New Exporters and Continuing Exporters under Exchange Rate Fluctuations

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Abstract

In this paper we investigate the different behaviors between new and continuing exporters in response to exchange rate shocks. We establish a dynamic model, in which new exporters strategically charge a lower price than continuing exporters in order to increase their current sales and accumulate their consumer base in future periods. The model predicts that new exporters adjust their price more aggressively relative to their continuing counterparts in response to exchange rate fluctuations in order to build future demand stock. Using a transaction-level dataset containing all Chinese exporters over the 2000-2009 period, we find supporting evidence for the model's predictions: new exporters adjust their price 1.5 times more than the continuing exporter. Our findings imply different exchange rate pass-through between new and continuing exporters, and the various ratios of new exporters lead to different degree of exchange rate pass-through across countries at the aggregate level.

Keywords: · New Exporters · Continuing Exporters· Exchange Rate Shock · Pass-through
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1 Introduction

New exporters differ from continuing exporters in a number of dimensions, e.g., not only in their productivity (Aw et al., 2000; Eaton et al., 2007; Melitz, 2003), but also their market demand (Eaton et al., 2007; Melitz, 2003; Foster et al., 2015; Roberts et al., 2012).[1] These heterogeneities imply that new exporters perform differently from continuing exporters in international markets.

How to survive and grow in international markets are crucial for both new and continuing exporters. However, uncertainties in international markets, including exchange rate fluctuations, result in a strikingly high turnover (failure) rate, especially for new exporters (Bernard et al., 2007; Hu et al., 2016). Until so far, there is few study explores the different strategic responses between new and continuing exporters under external fluctuations, and how do the different responses shape future growth path for new exporters.

To be specific, exchange rate fluctuation is one of the most common and important uncertainties the exporting firms have to face in international markets. A vast amount of literature documents the profound influence of exchange rate movements on exporters' profitability through changing their markup, price, product mix, entry and exit decisions (Chatterjee et al., 2013; Berman et al., 2012; Greenaway et al., 2008; Chen and Juvenal , 2016; Li et al., 2015; Atkeson and Burstein, 2008). However, the heterogeneities in price adjustments between new and continuing exporters under exchange rate fluctuations have been neglected in previous literature. This research question is of economic importance to uncover how new exporters survive and grow in international markets.

In order to fill the gap, we employ a detailed Chinese micro-level export data to capture the heterogeneous responses between the two different groups. We find that comparing with continuing exporters, new exporters tend to adjust their export price more aggressively in response to exchange rate fluctuations. Our finding offers a new perspective of firm-level heterogeneous price responses under exchange rate shocks, and it also provides a possible explanation for the cross-country different ERPT: the ratio of new exporters varies across countries. In addition, our finding sheds new light on the observed declining pattern of exchange rate pass-through (ERPT thereafter) during the past two

[1] for instance, Aw et al. (2000) show that the average productivity is highest for continuing exporters followed by the group of entrants, exits, and non-exporters. Foster et al. (2015) find that demand gaps close slowly between continuing firms and new entrants.

decades (e.g. Campa and Goldberg, 2005; Marazzi and Sheets, 2007): the globalization trend in the past two decades brings a surge of new entrants into international markets, which drives down the aggregate ERPT.

To motivate our study we first present two stylized facts: 1. the firm-level exporting price is increasing in firms' age in a particular market; 2. the firm-level exporting market share also increase in firms' age in the exporting market. These patterns we found are in line with Piveteau (2016), who find a very similar pattern among French exporters.

Motivated by the observed patterns, we establish a simple dynamic model where firms choose their export prices to maximize their long-run profits. In particular, this model features an endogenous demand accumulation mechanism where exporters optimally choose their current export price to build their reputation for future demand stock at the cost of lower current profits. The model predicts that the reputation building or consumers accumulation is more important for new exporters than continuing exporters.[2] This implies that *new exporters* tend to lower their current price and increase their current sales in order to obtain a higher demand in subsequent periods. In response to exchange rate shocks, an appreciation for instance, new exporters have an incentive to reduce their F.O.B export price more than their continuing counterparts to accumulate their consumer base.

We test the predictions of the model with a rich dataset containing comprehensive Chinese exporters during 2000-2009. This dataset provides detailed information on firm-level export price, quantity by destination countries and HS 8-digit product codes. Combining this dataset with the exchange rate information downloaded from Bloomberg, we find that the price set by new exporters is 13.5% lower than that set by continuing exporters; second, relative to continuing exporters, new exporters have lower sales for a particular product in a given market; third, in response to a 10% appreciation of RMB, both new and continuing exporters reduce their export price, but new exporters reduce an additional 0.65% than continuing exporters. Although this figure seems small, it accounts for 52% of continuing exporters' price reduction in response to the same appreciation. All results are consistent with the model's predictions and robust to different specifications.

