Understanding Exchange Rate Pass-through across firms and destinations

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Abstract

We empirically assess how different firm characteristics matter for the degree of exchange rate pass-through, using data with 53,355 Chinese production firms exporting 6,314 products to 179 destinations over 2000-2006. We find an important role for firm productivity in reducing the degree of pass-through, which can be partly attributed to a stronger response of export quality to exchange rate movements for firms with high productivity or larger shares of imported inputs. More fundamentally, our quality regressions imply that pass-through estimations are biased if contemporaneous quality changes are not accounted for. Next, we document pass-through asymmetries between depreciations and appreciations. We find that the average firm is less responsive to appreciations than depreciations, with greater pass-through into importers' currency prices during appreciations and lower pass-through during depreciations, in line with inelastic foreign demand. Furthermore, we show a special or "dominant" role of the US dollar: changes in the real RMBUSD exchange rate affect export prices and quality strongly and more so than the bilateral RMB exchange rate vis-a-vis destinations currencies.

Keywords: asymmetric pass-through, imported inputs, productivity.

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1 Introduction

We set out to understand what determines differences in pass-through of real exchange rate changes across firms and destinations. We use a broad product-level dataset across Chinese firms that produce for foreign customers across the globe over time. More specifically, our data has 53,355 firms and 6,314 6-digit HS products across 179 destinations over seven years during the period from 2000 to 2006. This allows us to assess the relative importance of a number of potential determinants. We first assess the extent to which different firm characteristics matter for the degree of pass-through. Such characteristics include firm-level Total Factor Productivity (TFP), the share of imported inputs used in the production of exports, and the firm's destination-specific market share. That is, we estimate the effect of exchange rate movements on firms' export prices dependent on the firm's productivity and on its integration in imported inputs and specific export markets. These firm-level characteristics would be expected to induce variability of pass-through across exporting firms and destinations.

In addition, pass-through can exhibit variability across destinations and time to the extent that different shocks characterize each period under study for different destinations. In related fashion, there is no reason to expect pass-through to be symmetric for depreciation versus appreciation episodes. In fact, asymmetric affects of depreciations versus appreciations would result from either inelastic or elastic destination market demand facing exporting firms. With *variable markups* for price-discriminating firms as in e.g. Atkeson and Burstein (2008), the perceived demand elasticity in a certain destination market would affect whether a firm chooses high or low pass-through after a depreciation or appreciation. The resulting degree of pass-through will in general be different across depreciation versus appreciation episodes as we explain in detail later on.

Finally, we will allow for depreciations and appreciations relative to the US dollar to play a potentially distinct role in terms of pass-through, in line with the "dominant currency paradigm" proposed by Gopinath and co-authors. That is, we will allow for a special "dominant" role of the US dollar in international trade by incorporating the RMB exchange rate relative to the US dollar in addition to the bilateral exchange rate with each exporting destination. As both export prices and quality might be responding at the same time to dominant currency exchange rate changes, we consider again quality regressions in order to aid interpretation of our estimates from the above-described dominant-currency paradigm related pass-through regressions.

To sum up, our study utilizes Chinese firm-product level data across destinations over time to understand the variation in the degree of exchange rate pass-through across markets and for different types of episodes. Our study will take into consideration the cost and quality effect of exchange rate changes via imported input prices and a host of other factors, while allowing for potentially asymmetric effects of depreciations versus appreciations depending on firm characteristics such as imported inputs or firm productivity. To our knowledge, we are the first to address asymmetric pass-through due to currency depreciations and appreciations and the quality response to exchange rate movements using firm-product-destination level data. Furthermore, considering a potentially special role of the US dollar exchange rate enables us to further understand the determinants of pass-through and the role of changes in quality in response to relevant depreciations and appreciations.

Based on our discussion in the previous paragraphs, different types of source countries should be associated with different degrees of pass-through overall. While we cannot test this directly given that our micro-trade data is available for a single source country, we deem that the interplay of the degree of pass-through with the share of foreign input content and demand elasticities characterizing an economy, renders the study of a large country like China a much needed complement to the important existing study of Amiti et al. (2014) for the small Belgian economy and to studies using extensive firm-product-level Swiss data (Fauceglia et al., 2014).[1] In particular, the importance of import shares and export market

[1]For example, bigger economies could be associated with higher demand elasticities as destinations

shares for the degree of pass-through is emphasized by Amiti et al. (2014) using Belgian firm-product-level data. In similar fashion, we intend to assess the degree of pass-through taking into account changes in costs and export quality arising from changes in the exchange rate that affect prices of imported inputs, while accounting for firm-destination-specific sectoral export shares, firm TFP, and other factors in a broader framework applied to Chinese firm-product-level data across destinations over time. This extends the recent study by (Manova and Yu, 2017) on quality differentiation and adjustment that uses Chinese firm level trade data, only without controlling for firm characteristics from production data or analyzing the response of prices and quality to exchange rate movements as in our paper.

We find an important role for firm-specific productivity in reducing the degree of pass-through. Quality estimations suggest that export quality increases (decreases) in depreciation (appreciation) episodes for firms with productivity sufficiently above average or for firms with larger shares of imported inputs. Accordingly, this implies that the estimated pass-through rates are confounded by simultaneous quality adjustments at the firm-product-destination level, with a more pronounced bias for larger importing and productive firms.

Moreover, when we allow for asymmetries in how potential determinants affect pass-through during depreciations and appreciations, we find that the average Chinese exporting firm is less responsive to appreciations than depreciations so that pass-through into importers' currency prices is greater during appreciations and lower for depreciations. This is consistent with the presence of inelastic foreign demand for Chinese products during the period under study.

Finally, when we allow for a special "dominant" role of the US dollar in international trade by incorporating the RMB exchange rate relative to the US dollar in addition to the

of intermediate inputs or consumption goods and at the same time associated with an overall smaller imported input content for producing their exports as compared to smaller economies characterized by lower demand elasticities for their imports and a higher imported input content of their exports.

bilateral exchange rate with each exporting destination, the results indicate that changes in the real RMBUSD exchange rate affect export prices in USD strongly, more so than the bilateral RMB exchange rate vis-a-vis exporting destinations currencies and in the opposite direction as compared to the latter. A 10% depreciation (appreciation) of the RMB against the USD increases (reduces) the export price in USD by about 2.5%. This may well be driven by higher input costs after a RMB depreciation against the USD, which forces firms to increase export prices in order to compensate for the squeezed profit margins. Conversely, a RMB appreciation relative to the USD allows Chinese exporters to reduce export prices due to lower imported input costs. There is also supporting evidence that appreciation in the RMBUSD exchange rate allows Chinese firms to benefit from lower import prices for more sophisticated inputs in order to improve the quality of their products. Specifically, a 10% appreciation (depreciation) of the RMB against the USD improves (reduces) export quality by more than 8%.

