices, pay higher input prices and higher wages, and use capital more intensively. In this paper therefore we make an assumption that both product and process innovations increase the product-quality of exports according to which firms producing high quality products could be more productive, as their ability to innovate high quality products could make them offer a more competitive price by lowering fixed costs of exporting and thereby becoming more productive.

Feenstra and Romalis (2014) find that quality-adjusted prices vary much less across countries than do unit values, emphasising the role of quality in influencing the unit values of internationally traded goods. Dinopoulos and Unel (2013) find that firms producing high-quality (high-price) products tend to export, whereas firms producing lower-quality (lower-price) products serve the domestic market. Besides, Crinò and Epifani (2012) find results suggesting that high-quality firms should concentrate their sales in high-income markets.

Nevertheless, the structural determinants of incomplete exchange-rate pass-through have also been emphasised by Goldberg and Hellerstein (2008) in order to forecast future pass-through patterns and to provide guidance regarding the specification of the appropriate reduced-form regression and more generally the measurement of pass-through. For these reasons, destination-level variables are used to identify whether destination market characteristics matter in the pricing behaviour of Chinese/Indian exporters, including bilateral distance as a measure of transport costs. Facing different demand levels in each market, the exporting firm will establish a market-varying mark-up over marginal costs. The mark-up established over destination country m partly depends on the wage level of that country (Alessandria and Kaboski, 2011) or relative wage between exporting and importing countries as opposed to absolute wage cost in the importing country. In studies on other emerging markets, Alvarez and Fuentes (2011) use the income per capita of Chile's export markets, whilst Marmolejo (2011) includes both Mexican and US wages in a model of exchange rate pass-through into Mexican import prices after the constitution of NAFTA. In the absence of wage data, using income per capita would be a good proxy to control for increasing globalisation of production activity, when a large share of international trade occurs through intra-firm transactions, leading to incomplete pass-through (see Hellerstein and Villas-Boas, 2010). Ferrantino, Feinberg and Deason (2012) have also used the per capita income of exporters to introduce vertical differentiation and the per capita income of importers to introduce pricing-to-market in a cross-section of 6-digit unit values for 2005. We will use income per capita in relative terms as data is available for the whole sample and this can also reflect external demand making it a key determinant of the extent of foreign exchange exposure in a particular market by exporters.

3. Empirical strategy

The paper uses UN Comtrade data of Chinese and Indian product-level exports by country, year and HS6 product, consisting of location- and product-specific export price data (in USD) during 1994-2007 allowing us to identify pricing strategies in traded goods at the 6-digit level. Given the global trade collapse in 2008 which has interfered with the normal trade flows, we use data up to 2007, distinguishing Chinese and Indian exports into high and low-income countries. The Appendix provides the description of the eight types of quality differentiation as well as some descriptive distribution of the data for those eight types. The pricing equation (4) and the quality equation (5), derived from profit maximization, are converted into two estimable equations by applying logarithms. However, due to the relationship between prices and quality, first it is necessary to establish an empirical strategy which takes that relationship into account.

To obtain an empirical measure of quality, previous work used to take unit values themselves as a proxy for quality (higher unit value would mean more quality). But unit values also proxy for prices, especially when using highly disaggregated data, such as the one we have here (HS6 or above). The first challenge is to take a different approach to quality following recent literature such as Feenstra and Romalis (2014), Henn et al (2013), Johnson (2012), Feinberg et al (2012), Hallak and Schott (2011), Khandelwal (2010), among others. Their approach is generally to estimate both an export and a price equation which allow modelling of demand and supply and the computation of quality estimates that go beyond prices (unit values). Of course, price (unit value), exports and quality are all endogenous, and prices and quality are determined simultaneously. This requires a two-step estimation procedure using instruments for the endogenous variables.

As Henn et al (2013) point out, most authors use US data, which is very detailed, but when estimating for developing countries researchers face important data constraints. They propose a simplification of the methodology in Hallak (2006) using data that is readily available for most developing countries. Here we extend that methodology to take into account the final price paid by the consumer, which is the price denominated in the currency of the importing country p^{*}_{mxkt}, for each importer m, exporter x, product k, and year t. Taking the log of the exchange rate definition we have:

$$ln\, p^{*}_{mxkt} = ln\, p_{mxkt} - ln\, e_{mxt} \qquad [6]$$

where an appreciation of the exporter's currency corresponds to an increase in its price denominated in the importer's currency.

The consideration of the exchange rate is important as our sample consists of countries with different currencies that may or may not invoice in the same currency (typically USD). Besides, exchange rate movements may signal changes in competitiveness and thus affect bilateral trade. Finally, our purpose is to produce estimates of ERPT net of quality effects.

Taking together the demand equation (1), the pricing equation (4), and the quality equation (5), considering that foreign demand C_{mxkt} is totally satisfied by exports X_{mxkt}, and applying logs, we obtain the following (foreign-denominated) price and export estimable equations:

$$ln\, p^{*}_{mxkt} = \alpha_0 + \alpha_1 ln\, \theta_{mxkt} + \alpha_2 ln\, y_{xt} + \alpha_3 ln\, d_{mx} + \alpha_4 ln\, e_{mxt} + FE^{p}_{mxk} + u_{mxkt} \quad [7]$$

$$ln\, X_{mxkt} = \alpha'_0 + \gamma GRAV_{mx} + \delta ln\, \theta_{mxkt} ln\, y_{mt} + FE^{x}_{mxk} + v_{mxkt} \quad [8]$$

Equation (7) stems directly from substituting $ln\, p_{mxkt}$ with its logged determinants (unobservable quality θ_{mxkt}, the exporter's per capita income y_{xt} as a proxy for production costs, the distance between exporter and importer d_{mx} as a proxy for τ_{mxk}, and an exporter-importer-product fixed effect FE^{p}_{mxk} to account for other sources of unobserved heterogeneity that may affect each bilateral export flow of each particular product).

Equation (8) is an export demand equation that will allow the computation of quality estimates. It is assumed that the demand for exports X_{mxkt} depends on the interaction between unobservable quality and the importer's per capita income y_{mt}, plus a vector of typical gravity variables $GRAV_{mx}$, and an exporter-importer-product fixed effect FE^{x}_{mxk} as before.[4] The importer's per capita income is used to proxy demand for quality and the income-dependent price elasticity of demand, since product quality has richer implications with non-homothetic preferences.

Equations (7) and (8) cannot be estimated directly because quality is unobservable. However, following a simplified approach as suggested by Henn et al (2013), it is possible to arrive at the estimation of both equations, as well as to obtain quality

[4] The vector of gravity variables includes bilateral distance, common border, common language, a measure of the internal distance of the importer based on its area, and a dummy signalling when the importer is a landlocked country. This data was extracted from Mayer and Zignago (2011). In the full dataset, the exporter-importer-product fixed effect is not collinear with the vector of gravity variables because these are all defined at the country level, whereas the fixed effect is defined at the product level. However, as we start using subsamples for common importers or common products, the gravity variables become collinear with the fixed effect. We simply drop them as the results show that, whilst the gravity variables are significant in the full dataset, they do not change the main results of the paper. Other bilateral gravity variables that facilitate or impede bilateral trade, such as free trade agreements and tariff rates, are defined at the bilateral and product level, and thus would be collinear with our fixed effect. In fact, distance is actually incorporated as a proxy for transport costs, which are also defined at the bilateral and product level (see Novy, 2013).

estimates, with few data requirements. To achieve this, rewrite equation (7) with respect to quality and substitute into equation (8) to obtain:

$$ln\, X_{mxkt} = \alpha'_0 + \alpha'_1 ln\, p^*_{mxkt}\, ln\, y_{mt} + \alpha'_2 ln\, y_{xt}\, ln\, y_{mt} + \alpha'_3 ln\, d_{mx} ln\, y_{mt} + \alpha'_4 ln\, e_{mxt} ln\, y_{mt} + \gamma GRAV_{mx} + FE^x_{mxk} + v_{mxkt} \quad [9]$$

The estimation of equation (9) through the within panel fixed effects estimator is the first step to obtain the estimated coefficients α'_1, α'_2, α'_3, and α'_4, which plugged back into equation (7) will allow the computation of quality estimates. Finally, equation (7) is estimated using a two-stage within panel fixed effects estimator where quality is instrumented by the lagged values of its time-variant determinants plus distance, which of course is time-invariant. The unbalanced panel structure of the data allows the use of up to two lags to avoid endogeneity and simultaneity.

4. Benchmark estimation results

The benchmark estimation results for the full dataset are provided in Tables 1 and 2 for the export equation and the pricing equation respectively. The exporter-importer-product fixed effects are jointly significant, thus validating the use of the fixed effects estimator.

Tables 1 and 2 here

In the export equation, the interaction coefficient of unit value and importer's income remains near (or below) the estimates of Henn et al (2013) although it is positive for China and negative for India, whereas the coefficient for the importer-exporter income interaction lies above their 0.10 estimate. The exporter's income represents production costs, which may increase due to quality upgrading (Amiti and

Khandelwal, 2013). A positive exporter's income coefficient, conditioning on the importer's income, implies that this is indeed the case. Note, however, that the income effect is lower for India than for China, implying less quality upgrading by India. Our data reveals that this seems to be the case, as will be shown later.