This paper is closely related to two strands of literature. First, it relates to the

[2]This is consistent with Piveteau (2016) and Rodrigue and Tan (2016). In particular, Rodrigue and Tan (2016) shows that the consumer accumulation process last only 4-5 periods, and after that increase sales cannot increase firm-level competition.

recent and growing literature on the connection between the exchange rate fluctuations and firm-level export performance in particular, the ERPT literature.[3] The availability of micro firm-level data encourages research to study the heterogeneous ERPT across firms. Chen and Juvenal (2016) and Bernini and Tomasi (2015), for instance, find the ERPT is decreasing in firm-level export quality. Berman et al. (2012) and Li et al. (2015) document a negative relationship between the ERPT and firm-level productivity. Amiti et al. (2014) address that the firm-level import intensity and export market shares (markups) have negative influence on firm-level ERPT. Chatterjee et al. (2013) analyze how multi-product firms respond to exchange rate fluctuations.

Our work contributes to the ERPT literature by offering a new dimension of firm-level heterogeneity: a firm's age in an exporting market affects its ERPT. The fact that the ERPT varies widely across countries: 22% for the American importers (Gopinath and Rigobon, 2008); 79% for Belgian exporters (Amiti et al., 2014); 77% for Brazilian exporters (Chatterjee et al., 2013); 92% for French exporters (Berman et al., 2012) and 96% for China Li et al. (2015) can partly be explained by the cross-country different new exporter ratios.

Second, our work relates to the literature studying firm-level dynamics in export markets, particularly, the mechanism how the successful entrants survive and grow into large exporters. As such, our work closely relates to that of Costantini and Melitz (2008), Atkeson and Burstein (2008) and Arkolakis (2015). Unlike these papers, we focus on firm-level dynamics through the evolution of firms' consumer base rather than productivity evolution. The evolution of demand is important for exporter's growth in international markets. Rodrigue and Tan (2016) and Piveteau (2016) suggest that a firm's active manipulation of its price and quality to optimally grow future demand improves the firm's long-run profitability and survival rate. New entrants aiming to build their consumer base behave differently from their older cohorts. These works study firm-level demand dynamics in a stationary framework. Our work contributes to the literature by studying how differently the growing firms respond to exogenous shocks from the continuing or maturing exporters. The different responses between new and continuing exporters to exogenous shocks provides evidence for demand dynamics.

[3]For instance, Atkeson and Burstein (2008); Amiti et al. (2014); Berman et al. (2012); Chatterjee et al. (2013); Campa and Goldberg (2005); Gopinath and Rigobon (2008); Knetter (1993); Giri (2012); Li et al. (2015); Chen and Juvenal (2016),

The rest of the paper will proceed as follows: section 2 describe the data we used and present the stylized facts. Section 3 introduces the model and presents its testable predictions. Section 4 outlines the empirical specifications and test the model's predictions. Section 5 presents the influence of new exporters on the average ERPT, and finally, section 6 concludes.

2 Data and Stylized Facts

2.1 The Data

Our primary objective is to provide a simple characterization of the nature of firm-level price and sale evolutions in export markets. The data we use is collected by the Chinese General Administration of Customs (GAC) and reports detailed firm-level export and import information during 2000-2009. Specifically, the data include information of the traded F.O.B value, quantity and price at firm-level across products (disaggregate as HS8 digit) and destination countries. These dimensions of firm-level export information allow us to study the evolution of firm, product and destination specific market prices over time. In Table 1, we report the descriptive statistics of the main variables we use in the dataset. It includes logarithm of export price, export quantity, import revenue, the number of destinations a firm exports to and the number of products a firm export in the sample.

[Table 1: add a table here]

The exchange rate is the key variable in this paper, which we download from Bloomberg,[4] which provides bilateral nominal exchange rates between major currencies and US dollars. Using this information, we can calculate the nominal exchange rates between China and its trading partners. We match the exchange rate information with the customs data. Since Bloomberg reports the exchange rates for major currencies, the matching

[4]One advantage of using exchange rate information from Bloomberg is that the annual exchange rate is calculated as the average mean over the monthly exchange rate. Therefore, the exchange rate in Bloomberg has a high frequent and be more accurate. In contrast, other sources, such as PennWorld Table or World Bank, only provide the exchange rate at the start/end of each year as the annual exchange rate, which is less accurate.

of the two datasets decreases our sample size.[5] The matching rate is 40.0% overall the total observations in the customs dataset, and the matched sample accounts for 46.3% of the total export value.[6] The matched sample includes 40 OECD countries with 16 currencies, including USD, AUD, EUR, CAD, DKK, HUF, NZD, GBP, JPY, SEK, KRW, NOK, CHF, MXN, PLN, and CZK.