The remaining part of the paper is organized as follows. In Section 2 we describe two firm-level datasets, the key data used in the paper, their scope, matching strategy and potential problems. In Section 3, we set up empirical specifications for baseline and asymmetric exchange rate pass-through estimations as well as to test the dominant currency paradigm hypothesis; we also use a well-known quality proxy estimation method and specification to test how export quality depends on the exchange rate and other determinants . Estimation results are presented in Section 4. Section 5 concludes.

2 Data

The primary dataset used in this paper consists of two sets of Chinese firm-level data for the period of 2000-2006. The Customs data has product-level transaction information and is the entire population of firm-level trade statistics. It includes variables for source and destination countries, products at the level of 8-digit HS codes, and customs regimes classified mainly as normal and processing trade. The firms are registered as trading companies but can also engage in production. This makes it possible to merge the customs data with production data.

The firm-level production data comes from the Annual Survey of Industrial Production (ASIP) by China's National Bureau of Statistics. The ASIP data has production and financial information for all state-owned enterprises and other enterprises with annual sales of more than 5 million yuan, and it covers 95 percent of industrial output and 98 percent of industrial exports.

Merging the two data sets by firm name and other identifying information produces the linked dataset we use here, which is thus a subset of the two above-described datasets. This is a standard exercise for researchers working with Chinese microdata, though they may differ in the specifics of matching criteria with varying degree of success. Our matching exercise produces 14,603 to 40,539 matched firms each year over 2000-2006, more in recent years, which is an indication of more firms participating in international trade as a result of trading rights liberalization required by China's WTO accession protocol. The number of firms matched in total in the seven years is 53,355. If indexed with product and destination, the firm-product-destination specific data has 1,801,397 records. Further indexing the data with year and dropping records with missing value, we finally have total 3,239,260 observations, which is the panel data used in our econometric estimation. Distribution over years and summary statistics of the data and other variables are listed in Table 1.

[insert Table 1 here]

Our matching exercise includes only trade data with nonzero exports. As firms in the production dataset are mainly above scale in size, the matched data then consists of large and medium sized firms that do both production and direct trade. The pure trading companies in the customs data are screened out by this matching procedure, as they are not in the ASIP dataset. However, some matched firms may also act as trading agencies for other firms that do not engage in international trade. In other words, they may import or export goods for other production firms. For firms' imported input share in its total input, our matched data after winsorizing, has a mean of 33.4% but also has records with values bigger than unity as shown for variable *impshr* in Table 1. The trading agency issue in the Chinese microdata can be neutralized at the sectoral level by summing up the data across sectors and assuming domestic trading only happens within the same sectors (Yao et al., 2015). But at the firm-level, studies still treat firms' imports as if these were for their own use (Upward et al., 2013; Manova and Yu, 2017), which is also the approach we adopt in the current paper.

3 Empirical specifications

3.1 Pass-through equations

3.1.1 First-difference baseline specification

We estimate variants of the following first-difference pass-through equation in Table 2:

$$\begin{aligned}\Delta ln(p^{fob}_{fict}) = (\beta_1 + \beta_2 lnTFP_{ft-1} + \beta_3 Imp_{ft-1} + \beta_4 S_{fsct-1})\Delta lne_{ct} + \gamma \Delta lnTFP_{ft} + \delta \Delta Imp_{ft-1} \\ +\lambda \Delta lnGDP_{ct} + \eta_2 lnTFP_{ft-1} + \eta_3 Imp_{ft-1} + \eta_4 S_{fsct-1} + \psi_t + \mu_{fic} + \epsilon_{fict},\end{aligned} \quad (1)$$

with $\Delta ln(p^{fob}_{fict}) = \Delta ln \frac{ExportValue_{fict}}{ExportQuantiy_{fict}}$ being the first difference of the free on board (fob) unit value at the firm-product-destination level employed as a proxy for export price changes (in USD). It is calculated as the division of the exported value by export quantity (units or weights in kg) by firm f, at HS 6-digit level i, to destination c at time t. Unit values are calculated for every transaction and then averaged at the annual level before taking the natural log (ln) value of it. Then, taking the first difference, $ln(p^{fob}_{fict}) - ln(p^{fob}_{fict-1})$ results in our dependent variable; $\Delta ln(p^{fob}_{fict})$. Δlne_{ct} is the change in the natural log of the average real exchange rate in year t between China and the export destination c, measured as RMB over the destination currency times the Chinese GDP deflator relative to the destination's GDP deflator (an increase denotes a real depreciation of the CNY). Our specification here follows the seminal application of Amiti et al. (2014) using Belgian data and Li et al. (2015).

Time (ψ_t) and firm-destination-product (μ_{fic}) fixed effects are included in the baseline specification (1), so that the effect of exchange rate movements on export pricing is identified rigorously from within firm-destination-product variation over time. Throughout, we also control for demand-driven price adjustments by adding the changes in log nominal GDP in destination c at time t ($\Delta lnGDP_{ct}$) to our baseline specification.

Importantly, we control for firm productivity with a TFP measure at the firm-level that changes over time, $lnTFP_{ft-1}$.[2] To construct TFP, we use the Levinsohn and Petrin (2003) method which extends Olley and Pakes (1996). This uses the firm's revenue, available in our firm-level dataset, rather than its value-added and allows for the presence of intermediates, the key idea being to use intermediate inputs as an instrumental variable.

Similarly, we take into account the share of imported inputs in total costs, Imp_{ft-1}, that is calculated at the firm-level and varies over time. This is a potentially important determinant for the degree of pass-through since, for example, imported inputs might act as a natural hedge during appreciations for firms producing product with potentially high imported input content. The importance of import shares for the degree of pass-through has also been emphasized by Amiti et al. (2014).