The distance-importer's income interaction could impact either positively or negatively on exports due to two conflicting effects. On the one hand, transport costs increase with distance; therefore higher distance would force up prices and thus drive down exports. If this price effect predominates, given market income, distance would impact negatively on exports. On the other hand, quality increases with distance as firms facing higher transport costs have an incentive to offset these higher costs by upgrading the quality of their exports. This is known as the "Washington apples" effect (Alchian and Allen, 1964), supported empirically by Hummels and Skiba (2004) and Feenstra and Romalis (2014), whereby firms export their higher quality products and the quality level of exports increases with distance. In this case, if quality upgrading is high enough, the quality-adjusted price of exports may actually decrease with distance. If this effect is strong enough, and the foreign market's preference for quality is high enough, exports could actually increase with distance. This quality-driven effect will be revealed later on, but for now Table 1 shows negative distance effects. The exchange rate variable interacted with the importer's income gives a measure of the pricing-to-market (PTM) effect on exports, assuming that the exporter's pricing strategy is dependent on both the exchange rate variations and the importer's income, which we will show to be the case. Table 1 shows that, conditioning on the importer's income, a 1% depreciation would decrease India's exports by around 0.06%, which is statistically significant but economically insignificant, whereas for China this coefficient is insignificant. The exchange rate-importer's income interaction was lagged two periods (as well as the exporter-importer income interaction), so the one-period lag of the price-importer's income interaction is already net of any price adjustment by the exporter following an exchange rate variation. Given that exchange rate pass-through (ERPT) is often incomplete in emerging markets (see, for example, Mallick and Marques, 2012), it is not surprising to see a small (although significant) price effect on exports.

China and India's pricing behaviour taking quality into account is significantly different in terms of signs and magnitudes of the coefficients (Table 2). For China, a 1% depreciation reduces the USD price of its exports in the following period by up to 2.4% of the exchange rate variation, an extent that is statistically significant but economically insignificant. The results remain qualitatively the same for India, with a 1% depreciation decreasing the USD price of exports by up to 1.5%. In both cases the results imply that exporters take advantage of the depreciation to increase their mark-ups by slightly less than the depreciation.

At the same time, export prices decrease for India (increase for China) with lagged income and the reverse is the case with the instrumented quality measure. Thus, the net effect of quality upgrading on prices is negative for China (positive for India): even though the cost of producing higher quality products may be higher, it is more than compensated by productivity gains.

The correlation between distance and export volumes is negative (Table 1) but mixed with regard to prices (negative for China and positive for India). A possible explanation for this mixed result is the quality composition of the export basket, as shown in Figure 1. Panel A shows that the unit value distribution is not significantly different for the two exporters (if anything, India's unit values could be slightly higher on average). However, Panel B shows that China's quality estimates are significantly higher. This result is in accordance with Khandelwal (2010), who found a higher quality index for China than for India. Hallak and Schott (2011) present very similar values for the two countries, whereas Feenstra and Romalis (2014) actually reverse Khandelwal (2010)'s result.

Figure 1 here

5. Robustness checks

The use of the within panel fixed effects estimator prevented the inclusion of all the gravity controls in the export equation given that the fixed effects estimator eliminates the time-invariant variables. Here these are introduced using Hausman-Taylor GLS taking quality as endogenous in the pricing equation. Most of the results do not change qualitatively and in the few cases where that happens the fixed effects estimate is to be preferred, given that in the Hausman-Taylor GLS estimation the Sargan-Hansen test rejects the validity of the overidentifying restrictions possibly indicating an inconsistent estimator.[5] Moreover, as said before, in the fixed effects estimation the exporter-importer-product fixed effects are jointly significant.

5.1. Exports to common markets and the role of market income

The importer's income level plays an important role in determining the quality of imports because it determines the consumers' preference for quality. In the data we cannot observe whether the quality level of an export flow is due to the exporter's

---

[5] Note however that in the presence of heteroscedasticity the Sargan test overrejects the null hypothesis of validity of the overidentifying restrictions. Since it was calculated over the model assuming homoscedasticity, there is no guarantee that it has not overrejected. Nevertheless, since the test statistic values are very high, rejection occurs by a large margin and the validity of the overidentifying restrictions may be questioned.

quality choice or to the importer's preference for quality. However, their matching in an export flow implies that the importer selects exporter-product pairs that match its preference for quality and exporters choose to produce products with the quality level demanded by their importers (Bastos and Silva, 2010). This suggests that the export and price equations should be run for the same export markets of China and India in order to eliminate any endogenous quality heterogeneity due to the import market's preference for quality.

The results are provided in Table 3. In the export equation (Panel A), the interaction of India's export prices and the importer's per capita income is still a significant determinant of India's export flows after taking a one year lag. In the price equation (Panel B), the pricing strategy of India is definitely that of partially increasing mark-ups, but China does not pass-through any depreciation rather it increases mark-ups by more than the depreciation. As shown in Figure 2, India still shows higher unit values and China shows higher quality estimates.

Table 3 here

Figure 2 here

Since the importer's income may determine its preference for quality, we carry out separate regressions for high and low-income markets among the common group of markets in Table 3. Those results are shown in Table 4. Panel A shows the interaction of India's export prices and the importer's per capita income remaining significant in driving India's export flows, while the interaction of exchange rate and external demand with a positive coefficient suggests that currency depreciation increases export volume for India, but in case of China this effect holds for high income countries (not exports to low income destinations). Panel B shows that China increases export prices while

Indian exporters practice incomplete ERPT in both high-income and low-income markets.

Table 4 here

Panel A in Figure 3 confirms that, although India is selling at higher prices than China, both sell at higher prices to high-income markets. Panel B shows that both exporters sell at a higher estimated quality measure to low-income markets. This finding might seem surprising at first, but as explained by Feenstra and Romalis (2014), the quality interpretation of the Melitz (2003) model implies that low-income markets are net quality importers and may import higher average quality products. This is because under this interpretation, only firms producing the highest quality enter low-income (smaller) markets, where the fixed costs of exporting are relatively more important. On the contrary, in high-income (larger) markets the fixed costs of exporting are relatively less important, so that the quality threshold required to enter is lower, and average quality is thus lower in those markets. Since high-income markets are also exporters of higher quality goods, low-income markets become net quality importers. Still, Figure 3 shows that the differences in the importer's income level do not eliminate the difference in the distribution of the estimated quality measure between China and India.

Figure 3 here

5.2. Exports to common markets and export basket composition

The preference for quality in common export markets with different income levels helps in explaining the behaviour of export flows, rather than the exporter's pricing strategies or the quality distribution of their exports. Thus we check the possible role of export basket product composition differences. To that end, we run the export and price regressions only for those HS6 products that show the maximum number of export flows (that is, occur every year of the sample) from both China and India to the same market. In this way, we eliminate as much unobserved heterogeneity as possible, comparing export flows of the same products to the same markets in the same years. Under these conditions, the pricing strategies of the two exporters should be similar. Any observed quality differences should be due to production conditions, namely differing production costs, technology and productivity levels.

Panel A of Table 5 shows that price is a significant determinant of exports in both countries conditioned on external demand. Distance has a positive effect that becomes negative when conditioning on the importer's income. Moreover, Panel B of Table 5 shows that, once only long-duration common exports are taken into account, China's pricing strategy still reflects an increase in USD prices with depreciation while India's strategy still shows a decline in USD prices following depreciation.

Table 5 here

Figure 4 shows that the highest quality products exported by China are absent from this sample because they are not exported by India, although the relative location of China and India in the unit values and estimated quality distribution remains the same even within the same HS6 products. There is evidence in the literature that China is a supplier of inputs to global supply chains, which is not the case for India (Amiti and Freund, 2010; Hanson, 2012; Harrigan and Deng, 2010; Hsieh and Klenow, 2009). The Comtrade data used here reveals that the products with highest estimated quality (those exported by China but not by India) belong to the Machinery & Electrical (362 HS6 products) and Transport Equipment (85 HS6 products) groups, which is consistent with the literature's conclusion that China's integration in global supply chains fostered quality upgrading. On the contrary, India is not benefitting from that effect and is exporting products with higher quality-adjusted price, which hampers its competitiveness and forces the absorption of most of exchange rate variations by exporters, whilst China amplifies those variations by increasing mark-ups above exchange rate changes.

Figure 4 here

5.3. The role of quality differentiation in pricing strategies

It was seen that the pricing strategies of China vary with the quality level of the products exported. The highest quality level cannot be compared between China and India because India does not export any product at the highest quality levels in the dataset we use. In Tables 1 and 2 we had over 800,000 observations, out of which around 60% referred to the same importers for our two exporters, China and India, and around 25% referred to the same importers and HS6 products. Hence there is substantial variation in the importers and products for the two exporters. However, around 90,000 observations in our dataset can be classified according to the type of quality differentiation they embody as proposed by Alessandria and Kaboski (2011).

Based on this classification, it is possible to attempt some comparison of the two exporters' pricing strategies for groups of products differentiated by quality in the same way. As can be seen in the Appendix, unit values and estimated quality are distributed differently according to the rationale for quality differentiation. Those distributions also differ for each exporter and sector. Indeed, products in each sector are differentiated according to different rationales. By estimating export and price equations for product groups that are differentiated in particular ways we can exactly pinpoint the reason for that differentiation and better understand differences in pricing strategies.

Taking the same importers and HS6 products, we run the export and price equations for the six types of quality differentiation for which there are sufficient observations for the two exporters for the same markets and HS6 products. Tables 6 and 7 summarize the results for exports and prices respectively. It is not possible to conduct estimations for all types due to insufficient observations, especially in the case of India, confirming that China has more diversified exports even at the level of quality differentiation. When significant, the exchange rate elasticity of prices is positive, implying that the effect of a depreciation is an increase in the USD price, that is, mark-ups increase by more than the exchange rate change.