We use real exchange rates instead of nominal exchange rates in the empirical tests. To construct real exchange rates, we deflate the nominal exchange rate by consumer prices. The consumer price index (CPI) is obtained from the IMF website. CPI and CPI_j represent the consumer price index of China and of the corresponding trade country j, respectively. We use e_j and E_j to denote the real exchange rate and the nominal exchange rate between the home country, China, and foreign country j, respectively. E_j is defined as the price of the domestic currency in terms of the foreign currency in country j, for example, E_{US} was 0.125, i.e., one Chinese yuan was worth 0.125 USD according to official nominal exchange rates. Under this definition, an increase in E_j represents an appreciation of the domestic currency against a foreign currency. Finally, the bilateral real exchange rate is given by

$$e_j = \frac{E_j \times CPI}{CPI_j} \tag{1}$$

To be consistent with the customs trade data, real exchange rates in our analysis cover the period from 2000 to 2009. We use a log difference to measure the change in the bilateral real exchange rate between China and country j at an annual basis:

$$\Delta e_{jt} = \log\left(\frac{E_{j,t}}{E_{j,t-1}}\right) + \log\left(\frac{CPI_t}{CPI_{t-1}}\right) - \log\left(\frac{CPI_{j,t}}{CPI_{j,t-1}}\right) \tag{2}$$

In Figure 1, we depict the trend of bilateral exchange rate (in both nominal and real term) of CNY (Chinese Yuan) against a series of major currencies including USD, EUR, CAD, AUD, JPY and GBP, respectively. In Figure 1, both the nominal and real exchange rate are quite volatile during the sample period 2000-2009.

[5] We only focus on countries using major currencies in their international busyness settlement, including international trade

[6] The matching rate is slightly low is because we only account for OECD countries and their corresponding currencies. We drop small countries, whose currency is less likely to be used for invoicing in the bilateral trade. For instance, most of the non-OECD countries invoice their import via USD, rather than their own currencies. If keeps these countries in our sample may bias our estimation results. Thus, Following Li and Zhao (2016) we constraint our study to the OECD countries, whose own currencies are widely used in the international business settlement.

[Figure 1 is to be here]

2.2 Stylized Facts

We document two stylized facts which characterize our data. Specifically, we investigate the relationship between export price/quantity and the duration a firm exports a specific product to a particular destination, which we refer to as *age*. Note that the age, which is defined at firm-product-country-level, captures how many years a particular product has been exported by a firm to a given market.

Before we present the stylized facts, we depict four figures to show the general relationships between the export price, market share and ages. We classify firm-product-country observations into different age groups, and calculate the average (median) export price and market share. Figure 2 (Figure 3) depicts the relationship between the average (median) price with age, while Figure 4 (Figure 5) depicts the relationship between the average (median) export market share and age.

[Figure 2 is to be here]

[Figure 3 is to be here]

[Figure 4 is to be here]

[Figure 5 is to be here]

Figure 2 - Figure 5 show that the average (median) price and average (median) export market share are both increasing in ages but at a diminishing rate. However, it is unclear what factors have caused these depicted patterns.[7] In order to uncover the relationship between the firm-product-country age and firm-product-country-level export price and export market share, we estimate a simple regression using firm-product-country-level data.

Our simple exercise is to regress a current firm-level characteristics in a given destination country (export price, and export market share), denoted by x_{ikjt} on age, along with a series of controls.

$$x_{ikjt} = \alpha + \beta_1 age + \beta_2 age^2 + \chi_{it} + \eta_{ikjt} + \varepsilon_{ikjt} \tag{3}$$

[7]Since in each age group, we have many firms exporting multi-products to various markets, these patterns can simply result from product mix changes, export destination switching, etc.

where χ_{it} contains firm-level characteristics: firm-level total import in year t and the market share of product k in country j exported by firm i. $\eta_{kjt} = \eta_{ikj} + \eta_t$ captures the firm-product-country fixed effects and year fixed effects. The market share, s_{ikjt}, is calculated as:

$$s_{ikjt} = \frac{V_{ikjt}}{\sum_i V_{ikjt}} \tag{4}$$

where V_{ikjt} denotes the total sales of product i in market j exported by firm i in year t. The market share s_{ikjt} is the revenue ratio of product k exported to country j by firm i to the aggregate exports of k in the same country by all other firms.[8] The results are reported in Table 2.

[Table 2 is to be here]

The results in column 1 - 3 of Table 2 implies that firm-level export price is increasing in firm age (see the positive and significant coefficient of age), but at a diminishing rate (see the negative and significant coefficient of age^2). At the meanwhile, results in column 4 - 6 suggest that firm-level exporting market share also increases in firm age, and the increase rate exhibits a diminishing pattern. These observed patterns can be explained by firm-level productivity evolutions which increase firm-level export markups over time or any macro trend shifts world market demand for Chinese exports. We do not dispute these explanations whatsoever, but notice that in the regressions we have controlled for the firm-product-country fixed effects and year fixed effects, which, at some degrees, rule out the impact of product and country specific factors and time trend on export prices and market shares. Furthermore, in the price regression we have controlled for the market share to alleviate the influence from markups.[9] In the market share regression, we have controlled for firm-level total imports, which proxy for firm-level productivity.