Finally, demand elasticities characterizing the goods a firm produces and the specific destination markets where a firm sells its goods should also play a role in determining pass-through differences for different firms and destinations. We construct and use the firm's

[2] $lnTFP_{ft}$ should be centered around its sample mean (just subtract the average sample firm productivity from it) so that $lnTFP_{ft-1} = 0$ for the average productivity firm. This will facilitate the interpretation of the regression results.

export share in a specific market as a proxy for perceived demand elasticity or the degree of competition the firm faces in a specific market. More specifically, we include the firm-sector-destination specific export shares S_{fskt-1} within a broader HS 4-digit sector s. We calculate the export shares as $S_{fsct} = \frac{ExportValue_{fsct}}{\sum_{f' \in F_{f'sct}} ExportValue_{f'sct}}$ with $F_{f'sct}$ being the set of Chinese exporters supplying a product i in sector s to country c at time t.

3.1.2 Asymmetric pass-through of appreciations and depreciations

The resulting degree of pass-through will in general be different across depreciation versus appreciation episodes for both elastic or inelastic destination markets, as outlined in the table below, according to the reasoning spelled out in the next few paragraphs.

Degree of Pass-through of exchange rate change to destination price		
	elastic demand	inelastic demand
source-country currency depreciation	high	low
source-country currency appreciation	low	high

Exporters to a destination market with inelastic demand will opt for high pass-through of source country currency appreciations and low pass-through of depreciations. Such exporters would not gain as much market (measured by quantity Q_{fikt} sold by firm f for product i in destination market k at time t) by reducing the destination price in destination-country currency (P_{fikt}) after a source-country exchange rate (e_{kt}) depreciation (an increase in e_{kt} standing for more units of the source-country currency per unit of destination-country currency), thus they would likely avoid passing this change in the nominal exchange rate to the destination market buyers. Instead, they would likely absorb this exchange rate change which would then be reflected in an increase in the price they receive in units of the source-country currency (UV_{fikt}) and a low pass-through coefficient. Moreover, such exporters would not lose much market in the destination country by increasing P_{fikt} after a source country appreciation (i.e., a fall in e_{kt}) thus would likely pass through to the destination-country buyers this change in the exchange rate via an increase in P_{fikt} which would keep the price they receive in units of the source-country currency (UV_{fikt}) more or less constant thus avoiding a fall in revenue ($UV_{fikt} \times Q_{fikt}$) from this destination market.

Conversely, exporters to destination markets with elastic demand will be associated with low pass- through of source-country currency appreciations and high pass-through of source-country currency depreciations. Such exporters could gain much market (reflected in an increase in quantity Q_{fikt} sold in the destination market) by reducing P_{fikt} after a source-country currency depreciation to keep the price they receive in units of the source-country currency (UV_{fikt}) more or less constant and increase revenue ($UV_{fikt} \times Q_{fikt}$) (and profits if average cost is falling in quantities produced) from this destination market. Thus, high pass-through of source-country currency depreciations in destination markets with elastic demand is likely. On the other hand, exporters to a destination market with elastic Demand can lose much market by increasing P_{fikt} after a source-country currency appreciation, thus opt to absorb exchange rate changes reflected in lower UV_{fikt} that lowers revenue ($UV_{fikt} \times Q_{fikt}$) (and profits with falling average costs of production) from this destination market by less than a higher P_{fikt} would decrease Q_{fikt} and revenue or profits with a nearly constant UV_{fikt}.

Overall, for both elastic or inelastic destinations, there will be asymmetric pass-through of depreciations as compared to appreciations. A symmetric overall affect of depreciations and appreciations would be a rare event. For example, this could be the result of having an equal number of inelastic and elastic product markets in a given destination. We intend to explore this potential asymmetry by investigating how pass-through differs across destination countries and how pass-through varies across product markets with different elasticities, as the degree of pass-through of appreciations or depreciations will depend on the destination market elasticity for each product. Perceived demand elasticity for each market can be firm-destination specific so that firms' market shares in a specific destination is arguably a more relevant proxy as compared to the overall size of the destination country's economy. In this case, pass-through differences between depreciations and appreciations could depend on firms' market shares in a specific destination.

Based on the above, next we run a modified equation 1 that allows for differential pass-through effect of bilateral real exchange rate appreciations and depreciations:

$$\begin{aligned} \Delta ln(p_{fict}^{fob}) = (\beta_1 + \beta_2 lnTFP_{ft-1} + \beta_3 Imp_{ft-1} + \beta_4 S_{fsct-1})\Delta lne_{ct} \\ +(\beta_1 + \beta_2 lnTFP_{ft-1} + \beta_3 Imp_{ft-1} + \beta_4 S_{fsct-1})\Delta lne_{ct} \times AP \\ +\gamma \Delta lnTFP_{ft} + \delta \Delta Imp_{ft-1} + \lambda \Delta lnGDP_{ct} + \eta_2 lnTFP_{ft-1} \\ +\eta_3 Imp_{ft-1} + \eta_4 S_{fsct-1} + \psi_t + \mu_{fic} + \epsilon_{fict}, \end{aligned} \quad (2)$$

where AP denotes an appreciation dummy. The remaining variables are defined as in equation 1. The coefficients estimates for this specification are reported in Table 3.

3.1.3 Exchange rate pass-through and dominant currency paradigm

Next, we explore the empirical relevance of the dominant currency paradigm put forward by Casas et al. (2016) and Boz et al. (2017) as an alternative to local currency pricing and producers currency pricing for the understanding of exchange rate pass-through. More specifically, we run the following baseline specification to test whether pass-through behavior into export prices is consistent with an important and special or dominant role of the US dollar in international trade:

$$\Delta ln(p_{fict}^{fob}) = \beta_0 \Delta lne_{ct} + \beta_1 \Delta lne_{USD,t} + \lambda ln\Delta GDP_{ct} + \gamma \Delta lnTFP_{ft} + \mu_{fic} + \epsilon_{fict}, \quad (3)$$

where we add the real RMBUSD exchange rate Δlne_{USDt} in addition to the bilateral real exchange rate Δlne_{ct}. This allows us to test the importance of the USD as a potential dominant currency driving pricing decisions of Chinese exporters. We report results from this exercise in Table 4.As the real RMBUSD exchange rate only varies along the time dimension, we omit time fixed effects in this specification. This equation is also estimated without the US as an export destination, as that would confuse local currency pricing with dominant currency pricing in this case.