Tables 6 and 7 here

6. Conclusions

In this paper, we analyzed empirically the export-pricing strategies across export destinations using UN Comtrade detailed data of Chinese and Indian products. This paper used product-level for China and India to study the links between product quality and exchange-rate pass through, with a focus on the PTM behaviour. In the absence of firm-level export price data for these countries, this paper contributes to the literature on exchange-rate pass through by integrating how the quality heterogeneity due to differences in firm productivity and marginal production costs affects pass-through.

Most studies using disaggregated data to investigate why exporters charge different prices for the same product in different markets, focus on the cost component of prices, as the mark-up component is unobservable. We focused on measuring quality variations in order to account for mark-up changes and then assessed the consequent variations in export pricing strategies of Chinese and Indian products. Considering several exporter and destination characteristics to proxy for mark-up variations, we find that product quality plays an important role in price discrimination across destination markets, even for products originating from emerging markets such as China and India.

The evidence on changes in quality-adjusted prices appears to be inconclusive in the case of India, while in China prices are sensitive to quality. We find that Chinese varieties typically sell for a higher price than Indian differentiated products, and possibly Chinese varieties are gaining higher market share. As we demonstrated in this paper, the income elasticity in the export demand equations and the exchange rate elasticity in price equations would be overestimated if new varieties of goods and quality improvements are omitted in the export demand and price equations. In that sense, this paper provides new evidence on the role of product quality in export demand and price functions for emerging market exporters while considering transport and other trade costs.

References

Alchian, A.A. and W.R. Allen (1964), *University Economics*, Belmont: Wadsworth.

Alessandria, G. and J.P. Kaboski (2011), Pricing-to-Market and the Failure of Absolute PPP, *American Economic Journal: Macroeconomics*, 3 (1), 91-127.

Alvarez, R. and Fuentes, J.R. (2011), Entry into Export Markets and Product Quality, *World Economy*, 1237-1262.

Amiti, M. and A. Khandelwal (2013), Import Competition and Quality Upgrading, *Review of Economics and Statistics*, 95(2), 476-90.

Amiti, M. and Freund, C. (2010), "The Anatomy of China's Export Growth", in *China's Growing Role in World Trade*, R. Feenstra and S. Wei (eds.), Chicago: NBER and University of Chicago Press, pp. 35–61.

Bastos, P. and J. Silva (2010), The Quality of a Firm's Exports: Where You Export To Matters, *Journal of International Economics*, 82(2), 99-111.

Berman, N., P. Martin, and T. Mayer (2012), How do Different Exporters React to Exchange Rate Changes?, *The Quarterly Journal of Economics*, 127(1): 437-492.

Bernard, A., Jensen, B., Redding, S. and Schott, P. (2012), "The Empirics of Firm Heterogeneity and International Trade", Annual Review of Economics, Annual Reviews, 4(1), 283-313.

Betts, C., and M.B. Devereux (2000), Exchange Rate Dynamics in a Model of Pricing to Market, *Journal of International Economics*, 50 (1): 215-244.

Cadot, O., Iacovone, L., Pierola, M.D. and Rauch, F. (2013), Success and Failure of African Exporters, *Journal of Development Economics*, 101, 284-96.

Chaney, T. (2008), Distorted Gravity: Heterogeneous Firms, Market Structure and the Geography of International Trade, *American Economic Review*, 98(4), 1707-21.

Chatterjee, A., R. Dix-Carneiro, and J. Vichyanond (2013), Multi-Product Firms and Exchange Rate Fluctuations, *American Economic Journal: Economic Policy*, 5(2): 77-110.

Corsetti, G., and L. Dedola (2005) A macroeconomic model of international price discrimination, *Journal of International Economics*, 67 (1): 129-155.

Costinot, A., Oldenski, L. and Rauch, J. (2011), Adaptation and the Boundary of Multinational Firms, *Review of Economics and Statistics*, 93(1): 298-308.

Crinò, R., and Epifani, P. (2012), Productivity, Quality and Export Behaviour, *Economic Journal*, 122 (565): 1206-1243.

Dinopoulos, E., and B. Unel (2013), A simple model of quality heterogeneity and international trade, *Journal of Economic Dynamics and Control*, 37 (1): 68-83.

Feenstra, R.C. and J. Romalis (2014), International Prices and Endogenous Quality, *Quarterly Journal of Economics,* 129: 477-527.

Feinberg, R.M., Ferrantino, M. and Deason, L. (2012), Quality Competition and Pricing-to-Market: A Unified Framework for the Analysis of Bilateral Unit Values, *Southern Economic Journal*, 78(3), 860-77.

Goldberg, P.K., and R. Hellerstein (2008) A Structural Approach to Explaining Incomplete Exchange-Rate Pass-Through and Pricing-to-Market. *American Economic Review*, 98(2): 423-29.

Greenaway, D. and Kneller, R. (2007), "Firm Heterogeneity, Exporting and Foreign Direct Investment", Economic Journal, 117 (517), 134–61

Hallak, J.C. (2006), Product Quality and the Direction of Trade, *Journal of International Economics*, 68, 238-65.

Hallak, J.C. and P. Schott (2011), Estimating Cross-Country Differences in Product Quality, *Quarterly Journal of Economics*, 126, 417-74.

Hallak, J.C., Sivadasan, J. (2013) Product and process productivity: Implications for quality choice and conditional exporter premia, *Journal of International Economics*, 91 (1): 53-67.

Hanson, G. (2012), The Rise of Middle Kingdoms: Emerging Economies in Global Trade, *Journal of Economic Perspectives*, 26(2), 41-64.

Harrigan, J. and Deng, H. (2010), China's Local Comparative Advantage", in *China's Growing Role in World Trade*, R. Feenstra and S. Wei (eds.), Chicago: NBER and University of Chicago Press, pp.109–136.

Hellerstein, R., S.B. Villas-Boas (2010), Outsourcing and pass-through, *Journal of International Economics*, 81 (2): 170-183.

Helpman, E. (2006), "Trade, FDI and the Organization of Firms", Journal of Economic Literature, 44, 589-630

Helpman, E., Melitz, M. and Rubinstein, Y. (2008), Estimating Trade Flows: Trading Partners and Trading Volumes, *Quarterly Journal of Economics*, 123(2), 441-487

Henn, C., Papageorgiou, C. and Spatafora, N. (2013), Export Quality in Developing Countries, *IMF Working Paper*, WP/13/108.

Hummels, D. and A. Skiba (2004), Shipping the Good Apples Out? An Empirical Confirmation of the Alchian-Allen Conjecture, *Journal of Political Economy*, 112(6), 1384-1402.

Hsieh, C. and P. J. Klenow (2009), Misallocation and Manufacturing TFP in China and India, *Quarterly Journal of Economics*, 124(4), 1403–48.

Johnson, R.C. (2012), Trade and Prices with Heterogeneous Firms, *Journal of International Economics*, 86, 43-56.

Khandelwal, A. (2010), The Long and Short of Quality Ladders, *Review of Economic Studies*, 77, 1450-76.

Kugler, M., and Verhoogen, E. (2012) Prices, plant size, and product quality, *Review of Economic Studies*, 79 (1): 307-339.

Mallick, S. and H. Marques (2012), Pricing-to-Market with Trade Liberalization: The Role of Market Heterogeneity and Product Differentiation in India's Exports, *Journal of International Money and Finance*, 31(2), 310-336.

Mallick, S. and Y. Yang (2013), Productivity performance of export market entry and exit: Evidence from Indian firms, *Review of International Economics*, 21 (4): 809-824.

Manova, K., and Zhang, Z. (2012) Export prices across firms and destinations, *Quarterly Journal of Economics*, 127 (1): 379-436.

Marmolejo, A. (2011), Effects of a Free Trade Agreement on the Exchange Rate Pass-through to Import Prices, *Review of International Economics*, 19(3), 475–493.

Mayer, T. and Zignago, S. (2011), Notes on CEPII's distances measures (GeoDist), CEPII Working Paper 2011-25.

Melitz, M. (2003), The Impact of Trade on Intra-industry Reallocations and Aggregate Industri Productivity, *Econometrica*, 71, 1695-1725.

Melitz, M. J. and Ottaviano, G. I. P. (2008), Market Size, Trade, and Productivity, *Review of Economic Studies*, 75 (1), 295–316.

Melitz, M. and Redding, S. (2014), "Heterogeneous Firms and Trade", in Handbook of International Economics, vol. 4, pp. 1-54, Elsevier, available online February 22nd, DOI: 10.1016/B978-0-444-54314-1.00001-X

Novy, D. (2013), Gravity Redux: Measuring International Trade Costs with Panel Data, *Economic Inquiry*, 51(1), 101-21.

Rodriguez-Lopez, J.A. (2011), Prices and exchange rates: a theory of disconnect, *Review of Economic Studies*, 78, 1135-77.

Verhoogen, E. (2008), Trade, quality upgrading, and wage inequality in the Mexican manufacturing sector, *Quarterly Journal of Economics* 123(2), 489-530.