The truncated feature of the customs data ranging from 2000-2009 arises a concern about our measure of firm age. We cannot know the age of a firm-product-country pair if it appears since the year 2000.[10] As such, our age measure is downward biased. To

[8] In our case, the numerator is a sum of the product values in a particular product category and destination country exported by all Chinese exporters.

[9] According to Atkeson and Burstein (2008), firms with a higher market share tend to charge a higher markup, which in turn, results in a higher price.

[10] To make this clear, consider that we observe firm i exporting product k to country j in the year 2000, but it does not imply this firm-produce-country pair is of age 1 in 2000, as this firm may have started exporting k to j earlier.

alleviate this concern, we re-estimate regression (1) by only keeping observations entering our sample after the year 2000. In this way, we can precisely compute the age for each firm-product-country pair. The results are reported in Table 3.

[Table 3 is to be here]

The results for both price (column 1 - column 3 of Table 3) and market share (column 4 - column 6 of Table 3) show very similar pattern as those in Table 3. Carefully comparing the magnitude of the coefficients in Table 3 and Table 2, we find that the coefficient of *age* in any column of Table 3 is larger than the counterpart in Table 2.

All stylized facts are consistent with a story where new exporters accumulate their consumer base (or build their brand): a new exporter lowers its current price and increases sales to grow its demand in the future. After the new entrant builds its consumer base, it increases its export price to the optimal level. If the consumer accumulation process exhibits diminished return, that is, demand growth is slower for a well-established firm or product brand in a market, we should expect the patterns appeared in Table 2 and Table 3. Furthermore, in Table 3 since we have deleted all firms entering our sample before the year 2000 (or in the year 2000), whose ages are underestimated in Table 2, we get a larger "grow" coefficient (coefficient of *age*). This pattern suggests that the new exporters tend to grow faster than their older cohorts when the consumer accumulation process exhibits a diminishing pattern.

In the next section, we develop a dynamic model of demand accumulation where new exporters optimally set their prices to grow demand and maximize their long-run profits. Based on this framework, we explore how the firm-level export profit being affected by the exchange rate movements, and how new and continuing exporters respond differently to exogenous exchange rate fluctuations.

3 Model

In this section, we develop a dynamic model to link firm-level export price to exchange rate shocks. Based on this framework, we compare new and continuing exporters' different pricing strategy, as well as their different response to exchange rate movements.

To focus our analysis on the impact of exchange rate movement on firm-level export

price, we have made a number of simplifying assumptions. First, similar to Amiti et al. (2014), we do not model firms' entry and exit decisions. This means that we condition our analysis on a subset of firms: the continuing exporters and survived new exporters. Second, the model is a partial equilibrium model. In the partial equilibrium framework, we do not model the impact of exchange rate movements on the wage level, tariff, etc, instead, we study the influence of exchange rates on firm-level export price by treating wage and tariff are exogenous given or evolved independently from exchange rate changes.

3.1 Demand

The preference in country j are assumed to take a C.E.S. form as in equation (5)

$$\left[\int_{i\in\Omega_j}\left(\theta_{ijt}^{\frac{1}{\sigma-1}}q_{ijt}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{5}$$

where q_{ijt} denotes the quantity of product i consumed in country j in year t.[11] θ_{ijt} captures consumers' taste for variety i in country j at year t. A higher θ_{ijt} implies more favorable of product i in country j.[12] The taste parameter acts as a demand shifter which contains all factors affecting firm-level sales (e.g. Manova and Zhang, 2012; Rodrigue and Tan, 2016; Fitzgerald et al., 2016; Piveteau, 2016). [13] The current taste, θ_{ijt}, is assumed to be an increasing function of $q_{ij,t-1}$, the past sales of variety i in country j, $\theta_{ijt} = \theta(q_{ij,t-1})$, and satisfies

$$\frac{\partial\theta(q_{ij,t-1})}{\partial q_{ij,t-1}} > 0 \tag{6}$$

Equation (6) implies that firms with higher past sales have a larger current consumer base (or a better reputation). Thus, the taste of consumers, $\theta(q_{ij,t-1})$, increases in the subsequent periods. We refer to this tendency as "reputation effect". Based on our

[11]Note that in the framework of monopolistic competition, firms produce differentiated varieties, and hence, we interchangeably use i to refer a firm and its product.