3.2 Quality

Our pass-through estimation exercise above can potentially provide us with implicit evidence for the presence of quality upgrading during appreciations for firms with specific characteristics. For example, a role for the imported input share in the degree of pass-through would imply that imported inputs act as a natural hedge in restraining input costs during appreciations or allowing the firm to import higher quality inputs at the same price it was importing lower quality inputs prior to the appreciation. In this section, we test explicitly for the presence of quality upgrading, by considering quality regressions with a proxy of product quality for each firm as the dependent variable. First, we explain how we estimate this proxy for quality in the next subsection.

3.2.1 Estimating Quality

Since export quality is not directly observable in our data, we infer quality from observed demand patterns in Chinese export destinations as in Khandelwal et al. (2013). In this framework, a higher quality increases demand for given relative prices and income in export destinations. This implies that quality in our understanding is not limited to physical characteristics of the good, but also entails firm activities like branding, advertising, and the coupling of products with related services such as maintenance in order to enhance the perceived quality of the product from the viewpoint of the consumer. More formally, demand in a destination is assumed to follow an empirical CES demand function, $x_{fict} = q_{fict}^{\sigma-1} p_{fict}^{-\sigma} \widetilde{P}_{ct}^{\sigma-1} E_{ct}$, where x_{fict} corresponds to demand of good i supplied by firm f to destination c in year t. This demand depends on product quality q_{fict} that acts as a demand shifter, the price of the exported good in local currency p_{fict} relative to aggregate prices $\widetilde{P_{ct}}$ and income E_{ct} in destination countries. As we do not have information on local prices in our dataset, we multiply fob export prices denominated in USD p^{fob}_{fict} by the destination country's exchange rate against the USD and (iceberg) trade costs τ_{ct}, $e^{*}_{USDt}\tau_{ct}p^{fob}_{fict} = p_{fict}$, to replace local currency prices p_{fict} with observables in the demand function above. We then take logs of the demand function and recover export quality from the residuals obtained from the following OLS regression:

$$ln(x_{fict}) + \sigma ln(p^{fob}_{fict}) = (\sigma - 1)log\widetilde{P}_{ct} - \sigma ln(e_{USDt}\tau_{ct}) + log(E_{ct}) + \underbrace{(\sigma - 1)ln(q_{fict})}_{=e_{fict}} \quad (4)$$

$$ln(x_{fict}) + \sigma ln(p^{fob}_{fict}) = \alpha_i + \alpha_{ct} + \underbrace{(\sigma_s - 1)ln(q_{fict})}_{=e_{fict}} \quad (5)$$

We estimate equation (4) with destination-time fixed effects α_{ct} that absorb income (E_{ct}) aggregate price movements ($\widetilde{P}_{ct}$) and changes in trade costs(τ_{ct}), and exchange rates (ϵ_{jt}) over time (see equation (5)). Because products may not be comparable among them, the α_i fixed effects pick up fundamental differences across products. The basic idea of this method is intuitive: Conditional on product price and income in the destination country, increases in demand within a HS 6-digit product are associated with a higher quality. Put differently, the quality of a product is identified from demand changes within a HS 6-digit product for a given fob export price after controlling for the price index, income, tariffs, and exchange rate changes. After estimating equation (10), the quality of exports is then calculated from predicted residuals $\hat{e_{fict}}$:

$$ln(\hat{q_{fict}}) = \frac{\hat{e_{fict}}}{\sigma_s - 1} \quad (6)$$

To obtain the predicted quality $ln(\hat{q}_{fict})$ in equation (6), we use the elasticities of substitution σ_s from Imbs and Méjean (2015) available at the 3-digit ISIC (Revision 2) sector-level

s.[3]

3.2.2 Explaining Quality

We estimate the following equation to test whether export quality changes depend on the bilateral exchange rate and on potentially important firm characteristics such as productivity, and their interactions:

$$\Delta ln(\hat{q}_{fict}) = (\beta_1 + \beta_2 lnTFP_{ft-1} + \beta_3 Imp_{ft-1} + \beta_4 S_{fsct-1})\Delta lne_{ct} + \gamma \Delta lnTFP_{ft} + \delta \Delta Imp_{ft-1} + \lambda \Delta lnGDP_{ct} + lnRGDP_{ct-1} + \eta_2 lnTFP_{ft-1} + \eta_3 Imp_{ft-1} + \eta_4 S_{fsct-1} + \psi_t + \mu_{fic} + \epsilon_{fict}, \quad (7)$$

Results from this estimation exercise are reported in Table 5. In addition, to examine the potential role of a dominant currency for quality adjustments at the firm-product level, we also add the real RMBUSD exchange rate $\Delta lne_{USD,t}$ to equation (7) omitting in this case year fixed effects. Estimated coefficients based on this specification are shown in Table 5.

4 Empirical results

4.1 Firm characteristics and exchange rate pass-through

In Table 2, we present results on how the fob export prices denominated in USD react when the bilateral RMB exchange rate against the destination's currency changes. The coefficient estimates in the first row reveal that changes in the bilateral real exchange rates do not affect USD export prices at the dock for the average firm across columns 1 to 4. This means that the average Chinese firm does not adjust mark-ups in response to real exchange rate movements, which then implies that most of currency fluctuations are passed on to foreign consumers ("high pass-through") in their local currencies, except for

[3] Imbs and Méjean (2015) employ the novel tetrad method proposed by Caliendo and Parro (2014) to estimate the trade elasticities.

consumers using the US dollar as their local currency, consistent with previous results on Chinese exporters (Li et al., 2015).

[insert Table 2 here]

Moreover, Chinese firms price to market according to the business cycle of each destination economy: they raise export (dollar) prices in destinations facing booming times as nominal GDP is increasing, and reduce prices in destinations facing slumps as nominal GDP is falling. This is shown in the first specification in column 1 of Table 2, and persists in columns 2 to 4 when we add other potential determinants in addition to $\Delta lnGDP$. Furthermore, as shown in columns 2 to 4, firms experiencing productivity gains ($\Delta lnTFP_{ft} > 0$) increase export prices significantly, suggesting that some of the productivity gains of Chinese exporters are associated with quality improvements, as also argued in Fan et al. (2015) and as shown in our quality regressions results for which are presented in Tables 5 and 6 later on.