Tables

Table 1: Export equation (Dep var: $ln\ X_{mxkt}$)

VARIABLES	(1) All FE	(2) China FE	(3) India FE
L.lnuvXGDPpcm	0.00572**	0.0123***	-0.0122**
	(0.00287)	(0.00346)	(0.00489)
L2.lnGDPpcxXGDPpcm	1.589***	1.700***	1.070***
	(0.00945)	(0.0108)	(0.0222)
L2.lndistXGDPpcm	-0.115***	-0.121***	-0.0769***
	(0.00164)	(0.00206)	(0.00287)
L2.lnerXGDPpcm	-0.0250***	0.000971	-0.0637***
	(0.00407)	(0.00427)	(0.0122)
Lndist	-1.047***	-1.783***	-0.610***
	(0.0619)	(0.107)	(0.0680)
Constant	5.329***	10.10***	7.424***
	(0.550)	(0.944)	(0.618)
Observations	839,917	599,935	239,982
R-squared	0.141	0.181	0.044
Number of panelcode	136,375	93,351	43,024
Model F	8537***	8122***	723.2***
Corr FE-Xb	-0.439	-0.576	-0.366

FE: Fixed effects estimation by exporter-importer-product. Robust standard errors clustered by exporter-importer-product fixed effect in parentheses. Model F H0: coefficients jointly insignificant. *** p<0.01, ** p<0.05, * p<0.1

Table 2: Price equation (Dep var: $dln\ p^{*}_{mxkt}$)

VARIABLES	(1) All IVFE	(2) China IVFE	(3) India IVFE
LD.ln_er	-0.0211***	-0.0237***	-0.0149**
	(0.00145)	(0.00152)	(0.00641)
L.ln_GDPpc_x	-0.274***	0.473***	-26.22***
	(0.0690)	(0.0683)	(0.667)
lndist	-0.0577***	-0.131***	0.648***
	(0.0138)	(0.0220)	(0.0320)
qualy	0.200***	-0.208***	13.46***
	(0.0373)	(0.0374)	(0.341)
Constant	0.404***	0.00892	36.66***
	(0.150)	(0.215)	(0.972)
Observations	835,437	597,025	238,412
R-squared	0.00134	0.000162	0.00201
Number of panelcode	136,029	93,130	42,899
Model Wald Chi2	2614***	2056***	1843***
F for H_0: u_i=0	44.98***	46.04***	34.21***

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Standard errors in parentheses. Instrumented: qualy. Instruments: L.ln_reer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_reer. Model F H0: coefficients jointly insignificant. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Regressions for common export markets

A: Export equation (Dep var: $ln\ X_{mxkt}$)

VARIABLES	(1) All FE	(2) All HT	(3) China FE	(4) China HT	(5) India FE	(6) India HT
L2.lnGDPpcxXGDPpcm	1.475***	1.547***	1.470***	1.599***	1.198***	1.037***
	(0.0129)	(0.00645)	(0.0148)	(0.00702)	(0.0288)	(0.0155)
L2.lndistXGDPpcm	-0.0488***	-0.105***	0.0171***	-0.0737***	-0.151***	-0.0985***
	(0.00426)	(0.00153)	(0.00496)	(0.00186)	(0.00769)	(0.00289)
L2.lnerXGDPpcm	-0.363***	-0.0995***	-0.576***	-0.204***	0.144***	0.0448***
	(0.0145)	(0.00388)	(0.0173)	(0.00526)	(0.0235)	(0.00599)
L.lnuvXGDPpcm	0.00552	-0.00648***	0.0120***	0.000746	-0.00527	-0.0177***
	(0.00346)	(0.00227)	(0.00431)	(0.00264)	(0.00553)	(0.00431)
lndist		0.582***		0.356***		0.575***
		(0.0247)		(0.0289)		(0.0515)
contig		0.695***		0.669***		0.171
		(0.0370)		(0.0437)		(0.146)
comlang		0.235***		0.254***		0.0365
		(0.0263)		(0.0568)		(0.0315)
lndisintm		0.243***		0.164***		0.349***
		(0.0115)		(0.0176)		(0.0187)
Constant	-3.761***	-10.06***	-7.244***	-10.06***	3.754***	-4.543***
	(0.139)	(0.202)	(0.161)	(0.243)	(0.243)	(0.405)
Observations	569,254	569,254	375,710	375,710	193,544	193,544
R-squared	0.144		0.204		0.040	
Number of panelcode	92,084	92,084	56,963	56,963	35,121	35,121
Model F	6858***	10993***	6841***	10755***	695.9***	861.9***
Corr FE-Xb	-0.348		-0.431		-0.396	
Sargan-Hansen statistic		1.7e+04***		1.0e+04***		6620.712***

FE: Fixed effects estimation by exporter-importer-product. Robust standard errors clustered by exporter-importer-product fixed effect in parentheses. HT: Hausman-Taylor random effects IV estimation with lnuvXGDPpcm endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. *** p<0.01, ** p<0.05, * p<0.1. Common markets: high-income (Canada, Hong Kong, France, Germany, Israel, Italy, Japan, Korea, United States); low-income (Argentina, Brazil, Chile, Colombia, Egypt, Indonesia, Iran, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Russian Federation, and South Africa).

B: Price equation (Dep var: $dln\ p^{*}_{mxkt}$)

VARIABLES	(1) All IVFE	(2) All HT	(3) China IVFE	(4) China HT	(5) India IVFE	(6) India HT
LD.ln_er	0.0605***	0.0237***	0.112***	0.0918***	-0.0589***	-0.101***
	(0.00952)	(0.00914)	(0.0111)	(0.0107)	(0.0181)	(0.0174)
L.ln_GDPpc_x	-0.218***	0.0677***	-0.0311	0.0739***	-0.668***	0.125***
	(0.0346)	(0.00375)	(0.0387)	(0.00464)	(0.0679)	(0.00849)
lndist		-0.0226***		-0.0145***		-0.0221***
		(0.00213)		(0.00231)		(0.00544)
qualy	0.177***	-0.0794***	0.0641***	-0.0276***	0.434***	-0.0770***
	(0.0198)	(0.00626)	(0.0223)	(0.00794)	(0.0375)	(0.0130)
Constant	-0.187***	-0.172***	-0.406***	-0.336***	0.623***	-0.525***
	(0.0515)	(0.0218)	(0.0526)	(0.0306)	(0.125)	(0.0618)
Observations	566,677	566,677	374,378	374,378	192,299	192,299
R-squared	0.000178		0.000561		0.000108	
Number of panelcode	91,924	91,924	56,901	56,901	35,023	35,023
Model Wald Chi2	1535***		1059***		650.0***	
F for H_0: u_i=0	46.99***		51.47***		35.87***	
Model F		110.3***		126.6***		56.64***
Sargan-Hansen statistic		1490.986***		780.470***		306.187***

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Instrumented: qualy. Instruments: L.ln_neer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_neer. HT: Hausman-Taylor random effects IV estimation with qualy endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Common markets: high-income (Canada, Hong Kong, France, Germany, Israel, Italy, Japan, Korea, United States); low-income (Argentina, Brazil, Chile, Colombia, Egypt, Indonesia, Iran, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Russian Federation, and South Africa).

Table 4: Regressions for high- and low-income export markets

A: Export equation (Dep var: $ln\ X_{mxkt}$)

VARIABLES	(1) China HI FE	(2) China HI HT	(3) China LI FE	(4) China LI HT	(5) India HI FE	(6) India HI HT	(7) India LI FE	(8) India LI HT
L2.lnGDPpcxXGDPpcm	1.247***	1.231***	1.787***	2.108***	0.691***	0.853***	1.216***	1.065***
	(0.0181)	(0.00945)	(0.0271)	(0.0119)	(0.0459)	(0.0288)	(0.0531)	(0.0290)
L2.lndistXGDPpcm	-0.0712***	-0.0710***	-0.0581***	-0.169***	-0.0670***	-0.0405***	-0.164***	-0.132***
	(0.0110)	(0.00612)	(0.00771)	(0.00270)	(0.0109)	(0.00695)	(0.0139)	(0.00588)
L2.lnerXGDPpcm	0.500***	0.485***	-0.486***	-0.103***	0.513***	0.122***	0.0534	0.0181**
	(0.0524)	(0.0273)	(0.0230)	(0.00575)	(0.0409)	(0.0136)	(0.0368)	(0.00799)
L.lnuvXGDPpcm	0.0157**	0.00341	0.00464	-0.00852**	0.000611	-0.0114**	-0.0139	-0.0307***
	(0.00639)	(0.00373)	(0.00570)	(0.00373)	(0.00689)	(0.00542)	(0.00924)	(0.00711)
lndist		-1.691***		0.831***		0.168		0.889***
		(0.0644)		(0.0440)		(0.359)		(0.0640)
contig		-0.163		0.00155				0.0624
		(0.120)		(0.0627)				(0.132)
comlang				-0.185***		0.120		-0.0327
				(0.0660)		(0.0731)		(0.0512)
lndisintm		0.318***		0.396***		0.198**		0.497***
		(0.0292)		(0.0357)		(0.0893)		(0.0394)
Constant	-7.520***	5.145***	-7.099***	-16.94***	-0.109	-3.408	4.940***	-5.870***
	(0.422)	(0.594)	(0.166)	(0.370)	(0.449)	(2.568)	(0.275)	(0.580)
Observations	183,604	183,604	192,106	192,106	118,601	118,601	74,943	74,943
R-squared	0.167		0.250		0.050		0.032	
Number of panelcode	21,940	21,940	35,023	35,023	18,825	18,825	16,296	16,296
Model F	2620***	4833***	4852***	6891***	522.9***	754.9***	225.3***	239.1***
Corr FE-Xb	-0.222		-0.513		-0.403		-0.470	
Sargan-Hansen statistic		4859.738***		5476.843***		4203.553***		2424.312***

FE: Fixed effects estimation by exporter-importer-product. Robust standard errors clustered by exporter-importer-product fixed effect in parentheses. HT: Hausman-Taylor random effects IV estimation with lnuvXGDPpcm endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. *** p<0.01, ** p<0.05, * p<0.1 HI: high-income (Canada, Hong Kong, France, Germany, Israel, Italy, Japan, Korea, United States). LI: low-income (Argentina, Brazil, Chile, Colombia, Egypt, Indonesia, Iran, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Russian Federation, and South Africa).