[12]The taste parameter will show up as a demand shifter (equation (7)), and the power term, $\frac{1}{\sigma-1}$, on the taste parameter is to make the demand shifter as θ_{ijt}, which simplifies the presentation.

[13]Manova and Zhang (2012) attribute consumers' taste to product quality while Rodrigue and Tan (2016), Fitzgerald et al. (2016) and Piveteau (2016) believe firm-level reputation or consumer base is the key to determine the taste parameter.

stylized facts, we expect the reputation effect to exhibit a diminishing pattern:

$$\frac{\partial^2 \theta(q_{ij,t-1})}{\partial q_{ij,t-1}^2} < 0 \tag{7}$$

As shown by Rodrigue and Tan (2016), the reputation effect will reach its maximum and disappears quickly after several periods a firm consecutively exports to a market (e.g. three or four years in the stylized facts). As such, we assume $\frac{\partial \theta(q_{ij,t-1})}{\partial q_{ij,t-1}} = 0$ for continuing exporters.[14] We adopt several criteria to distinguish new entrants from continuing exporters in the empirical parts.

3.2 Supply

A domestic firm i, which exports to country j, faces three types of transaction costs altogether: an iceberg trade cost, $\tau_{jt} > 1$, a fixed exporting cost, $f_{ijt} = f_j + \epsilon_{ijt}$, and additional per unit distribution cost in destination j. Note that the fixed exporting cost contains two components: the time-invariant part f_j and a per-period random shock ϵ_{ijt}, with $\epsilon_{ijt} \sim N(0, \sigma_\epsilon)$. Firms which draw a bad shock chooses to exit the market. The distribution cost captures the selling or storage costs in country j which is paid in the currency of the destination country. We denote the distribution cost as $\eta_{jt} w_{jt}$, where w_{jt} and η_{jt} separately denote the labor wage and the distribution service labor requirement for per unit sold in country j. If an exporter charges an F.O.B price of p_{ijt}, the price faced by consumer in market j is

$$p_{ijt}^* = p_{ijt} \tau_{jt} e_{jt} + n_{jt} w_{jt} \tag{8}$$

where e_{jt} denotes the exchange rate between country j and the home country of firm i in year t. p_{ijt}^* denotes the consumer faced price in country j. We decompose the exchange rate into a time-invariant part, e_j, and a random part ε_{jt} : $e_{jt} = e_j + \varepsilon_{jt}$,

[14] Notice that we ignore the influence of product quality on consumers' taste. However, notice that in this paper we attempt to document the different responses of new entrants and continuing exporters to shocks (e.g. exchange rate shocks), and further disentangle the behind mechanism. This means that once product quality keeps constant or firms cannot adjust product quality as flexibly as their price in response to exchange rate shocks, introducing product quality into taste function would not alter the following propositions. We can rewrite equation (2) and (3) as $\frac{\partial \theta(q_{ij,t-1}, x_{ijt})}{\partial q_{ij,t-1}} > 0$ and $\frac{\partial^2 \theta(q_{ij,t-1}, x_{ijt})}{\partial q_{ij,t-1}^2} < 0$, where x_{ijt} denote the product quality of firm i exporting to country j in the year t.

with $\varepsilon_{jt} \sim N(0, \sigma_\varepsilon)$. The time-invariant component denotes the exchange rate in the steady state, and ε_{jt} captures random shocks to the exchange rate.[15] The exchange rate is defined as the domestic currency in terms of the foreign currency, and an increase in e_{jt} implies an appreciation of the domestic currency against the currency in country j.

3.3 Profit Maximization

The quantity demand for variety i of country j in year t is

$$q_{ijt} = A_{jt}\theta(q_{ij,t-1})[p_{ijt}\tau_{jt}e_{jt} + \eta_{jt}w_{jt}]^{-\sigma} \tag{9}$$

where A_{jt} denotes the residual demand shifter of market j in year t, $A_{jt} = Y_{jt}P_{jt}^{\sigma-1}$. P_{jt} and Y_{jt} are the price index and the total income of country j in year t, respectively.[16] By assumption, the sequences of $\{w_{jt}, \tau_{jt}, \eta_{jt}\}_t$ evolve exogeneously, and are not affected by exchange rate changes. Firms maximize the following long-run value function:

$$\begin{aligned} V(q_{ij,t-1}, f_{ijt}, e_{jt}) = max: \ & A_{jt}\theta(q_{ij,t-1})^{\sigma-1}[p_{ijt}\tau_{jt}e_{jt} + \eta_{jt}w_{jt}]^{-\sigma}(p_{ijt} - c_{it}) - f_{ijt} \\ & + \rho EV(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) \end{aligned} \tag{10}$$

where we assume the fixed exporting cost f_{ijt} is paid by firm i's domestic currency. c_{it} denote firm i's marginal production cost. $V(\cdot)$ denotes the value function conditional on firm-level past export, $q_{ij,t-1}$, fixed exporting cost, f_{ijt} and the current exchange rate, e_{jt}. Note that in equation (10), uncertainties in the future arise from shocks to the fixed exporting cost, $\epsilon_{ij,t+1}$, and the exchange rate, ε_{jt}, respectively.