In column 3 of Table 2, we present estimates from a specification that now includes the (lagged) TFP level and the imported input share along with their interactions, in addition to the explanatory variables already discussed above. As we can see in the second row in column 3, the estimated coefficient for the TFP interaction with the bilateral exchange rate is positive, and remains so in column 4 once we add the firm-destination-specific export share and its interaction. That is, in line with the broader pass-through literature (see Berman et al., 2012), more productive firms tend to absorb a higher share of RMB movements in their mark-ups, keeping local currency prices relatively more stable, and price more to markets. In other words, more productive firms tend to increase (decrease) dollar export prices more when the RMB depreciates (appreciates) so that the local currency price decrease (increase) is smaller after an RMB depreciation (appreciation) relative to pricing decisions of less productive exporters with higher pass-through rates.

Interestingly, estimates presented in column 3 of Table 2 do not confirm the role of the firm's share of imported inputs to total input costs for export pricing, present in previous applications, for the case of Chinese exporters we study here. Importantly, such a role re-emerges once we allow for the presence of asymmetries in pass-through for depreciations versus appreciations in the specifications results for which are presented in the next subsection in Table 3.

In column 4 of Table 2, we present estimated coefficients based on a specification that now also includes the firm-destination-specific export share and its interaction with the exchange rate. The insignificant estimated coefficient for the interaction of the export share with the exchange rate shown in row 4 here, does not imply a role for (Chinese) firms product market shares on their export pricing decisions in relation to changes in the exchange rate.

However, the firm-destination-specific export share has a direct negative effect on export USD prices suggesting that firms offer lower prices for the same product in destinations where their market share for that product is higher. To the extent that market share is positively associated with market power in a destination market, our finding here could imply (surprisingly) that firms sell more cheaply in markets where their perceived elasticity of demand is lower. However, market share is also an indicator of a firm's reliance or degree of dependence on a specific destination market. A firm might want to retain its dominant position in a destination market by maintaining somewhat lower price for the same product there as compared to other destinations. [4]

Asymmetric pass-through

The results become perhaps more intriguing and certainly more enlightening, once we allow for differential effects of appreciations and depreciations on exporters' pricing decisions, in the specifications shown in Table 3, which has results for the whole sample in the

[4] Another partial explanation may be "reverse causality" from export prices to market shares that might persist even though we used lagged market shares.

first 5 columns and the result for the sample of differentiated goods which are defined by the classification in Rauch (1999). For one, pass-through is not symmetric between appreciations and depreciations, suggesting these episodes should be treated differently in pass-through regressions commonly used in the pass-through literature, and in line with the recent asymmetric pass-through literature. More specifically, we find that fob export (dollar) prices are more responsive to depreciations than appreciations at least for the average firm, as can be seen from comparing (which involves adding for appreciations) the first two rows in Table 3. This suggests that Chinese firms do not completely pass on a depreciation of the RMB to foreign buyers in their local currency, or equivalently, that they increase fob export (dollar) prices (see columns 3 to 6). Appreciations on the other hand, have at best a marginal effect on fob export prices consistent with greater pass-through into (higher) foreign buyers local currency prices. In terms of our earlier analysis regarding the role of importers' demand elasticity in inducing asymmetries in the degree of pass-through in response to depreciations versus appreciations, our empirical findings here suggest that the average Chinese exporting firm faces inelastic foreign demand for its products during the period under study. This might be explained by China's accession to the WTO in 2001 that led to a surge in Chinese exports during the sample period or the high prevalence of processing firms (over 50% in our sample). These firms already established in existing supply chains and specialized according to their comparative advantage may arguably be less affected by price movements due to lower perceived demand elasticity compared to final goods producers.

[insert Table 3 here]

Furthermore, columns 1, 4 and 6 of Table 3 confirm the higher responsiveness of fob export prices in USD to exchange rate fluctuations for more productive firms, implying again a positive relationship between the degree of pricing to markets in export destinations and firm productivity. However, the interaction between firm productivity and exchange rate changes does not differ between appreciation and depreciation episodes, as revealed by the non-significant triple interactions ($lnTFP_{ft-1} \times \Delta lne_{ct} \times Appreciation$) in columns 1, 4 and 6.

By contrast, as we can see in columns 2, 5 and 6 of Table 3, the effect of real bilateral exchange rate changes on export pricing as a function of a firm's imported input share is only present during appreciation episodes, which might be one explanation for its insignificance in the results presented in Table 2, where asymmetries were not taken into account. Specifically, when the RMB appreciates against a destination's currency, Chinese firms with higher shares of imported inputs to total cost on average raise export prices in USD. This might be explained by a simultaneous increase in export quality for firms that rely more on imported inputs, as these firms can benefit more from cheaper high-quality inputs allowing them to upgrade product quality after a RMB appreciation. As we show later (in Table 6), an appreciation of the RMB against the USD results in higher export quality.[5]

Finally, as we can see in columns 3 to 6 of Table 3, pass-through into local consumer prices is very high irrespective of the level of a firm's product market share in a given destination. This also holds regardless of whether a firm faces an appreciation or a depreciation episode. The product-destination-specific export market share for a firm also has a direct negative effect on export USD prices for Chinese firms for the specifications shown in Table 3 as was the case in Table 2.

Furthermore, in Table 3 as in Table 2, Chinese exporting firms are shown to price to market based on the business cycle of each destination economy. That is, they charge higher USD prices to booming destinations where nominal GDP is growing faster. Finally, in Table 3 as in Table 2, firms experiencing higher productivity are shown to charge higher

[5]However, we do not find direct evidence for this particular link between quality and the interaction between the share of imported inputs and bilateral exchange rate changes for a firm in the quality estimations in Tables 4 and 5.

prices as compared to other firms. This implies that some of the productivity gains of Chinese exporters are associated with quality improvements. We confirm this in the quality regressions considered below in Tables 5 and 6.

A dominant role for the US dollar?

Next, in Table 4 we test the importance of the real RMBUSD exchange rate for export pricing in order to assess the potentially important or special role of the US dollar in international trade. This then serves as a broad test of the empirical relevance of the dominant currency paradigm proposed by Gopinath and co-authors (Casas et al., 2016; Boz et al., 2017) as an alternative to local currency pricing and producers currency pricing. The results indicate that changes in the real RMBUSD exchange rate affect export prices in USD strongly, more so than the bilateral RMB exchange rate vis-a-vis exporting destinations currencies and in the opposite direction as compared to the latter. Quantitatively, a 10% depreciation (appreciation) of the RMB against the USD increases (reduces) the export price in USD by about 2.5%. This may well be driven by higher input costs after a RMB depreciation against the USD, which forces firms to increase export prices in order to compensate for the squeezed profit margins. Conversely, a RMB appreciation relative to the USD allows Chinese exporters to reduce export prices due to lower imported input costs.