B: Price equation (Dep var: $dln\ p^*_{mxkt}$)

VARIABLES	(1) China HI IVFE	(2) China HI HT	(3) China LI IVFE	(6) China LI HT	(7) India HI IVFE	(8) India HI HT	(9) India LI IVFE	(10) India LI HT
LD.ln_er	0.407***	0.402***	0.0480***	0.0152	-0.348***	-0.411***	0.0144	-0.0396**
	(0.0278)	(0.0260)	(0.0134)	(0.0123)	(0.0404)	(0.0395)	(0.0219)	(0.0201)
L.ln_GDPpc_x	0.331***	0.0804***	-0.158**	0.115***	-1.731***	0.0886***	-0.452***	0.150***
	(0.0689)	(0.00974)	(0.0743)	(0.00781)	(0.126)	(0.0105)	(0.110)	(0.0148)
lndist		-0.0916***		-0.0125***		-0.0538***		-0.0124**
		(0.0206)		(0.00391)		(0.0124)		(0.00611)
qualy	-0.175***	-0.195***	0.147***	-0.0673***	1.066***	-0.108***	0.295***	-0.0648***
	(0.0426)	(0.0506)	(0.0394)	(0.0169)	(0.0742)	(0.0229)	(0.0549)	(0.0225)
Constant	-0.547***	0.388**	-0.416***	-0.609***	2.374***	0.00492	0.274	-0.770***
	(0.0708)	(0.160)	(0.119)	(0.0518)	(0.209)	(0.121)	(0.226)	(0.0888)
Observations	182,993	182,993	191,385	191,385	117,784	117,784	74,515	74,515
R-squared	3.43e-05		0.000117		7.25e-05		0.000149	
Number of panelcode	21,928	21,928	34,973	34,973	18,781	18,781	16,242	16,242
Model Wald Chi2	826.9***		515.6***		627.6***		202.5***	
F for H_0: u_i=0	56.65***		48.89***		37.29***		33.00***	
Model F		112.4***		81.20***		49.19***		27.81***
Sargan-Hansen statistic		139.405***		700.486***		122.663***		261.831***

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Instrumented: qualy. Instruments: L.ln_neer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_neer. HT: Hausman-Taylor random effects IV estimation with qualy endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Common markets: high-income (Canada, Hong Kong, France, Germany, Israel, Italy, Japan, Korea, United States); low-income (Argentina, Brazil, Chile, Colombia, Egypt, Indonesia, Iran, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Russian Federation, and South Africa).

Table 5: Regressions for common HS6 products

A: Export equation (Dep var: $ln\ X_{mxkt}$)

VARIABLES	(1) All FE	(2) All HT	(3) China FE	(4) China HT	(5) India FE	(6) India HT
L2.lnGDPpcxXGDPpcm	1.318***	1.315***	1.290***	1.319***	1.257***	1.246***
	(0.0158)	(0.00748)	(0.0177)	(0.00800)	(0.0402)	(0.0204)
L2.lndistXGDPpcm	-0.118***	-0.116***	-0.0557***	-0.0929***	-0.168***	-0.138***
	(0.00630)	(0.00212)	(0.00784)	(0.00300)	(0.0106)	(0.00419)
L2.lnerXGDPpcm	-0.00501	-0.00158	-0.233***	-0.0692***	0.215***	0.0760***
	(0.0244)	(0.00609)	(0.0319)	(0.00921)	(0.0350)	(0.00948)
L.lnuvXGDPpcm	0.0257***	0.0265***	0.0343***	0.0330***	0.0121	0.0139**
	(0.00564)	(0.00330)	(0.00720)	(0.00382)	(0.00815)	(0.00639)
lndist		0.476***		0.460***		1.114***
		(0.0298)		(0.0327)		(0.103)
contig		0.508***		0.488***		0.850***
		(0.0762)		(0.104)		(0.307)
comlang		0.106***				0.115**
		(0.0401)				(0.0480)
lndisintm		0.313***		0.219***		0.245***
		(0.0183)		(0.0320)		(0.0315)
Constant	1.528***	-4.453***	-1.080***	-5.214***	4.455***	-7.612***
	(0.250)	(0.244)	(0.306)	(0.296)	(0.392)	(0.741)
Observations	216,546	216,546	141,561	141,561	74,985	74,985
R-squared	0.159		0.207		0.072	
Number of panelcode	18,258	18,258	11,877	11,877	6,381	6,381
Model F	2320***	5003***	2040***	4998***	399.0***	682.3***
Corr FE-Xb	-0.243		-0.228		-0.408	
Sargan-Hansen statistic		5.979		67.448***		42.997***

FE: Fixed effects estimation by exporter-importer-product. Robust standard errors clustered by exporter-importer-product fixed effect in parentheses. HT: Hausman-Taylor random effects IV estimation with lnuvXGDPpcm endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. *** p<0.01, ** p<0.05, * p<0.1

B: Price equation (Dep var: $dln\ p^{*}_{mxkt}$)

VARIABLES	(1) All IVFE	(2) All HT	(3) China IVFE	(4) China HT	(5) India IVFE	(6) India HT
LD.ln_er	0.0350**	0.0999***	0.169***	0.223***	-0.0941***	-0.0642***
	(0.0145)	(0.0137)	(0.0176)	(0.0167)	(0.0247)	(0.0238)
L.ln_GDPpc_x	2.081***	0.000858	2.204***	-0.0262**	-1.312***	-0.0269
	(0.0613)	(0.00965)	(0.0626)	(0.0112)	(0.414)	(0.0197)
lndist		0.0439***		0.0591***		0.117***
		(0.00819)		(0.00843)		(0.0212)
qualy	-1.334***	0.353***	-1.454***	0.596***	0.859***	0.756***
	(0.0406)	(0.0513)	(0.0424)	(0.0666)	(0.254)	(0.104)
Constant	-3.242***	-0.467***	-3.140***	-0.529***	1.920***	-0.965***
	(0.0911)	(0.0572)	(0.0876)	(0.0535)	(0.726)	(0.154)
Observations	215,793	215,793	141,127	141,127	74,666	74,666
R-squared	0.00705		0.00724		0.0163	
Number of panelcode	18,258	18,258	11,877	11,877	6,381	6,381
Model Wald Chi2	1799***		1811***		241.8***	
F for H_0: u_i=0	39.46***		35.68***		6.23***	
Model F		72.10***		106.1***		34.10***
Sargan-Hansen statistic		325.898***		21.779***		81.700***

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Instrumented: qualy. Instruments: L.ln_neer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_neer. HT: Hausman-Taylor random effects IV estimation with qualy endogenous. Sargan test H0: overidentifying restrictions are valid. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Export equation by dimensions of quality differentiation for common markets and common HS6 products

A: China (Dep var: $ln\ X_{mxkt}$)

VARIABLES	(1) China freshness FE	(2) China freshness HT	(3) China identifiable FE	(4) China identifiable HT	(5) China packaging FE	(6) China packaging HT	(7) China price FE	(8) China price HT	(9) China size FE	(10) China size HT	(11) China stage FE	(12) China stage HT
L2.lnGDPpcxXGDPpcm	0.668***	0.685***	1.401***	1.405***	0.632	0.442	1.251***	1.274***	1.778***	1.826***	0.519***	0.520***
	(0.131)	(0.0597)	(0.260)	(0.133)	(0.595)	(0.310)	(0.224)	(0.103)	(0.142)	(0.0631)	(0.184)	(0.0941)
L2.lndistXGDPpcm	0.0827	0.0430	-0.192	-0.190***	-0.659*	-0.478***	-0.129*	-0.140***	-0.153***	-0.195***	-0.0209	-0.0213
	(0.0865)	(0.0378)	(0.127)	(0.0541)	(0.300)	(0.178)	(0.0709)	(0.0333)	(0.0438)	(0.0222)	(0.117)	(0.0619)
L2.lnerXGDPpcm	-0.371	-0.214	0.0167	0.0788	2.678**	1.397*	-0.282	0.0362	-0.246	0.0215	0.205	0.204
	(0.409)	(0.134)	(0.556)	(0.186)	(0.970)	(0.734)	(0.291)	(0.0947)	(0.181)	(0.0663)	(0.534)	(0.243)
L.lnuvXGDPpcm	0.254***	0.251***	-0.186	-0.189***	0.170	0.185	0.0171	0.00958	0.0873	0.0898**	0.0374	0.0375
	(0.0767)	(0.0523)	(0.219)	(0.0675)	(0.210)	(0.205)	(0.0674)	(0.0408)	(0.0676)	(0.0386)	(0.0411)	(0.0298)
lndist		-0.679*		1.147		1.220		1.205***		1.561***		-1.534**
		(0.386)		(0.777)		(3.294)		(0.422)		(0.246)		(0.617)
contig		-0.863		0.143		-0.552		0.866		-0.484		-0.926
		(1.214)		(2.488)		(7.879)		(1.415)		(0.911)		(1.279)
lndisintm		0.0691		-0.408		0.803		0.510		-0.241		0.330
		(0.388)		(0.773)		(2.273)		(0.442)		(0.293)		(0.438)
Constant	-3.054	3.919	10.03*	1.304	28.81**	16.14	5.193*	-10.30***	-1.129	-12.92***	4.485	15.93***
	(3.190)	(3.271)	(5.379)	(6.618)	(10.79)	(28.40)	(2.934)	(3.848)	(1.910)	(2.321)	(5.115)	(5.139)
Observations	1,837	1,837	563	563	96	96	814	814	3,227	3,227	1,164	1,164
R-squared	0.121		0.206		0.126		0.183		0.238		0.053	
Number of panelcode	155	155	48	48	8	8	69	69	270	270	98	98
Model F	18.63***	36.56***	15.81***	19.72***	3.097*	1.327	16.71***	24.39***	71.58***	134.2***	3.716***	10.42***
Corr FE-Xb	-0.0121		-0.319		-0.951		-0.743		-0.489		-0.159	
Sargan-Hansen statistic		3.907		2.341		-		-		4.759		1.489