[15] The random shocks are assumed to be i.i.d, but all results still hold if the random shocks are serial correlated if the serial correlation is sufficiently low. The proof for the serial correlated exchange rate shocks is in the Appendix.

[16] The price index is defined as a weighted average price of country j in year t, $P_{jt} = \left(\sum_{h=1}^{N} L_h \int_{\varphi^*_{hjt}}^{\infty} \left[\frac{\sigma w_{ht}}{\sigma-1}\left(\frac{1}{\sigma}\frac{\eta_{jt}w_{jt}}{w_{it}} + \frac{e_{hjt}\tau_{jt}}{\varphi}\right)\right]^{1-\sigma} dG(\varphi)\right)^{\frac{1}{1-\sigma}}$, where e_{hjt} is the bilateral exchange rate of country h and country j and τ_{hjt} the bilateral trade cost in year t. As in Berman et al. (2012), the number of firms who get a productivity draw is proportional to population size L_h in country h. P_{jt} depends on the bilateral exchange rates of country j with all its trading partners. In the price index, a measure of the exchange rate of the country appears in the second part of the bracket(in a nonlinear way). It is the weighted sum of bilateral exchange rates of country i with all its trade partners. An exchange rate appreciation of country j in year t that decreases P_{jt} leads to a fall of the volume of exports from an exporter of the home country.Following Berman et al. (2012) and Chatterjee et al. (2013), we assume that the home country is too small for its bilateral exchange rate to affect the price index in country j

For continuing firms, their reputation has been successfully established, and hence, the taste function does not increase in past sales anymore, $\frac{\partial\theta(q_{ij,t-1})}{\partial q_{ij,t-1}} = 0$, which leads to $\frac{\partial EV(q_{ijt},f_{ij,t+1},e_{j,t+1})}{\partial q_{ijt}} = 0$.[17] As such, continuing exporters maximize their current profits, and the optimal price is

$$p^c_{ijt} = \frac{\sigma}{\sigma-1}c_{it} + \frac{1}{\sigma-1}\frac{\eta_{jt}w_{jt}}{\tau_{jt}e_{jt}} \tag{11}$$

where p^c_{ijt} denotes the F.O.B export price of *continuing* exporter i at time t in country j. Equation (11) gives the optimal price for continuing exporters, which relies only on the firm-level marginal production cost, distribution cost and the exchange rate, e_{jt}.

For new exporters, their taste function in period $t+1$, $\theta(q_{ijt})$, is influenced by their sales in period t. As such, different from continuing exporters, $\frac{\partial EV(q_{ijt},f_{ij,t+1},e_{j,t+1})}{\partial q_{ijt}} > 0$ for new exporters.

Take derivative of equation (10) w.r.t. p_{ijt}, and we get:

$$p^e_{ijt} = \frac{\sigma}{\sigma-1}c_{it} + \frac{1}{\sigma-1}\frac{\eta_{jt}w_{jt}}{\tau_{jt}e_{jt}} - \frac{\sigma}{\sigma-1}\rho EV_1'(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) \tag{12}$$

where, p^e_{ijt} denotes the F.O.B export price of *new* exporter i at time t in country j. To obtain equation (12), we have made use of the fact

$$\frac{\partial q_{ijt}}{\partial p_{ijt}} = A_{jt}\theta(M_{ij,t-1})\left(p_{ijt}\tau_j e_{jt} + \eta_j w_j\right)^{-\sigma-1}(-\sigma)\tau_j e_{jt}$$

In the economy, a series of variables evolve exogenous, $\{e_{jt}, \tau_{jt}, w_{jt}, L_{jt}, \eta_{jt}\}_{jt}$, new and continuing exporters make their export price and quantity decisions according to equation (9), (10) and (12). We summarize the crucial predictions on firms' price setting in Lemma 1, and describe the stationary equilibrium equilibrium in the Appendix.

We summarized the stationary equilibrium in the Appendix. The remaining crucial results for firm's price choices are summarized below.

Lemma 1. *The representative new entrant's value function is increasing in its past market share,* $EV_1^{e\prime}(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) > 0$

Lemma 1 states that the past sales increase a firm's future valuation (for new exporters

[17] The intuition is that for continuing exporters, their reputation has reach its maximum, and hence, an increase in their current sales does not increase their reputation any further. Therefore, an increase in the current sales does not increase the future valuation of continuing exporters.

only). The intuition follows that: when two identical firms enter the same market, the firm with higher past sales will earn more profits than the other in every subsequent period. As a result, the total future valuation is increasing in firm-level past sales. The proof is in the Appendix.