[insert Table 4 here]

4.2 Exchange rate changes and quality adjustments

Some of our results on exchange-rate pass-through discussed in the previous section in relation, for example, to the imported input share or the role of TFP, may be affected by the presence of firm-level quality adjustments in response to bilateral exchange rate movements against the importer's currency. In this section, we therefore test explicitly whether exports quality reacts to the exchange rate by considering regressions where the dependent variable is (an estimated proxy of) product quality for each firm-product-destination triple. This also allows us to examine how the effect of the exchange rate on export quality depends on a firm's TFP, the share of imported inputs and the export market share.

Columns 1 and 2 of Table 5 show that export quality tends to go slightly up in periods of RMB appreciations against the destination's currency, and slightly down when RMB depreciates. The average firm is thus likely to upgrade quality after an appreciation episode. This relationship is reversed once we take firm productivity and the share of imported inputs into account, as displayed in columns 3 to 5. In column 3, we add the firm's TFP and its share of imported inputs along with their interactions with the exchange rate. As shown in column 3, export quality tends to rise (fall) with higher TFP during depreciations (appreciations). Relatedly, in columns 4 and 5, there's also some evidence that export quality rises (falls) with higher imported input shares during depreciations (appreciations). One interpretation is that high performing firms that exhibit productivity levels above average and source an important fraction of inputs abroad, are more equipped to upgrade their product quality to exploit export opportunities that arise after a RMB depreciation. Verhoogen (2008) finds a similar pattern of quality upgrading for more productive Mexican exporters in response to the peso devaluation after the Tequila crisis in the nineties. This result also implies that the significantly lower estimated pass-through of more productive firms observed in Table 2 and 3 is partly confounded by the quality response of firms that are more productive and/or rely more on imported inputs, which, for instance, enables them to raise USD export prices after a RMB depreciation. Therefore, the negative relationship between firm productivity and exchange rate pass-through is not only driven by local distribution costs or the product's *quality level*, as emphasized by the previous literature (Berman et al., 2012; Chen and Juvenal, 2014; Corsetti and Dedola, 2005), but is also a result of *quality increases (decreases)* of high productivity firms in response to depreciations (appreciations). In addition, there's strong evidence in columns 2 to 5 of Table 5 that firms with rising TFP tend to increase quality over time, consistent with the price estimations in Tables 2 to 4 where higher TFP was associated with higher export USD prices. Overall, our quality estimations imply that correcting for quality changes in price estimations is crucial for obtaining unbiased pass-through rates [6].

[insert Table 5 here]

In the specification shown in column 4 of Table 5, we also add the firm's share of the market for a specific product and destination along with its interaction with the exchange rate, while column 5 repeats the latter specification but considering only differentiated products per the Rauch classification. In columns 4 and 5 of Table 5, we see that a higher market share in a destination market reduces the exported quality to this destination. As the product market share of a firm in a destination can capture its market power and inversely relates to its perceived demand elasticity there, this would suggest that firms may offer lower quality for the same price (or the same quality for a higher price) to destinations they perceive as more inelastic in terms of their demand for a specific product. Moreover, we find some evidence[7] that higher market shares for a firm's product in a given destination are associated with relatively lower export quality during depreciations and higher export quality during appreciations as compared to other exporting firms.

Finally, throughout columns 1 to 5 of Table 5 we can see that firms tend to increase export quality of products to destinations that enjoy booming times in terms of rising nominal GDP and reduce it in times of falling nominal GDP. Thus, exporting firms do not only price to market depending on each destination market's business cycle and implied demand

[6] A similar point has been made in Fauceglia et al. (2017)

[7] Specifically, a marginally significant coefficient estimate in column 4 and marginally insignificant estimate in column 5.

conditions as shown in Tables 2 to 4, but also adjust quality accordingly as shown here in Table 5. That is, it appears that some of the apparent, so called, "pricing to market" has to do with greater quality of similar (HS6 category) products being sold in different markets, rather than exactly identical products being sold at different prices across destinations according to their demand conditions.[8]

Does the US dollar exchange rate matter for quality?

To further examine the importance of the US dollar as a dominant currency in international trade, we consider the impact of the RMBUSD exchange rate on export product quality. Columns 1 to 4 of Table 6 reveal a strong and significant effect of changes in the real RMBUSD exchange rate on quality adjustments of Chinese exporters. A 10% appreciation (depreciation) of the RMB against the USD improves (reduces) export quality by more than 8%. A likely explanation for this relationship is that Chinese firms can switch to sophisticated imported inputs more cheaply when the RMB gains value against the USD in real terms. By contrast, the bilateral real exchange rate and its interactions with firm productivity and imported input share lose significance once the real RMBUSD exchange rate is taken into account in column 3.[9]

[insert Table 6 here]

An interesting result appears in column 4 once we introduce the product market share of the firm in the destination country and its interaction: the bilateral exchange rate is now

[8] We note that the estimated impact of nominal GDP growth for differentiated products is greater than for the complete sample of products. This makes good economic sense to the extent that booming demand conditions should have a greater impact on differentiated products as compared to necessities. This is also a striking finding considering that non-differentiated products comprise only a small fragment of the complete sample of goods, suggesting that the difference between the impact of the cycle on the quality of differentiated as compared to non-differentiated products is much larger than the difference in the estimates presented in columns 4 and 5.

[9] It must be noted that the estimations in Table 6 are not directly comparable to those in Table 5 as we now exclude the US as a destination for Chinese exports to distinguish dominant currency (dollar) pricing from local (destination) currency pricing which coincide when the US is used as a destination.

estimated to have the opposite effect on product quality as compared to its estimated effect in Table 5 or as compared to the estimated effect of the RMBUSD exchange rate in Table 6. In this case, a depreciation of the bilateral exchange rate relative to a destination currency increases product quality in that destination, implying that firms attempt to exploit the export opportunities that arise after a RMB depreciation relative to an importing country's local currency, by increasing product quality in that destination. It could be argued that, as importing of inputs likely depends on the RMBUSD exchange rate rather than on the bilateral exchange rate, an RMB depreciation relative to an importing country's currency does not make imported inputs more expensive in RMB for Chinese firms. Thus, the main effect of such a bilateral depreciation of the RMB relative to a destination's currency, once we also control for the RMBUSD exchange rate, would be on the enhanced export opportunities that arise from being able to sell at lower prices in local currency in that destination market.