FE: Fixed effects estimation by exporter-importer-product. Robust standard errors clustered by exporter-importer-product fixed effect in parentheses. HT: Hausman-Taylor random effects IV estimation with lnuvXGDPpcm endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. *** p<0.01, ** p<0.05, * p<0.1

B: India (Dep var: $ln\ X_{mxkt}$)

VARIABLES	(1) India freshness FE	(2) India freshness HT	(3) India identifiable FE	(4) India identifiable HT	(5) India packaging FE	(6) India packaging HT	(7) India price FE	(8) India price HT	(9) India size FE	(10) India size HT	(11) India stage FE	(12) India stage HT
L2.lnGDPpcxXGDPpcm	0.605*	0.660***	2.199***	2.119***	0.490	0.264	1.603	1.589	0.595*	0.763***	2.058***	2.220***
	(0.345)	(0.199)	(0.489)	(0.375)	(0.894)	(0.679)	(1.644)	(1.116)	(0.350)	(0.155)	(0.524)	(0.245)
L2.lndistXGDPpcm	-0.0317	-0.0174	-0.202*	-0.215**	-0.0436	0.0493	-0.525	-0.516*	-0.00563	-0.0656**	-0.295**	-0.310***
	(0.0914)	(0.0488)	(0.105)	(0.0943)	(0.202)	(0.172)	(0.413)	(0.289)	(0.0802)	(0.0306)	(0.147)	(0.0636)
L2.lnerXGDPpcm	0.122	-0.0163	-0.716*	-0.402**	-0.234	-0.389	0.135	0.125	-0.160	-0.172**	0.242	0.0620
	(0.324)	(0.103)	(0.353)	(0.179)	(0.397)	(0.281)	(0.478)	(0.481)	(0.321)	(0.0672)	(0.368)	(0.114)
L.lnuvXGDPpcm	-0.0927	-0.0932	-0.109	-0.0943	-0.228	-0.253	0.00388	0.0294	0.0457	0.0494	0.155	0.107
	(0.148)	(0.0944)	(0.235)	(0.138)	(0.374)	(0.304)	(0.0751)	(0.0916)	(0.0578)	(0.0467)	(0.194)	(0.126)
lndist		0.251		7.781**		-1.222		10.05		0.580		1.263
		(2.014)		(3.621)		(4.270)		(6.583)		(0.823)		(2.233)
contig												-6.716
												(4.353)
comlang		-0.593		-2.149		-2.209				0.565*		-0.0818
		(0.599)		(1.695)		(1.823)				(0.336)		(0.691)
lndisintm		0.0527		-1.769*		1.775**		-1.806		0.0965		0.382
		(0.453)		(0.906)		(0.770)		(1.647)		(0.219)		(0.507)
Constant	5.539	2.889	5.338	-52.60**	14.46**	13.19	31.72**	-48.80	5.647**	2.252	1.545	-10.09
	(3.698)	(13.71)	(3.879)	(25.88)	(4.984)	(31.13)	(10.90)	(41.36)	(2.775)	(5.858)	(3.947)	(15.32)
Observations	1,043	1,043	200	200	132	132	126	126	1,774	1,774	648	648
R-squared	0.031		0.238		0.018		0.035		0.020		0.165	
Number of panelcode	90	90	17	17	11	11	11	11	151	151	55	55
Model F	2.419**	4.903***	6.081***	7.414***	0.380	1.806	1.165	0.939	3.233***	5.553***	14.60***	15.98***
Corr FE-Xb	-0.117		-0.834		-0.195		-0.988		-0.226		-0.483	
Sargan-Hansen statistic		0.904		4.368		4.987		-		4.713		-

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Instrumented: qualy. Instruments: L.ln_neer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_neer. HT: Hausman-Taylor random effects IV estimation with qualy endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Price equation by dimensions of quality differentiation for common markets and common HS6 products

A: China (Dep var: $dln\ p^{*}_{mxkt}$)

VARIABLES	(1) China freshness IVFE	(2) China freshness HT	(3) China identifiable IVFE	(4) China identifiable HT	(5) China packaging IVFE	(6) China packaging HT	(7) China price IVFE	(8) China price HT	(9) China size IVFE	(10) China size HT	(11) China stage IVFE	(12) China stage HT
LD.ln_er	0.0187	0.0426	0.161	0.174	-1.001	-0.853	-0.0737	0.110	0.0207	0.0286	1.043***	1.093***
	(0.117)	(0.114)	(0.208)	(0.204)	(0.953)	(0.949)	(0.353)	(0.349)	(0.0916)	(0.0883)	(0.294)	(0.274)
L.ln_GDPpc_x	-0.199	0.0446	1.945**	0.179	-0.538	-0.477	-0.283	-0.721**	1.948***	0.0903**	3.469***	-0.243*
	(0.299)	(0.0776)	(0.802)	(0.150)	(1.545)	(0.853)	(1.156)	(0.363)	(0.372)	(0.0434)	(0.738)	(0.141)
lndist		0.101		-0.0255		0.113		0.392		0.00147		0.342**
		(0.0778)		(0.0825)		(0.361)		(0.263)		(0.0237)		(0.152)
qualy	0.230	0.639	-1.233**	-0.256	0.421	3.641	0.219	5.009**	-1.257***	0.0871	-2.296***	2.193**
	(0.203)	(0.504)	(0.546)	(0.869)	(1.064)	(5.596)	(0.788)	(2.302)	(0.252)	(0.204)	(0.496)	(0.877)
Constant	-0.547	-1.425***	-3.232***	-0.932*	0.162	0.668	0.120	-0.463	-2.983***	-0.671***	-4.880***	-2.006**
	(0.409)	(0.433)	(1.109)	(0.528)	(2.003)	(3.057)	(1.513)	(1.808)	(0.504)	(0.230)	(1.070)	(0.937)
Observations	1,837	1,837	563	563	96	96	814	814	3,227	3,227	1,164	1,164
R-squared	0.0242		0.000163		0.0436		0.00637		0.00416		0.00580	
Number of panelcode	155	155	48	48	8	8	69	69	270	270	98	98
Model Wald Chi2	30.32***		10.29***		1.940		0.300		36.82***		42.13***	
F for H_0: u_i=0	57.81***		39.07***		6.87***		25.02***		71.68***		9.60***	
Model F		8.193***		1.525		0.401		1.229		3.350***		5.518***
Sargan-Hansen statistic		1.362		-								

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Instrumented: qualy. Instruments: L.ln_neer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_neer. HT: Hausman-Taylor random effects IV estimation with qualy endogenous. Sargan test H0: overidentifying restrictions are valid. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

B: India (Dep var: $dln\ p^{*}_{mxkt}$)

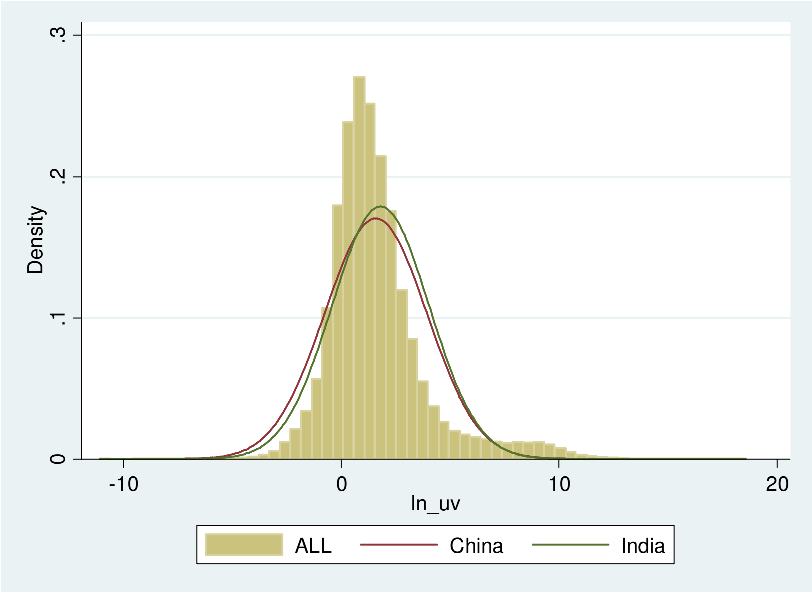
VARIABLES	(1) India freshness IVFE	(2) India freshness HT	(3) India identifiable IVFE	(4) India identifiable HT	(5) India packaging IVFE	(6) India packaging HT	(7) India price IVFE	(8) India price HT	(9) India size IVFE	(10) India size HT	(11) India stage IVFE	(12) India stage HT
LD.ln_er	0.297	0.440***	-0.0552	0.0294	0.213	0.320	0.668	0.235	0.204	0.228	0.0929	0.200*
	(0.198)	(0.169)	(0.398)	(0.253)	(0.369)	(0.261)	(3.861)	(2.955)	(0.239)	(0.181)	(0.171)	(0.113)
L.ln_GDPpc_x	-7.160***	0.0550	-18.73**	-0.00906	-9.254*	-0.125	-61.01***	-1.216	-21.96***	-0.626***	-11.04***	0.0334
	(2.420)	(0.124)	(7.789)	(0.177)	(5.470)	(0.349)	(14.73)	(1.218)	(2.544)	(0.196)	(2.395)	(0.116)
lndist		0.174		0.0615		0.394		1.294		0.636**		0.160
		(0.157)		(0.153)		(0.413)		(1.899)		(0.247)		(0.153)
qualy	4.536***	1.283*	11.55**	0.271	5.852*	2.232	37.07***	5.338	13.43***	4.149***	6.917***	1.315*
	(1.482)	(0.756)	(4.790)	(0.538)	(3.378)	(2.125)	(8.985)	(6.273)	(1.553)	(1.176)	(1.468)	(0.674)
Constant	11.53***	-2.111*	31.46**	-0.559	14.84	-3.114	104.5***	-4.976	38.03***	-2.488	18.23***	-1.841
	(4.287)	(1.095)	(13.25)	(1.480)	(9.426)	(2.402)	(25.47)	(13.82)	(4.451)	(1.731)	(4.208)	(1.127)
Observations	1,043	1,043	198	198	132	132	122	122	1,755	1,755	648	648
R-squared	0.0220		0.0193		0.0153		0.171		0.0456		0.0447	
Number of panelcode	90	90	17	17	11	11	11	11	151	151	55	55
Model Wald Chi2	27.09***		5.900***		5.972***		17.18***		75.24***		33.04***	
F for H_0: u_i=0	12.49***		11.32***		11.11***		1.19		6.54***		27.29***	
Model F		6.427***		0.0737		1.483		0.258		3.295***		6.774***
Sargan-Hansen statistic		3.865		-		0.676		2.533		4.972*		-