Further when the θ function is concave in the past sales , $q_{ij,t-1}$, the current profit function is also concave in the past sales, $q_{ij,t-1}$. This is a sufficient condition for the value function to be concave in $q_{ij,t-1}$.

Lemma 2. *When the θ function (taste) is concave in the past sales, $q_{ij,t-1}$, the value function, $V(q_{ij,t-1}, f_{ijt}, e_{jt})$ is also concave in $q_{ij,t-1}$:*

$$\frac{\partial^2 V(q_{ij,t-1}, f_{ijt}, e_{ijt})}{\partial q_{ij,t-1}^2} < 0$$

Lemma 2 demonstrates that although a firm's value increases in its past sales, the increasing rate exhibits a diminishing pattern. Such diminishing pattern has been clearly observed in the stylized facts.

With Lemma 1 and 2, we first compare the pricing strategy between the continuing and new exporters, in equation (11) and (12), respectively. All other things equal, the new exporters tend to charge a lower price relative to the continuing firms. This is because $EV_1'(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) > 0$ (from Lemma 1). This is intuitive: in order to build the reputation, new exporters are willing to lower their current price to sell more. A higher current sale leads to a better reputation, and hence, a higher future taste for the product, which shifts up the future demand and brings lager future profits. On the contrast, the continuing exporters cannot further increase their reputation, and the future taste. Therefore, they have no incentive to lower their current price. Furthermore, the concavity of the value function and equation (12) further implies that the price of new exporters increases over time, but at a diminishing pattern. We summarize our model's predictions in the following proposition.

Proposition 1. *When the taste, θ function, is concave in the firm-level past sales, q_{ijt}, the new exporters will charge a lower price relative to continuing exporters. The price charged by new exporters tend to increase, but at a diminishing way.*

Next, we investigate the response of the new and the continuing exporters to an exchange rate shock. In order to analyze the response of continuing exporters to an

exchange rate shock, we differentiate equation (11) and (9)w.r.t ε_{jt}:

$$\frac{\partial p^c_{ijt}}{\partial \varepsilon_{jt}} = -\frac{\eta_{jt} w_{jt}}{(\sigma-1)\tau_{jt}} \frac{1}{e^2_{jt}} < 0 \tag{13}$$

$$\frac{\partial q^c_{ijt}}{\partial \varepsilon_{jt}} = \theta(q_{ij,t-1})[p^c_{ijt}\tau_{jt}e_{jt} + \eta_{jt}w_{jt}]^{-\sigma-1}\left[-\sigma A_{jt}\left(p^c_{ijt}\tau_{jt} + \tau_{jt}e_{jt}\frac{\partial p^c_{ijt}}{\partial \varepsilon_{jt}}\right)\right] < 0 \tag{14}$$

Inequality (13) implies that the continuing exporters will decrease their F.O.B export price in response to an appreciation in the domestic currency (an increase of ε_{jt}). Inequality (14) says that the export quantity for continuing firms decreases in exchange rate shocks. The intuition is that although the F.O.B export price decreases in response to an appreciation, the consumer faced price increases in country j. Hence the export quantity negatively responds to the appreciation (e.g. Berman et al., 2012; Chen and Juvenal , 2016; Chatterjee et al., 2013).

For new exporters, we differentiate equation (12) and (9)w.r.t. ε_{jt}:

$$\frac{\partial p^e_{ijt}}{\partial \varepsilon_{jt}} = -\frac{\eta_{jt} w_{jt}}{(\sigma-1)\tau_{jt}} \frac{1}{e^2_{jt}} - \frac{\sigma\rho}{(\sigma-1)} EV''_{11}(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) \frac{\partial q^e_{ijt}}{\partial \varepsilon_{jtjt}} < 0 \tag{15}$$

$$\frac{\partial q^e_{ijt}}{\partial \varepsilon_{jt}} = \theta[p^e_{ijt}\tau_j e_{jt} + \eta_j w_j]^{-\sigma-1}\left[-\sigma A_{jt}\left(p^e_{ijt}\tau_j + \tau_j e_{jt}\frac{\partial p^e_{ijt}}{\partial \varepsilon_{jt}}\right)\right] < 0 \tag{16}$$

where $\frac{\partial q^e_{ijt}}{\partial \varepsilon_{jt}} < 0$ iff $p_{ijt}\tau_{jt} + \tau_{jt}e_{jt}\frac{\partial p_{ijt}}{\partial \varepsilon_{jt}} > 0$. In the Appendix, we show that $p_{ijt}\tau_{jt} + \tau_{jt}e_{jt}\frac{\partial p_{ijt}}{\partial e_{jt}} > 0$.[18] Inequality (15) is because the concavity of the value function, $EV''_{11} < 0$, and $\frac{\partial q^e_{ijt}}{\partial \varepsilon_{jtjt}}$. Comparing the price responses of continuing and new exporters in (13) and (15), we have:

$$\frac{\partial p^e_{ijt}}{\partial \varepsilon_{jt}} < \frac{\partial p^c_{ijt}}{\partial \varepsilon_{jt}}, \tag{17}$$