Interestingly, the interaction between the real bilateral exchange rate and the market share in a given destination becomes more negative and significant after controlling for the real RMBUSD rate in column 4 compared to the corresponding interaction in column 4 of Table 5. This suggests again that during depreciations (appreciations), firms offer lower (higher) quality in markets where they perceive themselves as having greater market power. Finally, the results in Table 6 provide supportive evidence for a positive relationship between productivity gains and quality improvements that we also encountered in the price estimations (see Tables 2 to 4) and in Table 5.

5 Conclusion

We have set out to explore the degree and determinants of pass-through across firms, products and destinations. We find an important role for firm productivity in reducing the degree of pass-through. Moreover, based on our quality regressions, we can partly attribute this to a stronger response of export quality to exchange rate movements for firms with high productivity or larger shares of imported inputs. Furthermore, we document potential pass-through asymmetries between depreciations and appreciations. More specifically, the average Chinese firm is shown to be less responsive to appreciations than depreciations, with relatively greater pass-through into importers' currency prices during appreciations than during depreciations. This finding is consistent with inelastic foreign demand for Chinese exports during the period under study. Finally, we have shown a special or "dominant" role of the US dollar. Specifically, we show that changes in the real RMBUSD exchange rate affect export prices and quality strongly and more so than the bilateral RMB exchange rate vis-a-vis destinations currencies.

Our results suggest that to appropriately assess the degree of pass-through in response to exchange rate changes, it is important to incorporate changes in quality along with potential asymmetries between depreciations and appreciations.

Table 1. Summary statistics

Panel A: size of variables by year and in total

Variable	Total	2000	2001	2002	2003	2004	2005	2006
firm	53,355	17,006	14,603	24,283	28,337	38,939	40,539	37,442
country	179	171	149	176	171	173	174	176
HS6 product	6,314	4,124	3,344	4,399	4,461	4,520	4,517	4,439
firm-prd-dest	1,801,397	231,675	88,113	375,785	474,433	673,291	691,271	718,539

Panel B: summary statistics of the panel data

Variable	Obs	Mean	Std. Dev.	Min	Max	note
unit price	3,239,260	106.61	653.04	5.47E-02	5.91E+03	in USD
real ex-rate	3,239,260	1.516	1.685	-0.632	20.85	
TFP	3,239,260	4.583	0.388	2.293	5.41	
impshr	3,239,260	0.334	0.768	0	5.71	
s_fskt	3,239,260	0.100	0.229	1.21E-06	1	
GDP	3,239,260	2,097,463	3,552,419	39.83	1.39E+07	in mil 2011 USD

Table 2. Benchmark Regressions

Dependent variable: lnUV				
	(1)	(2)	(3)	(4)
Δlne	0.00808	0.00528	-0.00145	0.0141
	(0.00796)	(0.00739)	(0.00786)	(0.0219)
lnTFPt-1 x Δlne			0.306***	0.283**
			(0.106)	(0.115)
IMP t-1 x Δlne			-0.0158	-0.0110
			(0.0174)	(0.0183)
S_fskt-1 x Δlne				-0.0233
				(0.0223)
lnTFP_t-1			-0.0270	-0.0118
			(0.0356)	(0.0359)
IMPt-1			-0.00371	-0.00391
			(0.00349)	(0.00374)
S_fskt-1				-0.0753***
				(0.00768)
ΔlnGDP	0.0443***	0.0400***	0.0394***	0.0377***
	(0.0112)	(0.0122)	(0.0121)	(0.0140)
ΔlnTFPt-1		0.142***	0.132***	0.132***
		(0.0190)	(0.0273)	(0.0275)
ΔIMP		-0.00232	-0.00461	-0.00486
		(0.00198)	(0.00283)	(0.00299)
FE: yr/fm-prd-dest	yes/yes	yes/yes	yes/yes	yes/yes
Constant	-0.00442	-0.00433	-0.000403	0.0131***
	(0.00330)	(0.00355)	(0.00481)	(0.00464)
Observations	1,471,598	1,304,065	1,304,065	1,177,901
R-squared	0.002	0.002	0.002	0.002
Number of groups	731,218	679,625	679,625	622,545

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3. Asymmetric effect of appreciations and depreciations

Dependent var: lnUV	(1)	(2)	(3)	(4)	(5)	(6)
Δlne	0.0232	0.0308	0.125***	0.0984**	0.108***	0.0774*
	(0.0164)	(0.0211)	(0.0386)	(0.0388)	(0.0401)	(0.0414)
Δlne x Ap	-0.0563**	-0.0467	-0.153***	-0.135***	-0.119***	-0.0993**
	(0.0271)	(0.0286)	(0.0386)	(0.0412)	(0.0417)	(0.0461)
lnTFPt-1 x Δlne	0.522**			0.417**		0.404*
	(0.220)			(0.206)		(0.218)
lnTFPt-1 x Δlne x Ap	-0.449			-0.289		-0.358
	(0.305)			(0.298)		(0.321)
IMPt-1 x Δlne		0.0410			0.0346	0.0344
		(0.0292)			(0.0287)	(0.0336)
IMPt-1 x Δlne x Ap		-0.0747**			-0.0653*	-0.0634*
		(0.0364)			(0.0361)	(0.0378)
S_fskt-1 x Δlne			-0.134***	-0.121**	-0.125***	-0.107**
			(0.0470)	(0.0496)	(0.0477)	(0.0511)
S_fskt-1 x Δlne x Ap			0.148***	0.143***	0.134***	0.125**
			(0.0489)	(0.0526)	(0.0515)	(0.0565)
Dummy for Ap	-0.00481*	-0.00468*	-0.00222	-0.00225	-0.00214	-0.00304
	(0.00256)	(0.00259)	(0.00276)	(0.00272)	(0.00275)	(0.00291)
lnTFPt-1	-0.0132	-0.00420	-0.00523	-0.0121	-0.00406	-0.0189
	(0.0359)	(0.0356)	(0.0357)	(0.0359)	(0.0356)	(0.0383)
IMPt-1	-0.00420	-0.00428	-0.00419	-0.00419	-0.00423	-0.00372
	(0.00369)	(0.00373)	(0.00368)	(0.00368)	(0.00372)	(0.00390)
S_fskt-1	-0.0756***	-0.0757***	-0.0757***	-0.0755***	-0.0756***	-0.0786***
	(0.00767)	(0.00767)	(0.00767)	(0.00767)	(0.00767)	(0.00878)
ΔlnGDP	0.0199	0.0192	0.0280*	0.0275*	0.0277*	0.0299*
	(0.0155)	(0.0156)	(0.0160)	(0.0160)	(0.0160)	(0.0172)
ΔlnTFPt-1	0.131***	0.131***	0.131***	0.131***	0.131***	0.122***
	(0.0275)	(0.0274)	(0.0275)	(0.0275)	(0.0274)	(0.0296)
ΔIMP	-0.00481	-0.00484	-0.00482	-0.00482	-0.00485	-0.00487
	(0.00298)	(0.00298)	(0.00298)	(0.00298)	(0.00298)	(0.00307)
FE: yr/fm-prd-dest	yes / yes	yes / yes	yes / yes	yes / yes	yes / yes	yes / yes
Constant	0.0291***	0.0283***	0.0261***	0.0268***	0.0258***	0.0280***
	(0.00401)	(0.00403)	(0.00417)	(0.00417)	(0.00415)	(0.00444)
Observations	1,177,901	1,177,901	1,177,901	1,177,901	1,177,901	1,049,173
R-squared	0.002	0.002	0.002	0.002	0.002	0.002
Number of groups	622,545	622,545	622,545	622,545	622,545	549,631