IVFE: Instrumental variables fixed effects estimation by exporter-importer-product. Instrumented: qualy. Instruments: L.ln_neer L.ln_GDPpc_x ln_dist L.ln_uv L2.ln_GDPpc_x L2.ln_neer. HT: Hausman-Taylor random effects IV estimation with qualy endogenous. Sargan-Hansen test H0: overidentifying restrictions are valid. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figures

Figure 1: Distribution of unit values and quality estimates

A: Unit values



B: Quality estimates

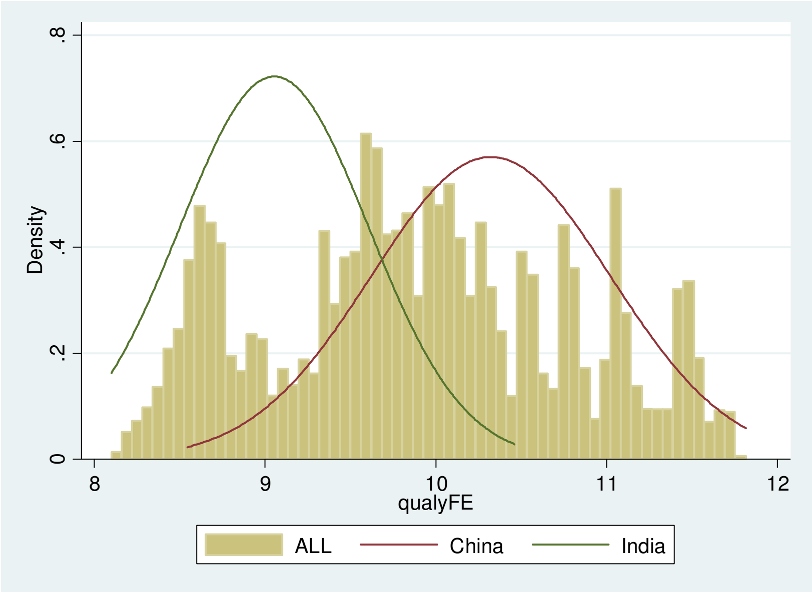
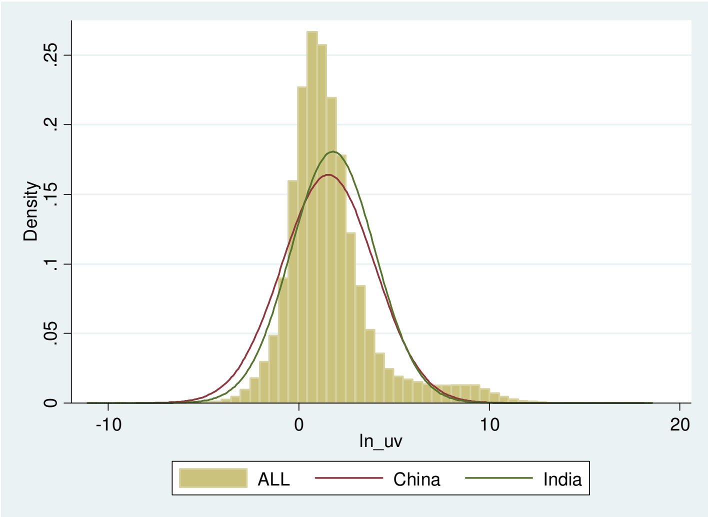
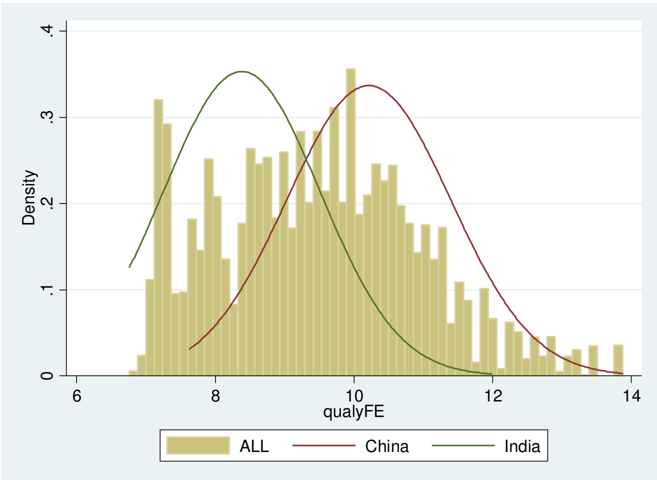


Figure 2: Distribution of unit values and quality estimates for a subset of export markets common to China and India

A: Unit values



B: Quality estimates



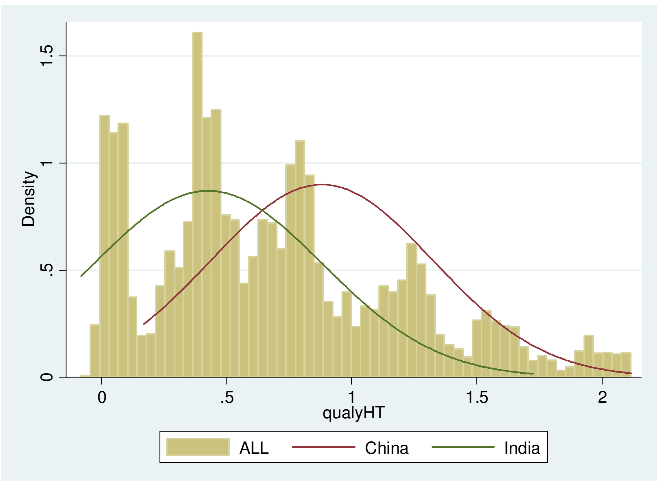
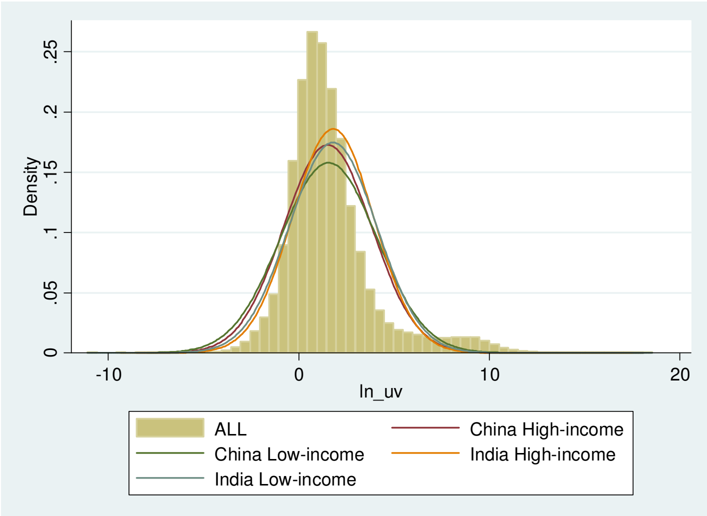
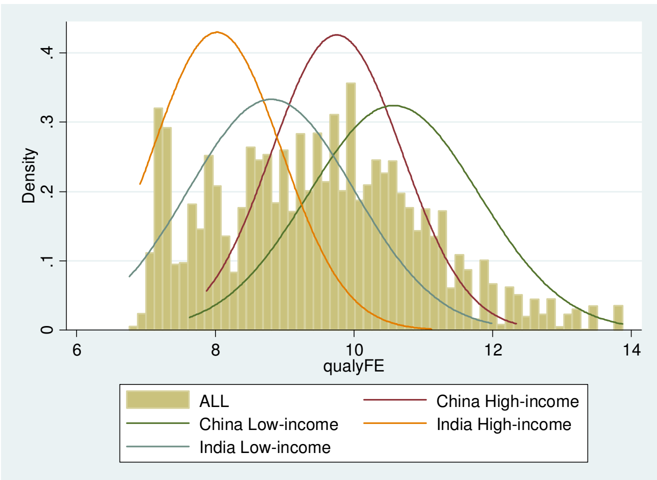


Figure 3: Distribution of unit values and quality estimates for high- and low-income export markets

A: Unit values



B: Quality estimates



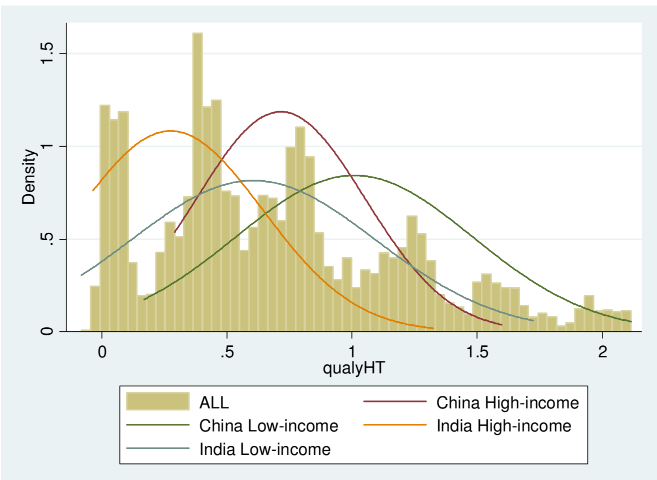
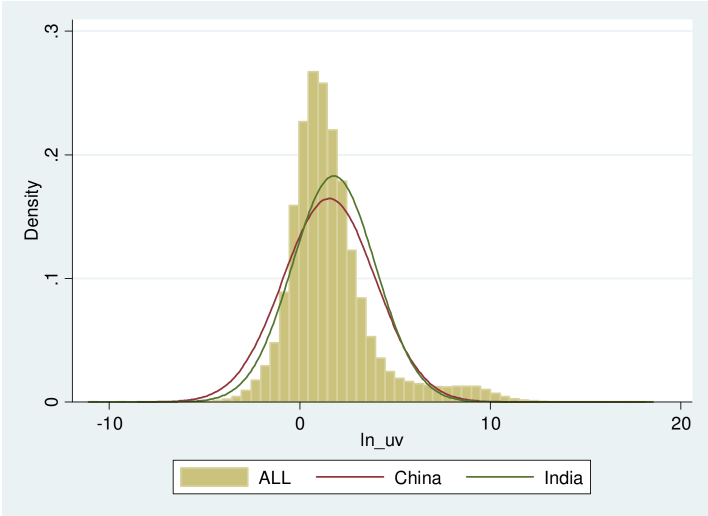
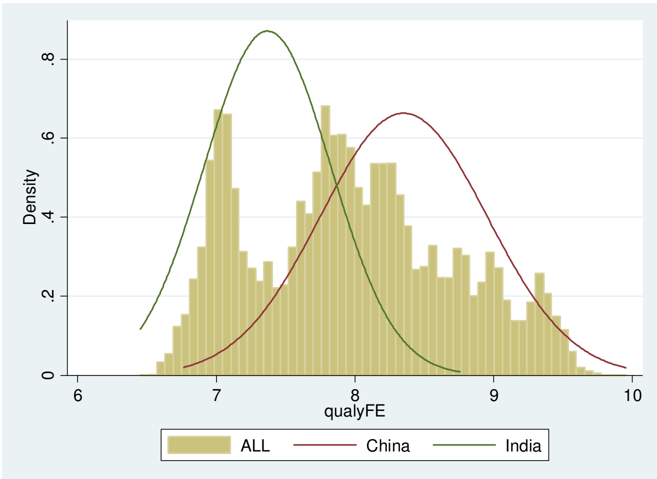


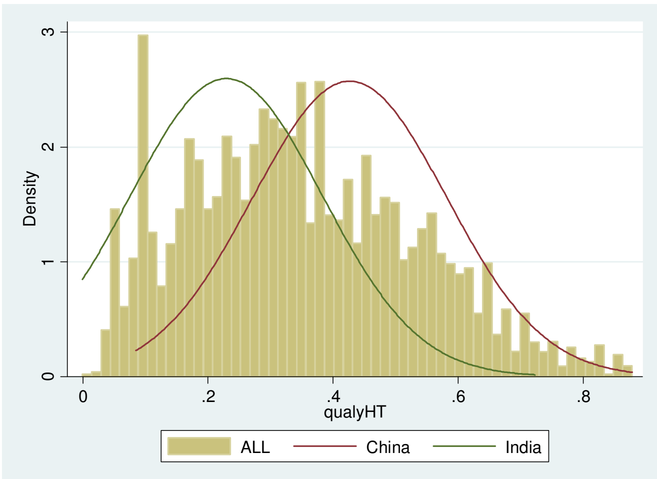
Figure 4: Distribution of unit values and quality estimates for common HS6 products

A: Unit values



B: Quality estimates





Appendix

Rationale for differentiation by quality as defined by Alessandria and Kaboski (2011)

Comtrade data is classified into 8 forms of quality differentiation:

- **Freshness** (frozen, fresh): Goods, mostly food products, that can be frozen, fresh, or live; Goods that can be fresh or dried.
- **Identifiable** (fancy, color, grade, purebred, electric): Goods that vary by identifiable qualities, like fancy vs. non fancy, color vs. monochrome, purebred or not, electric or not.
- **New or Used** (new): Goods that can be new, used, or rebuilt.
- **Packaging** (retail, bulk, in container, package): Goods that are packed according to how they will be sold or used, so they come in different sizes or types of containers.
- **Price** ($, valued): Goods that are valued at different prices.
- **Purity** (oil, modified, refined, virgin, leaded, medicinal, pure, purity, api): Goods with different levels of purity, mainly oils.
- **Size** (exceed, less): Goods that have different sizes, in terms of quantity, power, weight, density, volume, or capacity.
- **Stage of Processing** (processed, shell, prepared, split, cooked): Goods that vary by their stage of processing when classified, including fresh food products vs. prepared or cooked food products.

Table A1: Distribution of products differentiated by quality by exporter

Rationale		Reporter		
		China	India	Total
Freshness	obs	9,998	6,034	16,032
	%	10.52	6.35	16.86
Identifiable	obs	2,856	1,358	4,214
	%	3.00	1.43	4.43
New or used	obs	5,962	1,565	7,527
	%	6.27	1.65	7.92
Packaging	obs	1,061	1,29	2,351
	%	1.12	1.36	2.47
Price	obs	5,702	2,001	7,703
	%	6.00	2.10	8.10
Purity	obs	2,944	1,981	4,925
	%	3.10	2.08	5.18
Size	obs	24,009	16,302	40,311
	%	25.25	17.15	42.40
Stage	obs	8,054	3,959	12,013
	%	8.47	4.16	12.64
Total	obs	60,586	34,49	95,076
	%	63.72	36.28	100.00

Table A2: Descriptive statistics of unit values for product groups differentiated by quality

		Rationale								
HSgroup		freshness	identifiable	neworused	packaging	price	purity	size	stage	Total
Animal & Animal Products	N	6,563	42				8	588	1,484	8,685
	mean	0.820	5.094				7.209	1.464	0.798	0.887
	SD	0.934	1.178				1.763	0.964	2.523	1.403
Chemicals & Allied Industries	N		212				736			948
	mean		1.395				0.607			0.783
	SD		0.671				1.531			1.424
Foodstuffs	N	1,402			996				3,403	5,801
	mean	0.025			1.124				0.169	0.298
	SD	0.791			0.959				0.811	0.916
Machinery & Electrical	N		2,855	6,281		7,344		18,256		34,736
	mean		2.655	7.592		6.940		4.323		5.330
	SD		2.226	2.319		2.005		3.042		3.112
Metals	N			212			2,37	4,842		7,424
	mean			-0.287			-0.327	0.461		0.188
	SD			0.924			0.503	0.975		0.930
Mineral Products	N						619			619
	mean						-0.640			-0.640
	SD						1.765			1.765
Plastics & Rubbers	N							878		878
	mean							0.057		0.057
	SD							0.596		0.596
Raw Hides, Skins, Leather & Furs	N		928						402	1,33
	mean		2.638						2.376	2.559
	SD		0.615						0.881	0.716
Stone & Glass	N							523		523
	mean							-0.377		-0.377
	SD							0.835		0.835
Textiles	N				1,298			7,112	1,86	10,27
	mean				1.483			1.353	0.607	1.234
	SD				0.738			0.796	0.769	0.839
Transport Equipment	N			225				4,472		4,697
	mean			9.769				6.426		6.586
	SD			2.187				2.055		2.182
Vegetable Products	N	7,542			2		893	3	4,541	12,981
	mean	-0.117			1.560		0.182	0.845	0.114	-0.015
	SD	0.874			0.375		0.711	0.051	1.042	0.935
Wood & Wood Products	N			531				2,21		2,741
	mean			1.239				-0.173		0.101
	SD			1.346				0.759		1.061
Total	N	15,507	4,037	7,249	2,296	7,344	4,626	38,884	11,69	91,633
	mean	0.293	2.611	6.964	1.327	6.940	-0.109	3.082	0.373	2.655
	SD	1.002	1.942	3.081	0.860	2.005	1.128	3.090	1.323	3.290

Figure A1: Log unit value and quality estimates histograms for products differentiated by quality