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4. Dominant currency paradigm and export prices

Dependent var : lnUV			
	(1)	(2)	(3)
Δlne	-0.0162**	-0.0175**	-0.0175**
	(0.00771)	(0.00865)	(0.00865)
ΔlnRMBUSD	0.235***	0.243***	0.243***
	(0.0173)	(0.0190)	(0.0190)
ΔlnGDP	0.289***	0.293***	0.293***
	(0.0178)	(0.0195)	(0.0195)
ΔlnTFPt-1		0.123***	0.123***
		(0.0198)	(0.0198)
ΔIMP		-0.00256	-0.00256
		(0.00202)	(0.00202)
Constant	0.0198***	0.0204***	0.0204***
	(0.00153)	(0.00167)	(0.00167)
FE: fm-prd-dest	yes	yes	yes
Observations	1,319,143	1,170,478	1,170,478
R-squared	0.001	0.001	0.001
Number of groups	661,408	614,499	614,499

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5. Relationship between real bilateral exchange rates and export quality

Dependent var: lnq

	(1)	(2)	(3)	(4)	(5)
Δlne	-0.0381***	-0.0381***	-0.0657***	-0.0244	-0.0276
	(0.00988)	(0.00980)	(0.0174)	(0.0344)	(0.0359)
lnTFPt-1 x Δlne			0.375*	0.130	0.164
			(0.197)	(0.205)	(0.210)
IMP t-1 x Δlne			0.0374	0.0475*	0.0559*
			(0.0269)	(0.0268)	(0.0287)
S_fskt-1 x Δlne				-0.0754*	-0.0744
				(0.0455)	(0.0457)
lnTFPt-1			-0.0623	-0.0190	-0.0202
			(0.0598)	(0.0595)	(0.0624)
IMPt-1			-0.000918	0.000299	0.00138
			(0.00572)	(0.00569)	(0.00588)
S_fskt-1				-0.554***	-0.582***
				(0.0170)	(0.0195)
ΔlnTFPt-1		0.450***	0.421***	0.427***	0.446***
		(0.0318)	(0.0437)	(0.0436)	(0.0460)
ΔIMP		-0.00257	-0.00246	-0.00165	-0.00159
		(0.00377)	(0.00530)	(0.00534)	(0.00549)
lnRGDP per capita t-1	0.00207	0.00136	0.00686	0.00455	0.00748
	(0.0232)	(0.0240)	(0.0241)	(0.0251)	(0.0268)
ΔlnGDP	0.0772***	0.0835***	0.0827***	0.0794***	0.0918***
	(0.0243)	(0.0255)	(0.0255)	(0.0256)	(0.0277)
FE: yr/frm-prd-dest	yes/yes	yes/yes	yes/yes	yes/yes	yes/yes
Constant	0.240	0.244	0.194	0.318	0.299
	(0.232)	(0.241)	(0.241)	(0.251)	(0.269)
Observations	1,224,151	1,155,216	1,155,216	1,155,216	1,045,287
R-squared	0.012	0.013	0.013	0.018	0.019
Number of groups	632,374	609,629	609,629	609,629	547,106

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6. Dominant currency paradigm and export quality

Dependent var: lnq				
	(1)	(2)	(3)	(4)
Δlne	-0.00196	-0.00415	-0.0124	0.307***
	(0.0172)	(0.0167)	(0.0202)	(0.0940)
ΔlnRMBUSD	-0.743***	-0.740***	-0.747***	-1.033***
	(0.0343)	(0.0356)	(0.0344)	(0.0660)
lnTFPt-1 x Δlne			0.230	-0.172
			(0.220)	(0.249)
IMP t-1 x Δlne			0.00342	-0.0110
			(0.0290)	(0.0299)
S_fskt-1 x Δlne				-0.403***
				(0.133)
lnTFPt-1			-0.0326	0.0346
			(0.0628)	(0.0626)
IMPt-1			-0.000847	0.000755
			(0.00619)	(0.00614)
S_fskt-1				-0.458***
				(0.0171)
ΔlnTFPt-1		0.453***	0.439***	0.461***
		(0.0334)	(0.0460)	(0.0461)
ΔIMP		0.00200	0.00161	0.00271
		(0.00494)	(0.00669)	(0.00688)
lnRGDP per capita t-1	-0.651***	-0.634***	-0.634***	-0.676***
	(0.0208)	(0.0214)	(0.0217)	(0.0234)
ΔlnGDP	-0.178***	-0.174***	-0.181***	-0.441***
	(0.0353)	(0.0365)	(0.0358)	(0.0592)
FE: frm-prd-dest	yes	yes	yes	yes
Constant	6.519***	6.351***	6.362***	6.842***
	(0.209)	(0.215)	(0.218)	(0.235)
Observations	1,094,844	1,033,479	1,033,479	1,033,479
R-squared	0.005	0.006	0.006	0.010
Number of groups	570,627	549,997	549,997	549,997

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

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