Inequality (17) implies that in response to exchange rate shocks, new exporters adjust their export price more aggressively relative to continuing exporters. The intuition is that a domestic currency appreciation increases the price faced by foreign consumers, which makes it more difficult for new exporters to accumulate their consumer base. Therefore, they have to reduce their F.O.B export price more.[19] As a result, the export quantity of

[18]The detailed proof is available in the Appendix. The intuition is that when domestic currency appreciates, although export firms decrease their F.O.B price, the price faced by consumers in the destination increased.

[19]On the contrast, it is easier to accumulate the consumer base during a depreciation period. Con-

new entrants decrease fewer than that of continuing exporters in response to a domestic currency appreciation. From quantities response (14) and (16), and given $\frac{\partial p^e_{ijt}}{\partial \varepsilon_{jt}} < \frac{\partial p^c_{ijt}}{\partial \varepsilon_{jt}}$, we have $|\frac{\partial q^e_{ijt}}{\partial \varepsilon_{jt}}| < |\frac{\partial q^c_{ijt}}{\partial \varepsilon_{jt}}|$. We summarize these results in the following proposition:

Proposition 2. *When a firm's value function is concave in its past sales, the new exporters adjust their price more and export quantities fewer relative to continuing exporters in response to an exchange rate shock.*

4 Estimation and Results

4.1 Export Price and Quantity

In this section, we empirically test the model's predictions using the disaggregate firm-product-country-level export data. We first examine the export price and quantity difference between the new and continuing exporters. We estimate the following specification:

$$lnx_{ikjt} = \alpha + \beta_1 entry_{ikjt} + \beta_2 import_{i,t-1} + \beta_3 share_{ikj,t-1} + \eta_{ijkt} + \varepsilon_{ikjt} \tag{18}$$

where lnx_{ikjt} denotes the firm-level characteristics including the log export price and quantity of product k exported to market j by firm i in the year t. $entry_{ikjt}$ is an entry dummy at firm-product-country-level. $entry_{ikjt}$ takes the value of 1 if firm i exports product k to country j in year t, but does not export in year $t-1$, 0 otherwise. This definition is referred as *entry 1* thereafter. To avoid estimation bias caused by re-enters,[20] we construct an alternative definition for the entry dummy. In particular, $entry_{ikjt}$ takes value 1 if firm i export product k to country j in year t, but does not export in year $t-1$ and $t-2$, 0 otherwise.[21] This definition is referred as *entry 2* thereafter.[22] $import_{i,t-1}$ is

sequently, new exporters have a lower incentive to cut their price, since the decreased consumer price in international markets help firms to accumulate their consumer base. As a result, we expect to observe new exporters increase their price more relative to their continuing counter parts in response to a depreciation.

[20]Re-enters are firms which had exported to a particular market, exit afterward, and enter the same market again. These re-enters might have consumer base in the market they had exported, and hence, their pricing strategy is not comparable to that of new entrants.

[21]In the second definition, entrants are those firms which do not have the export record in a particular market two periods before.

[22]The detailed annual export entry rates have been reported in Table 13 in the Appendix. The figures in Table 13 show that the entry ratios are quite similar in these two entry definitions. In addition, the entry ratios exhibit substantial annual fluctuations.

the total import values of firm i in year $t-1$, which controls for imported intermediate inputs in the production. $share_{ikj,t-1}$ is the market share, which controls for a firm-product specific market power in country j.[23] $\eta_{ikjt} = \eta_{ikj} + \eta_t$, which captures the firm-product-country fixed effects, and year fixed effects. ε_{ikjt} is the unobservable error term. The results of export price and quantity are reported in Table 4 and 5, respectively.

[Table 4 is to be here]

[Table 5 is to be here]

In column 1 - 2 of Table 4, the export price results are obtained using the entry dummy of *entry 1*, while in column 3 - 4, the results are obtained using the entry dummy of *entry 2*. Relative to column 1 and column 3, column 2 and column 4 add more controls, respectively. All results indicate a negative and significant coefficient of the entry dummy, no matter how we define it. This implies that new exporters tend to charge a lower price than their continuing counterparts. In particular, the results in column 2 and 4 suggest that the price charged by new exporters are $2\%-3\%$ lower than that charged by continuing exporters. These results are comparable with Rodrigue and Tan (2016), who find that the price charged by growing firms (new entrants) are 0.5% lower than that charged by stable firms (continuing exporters).[24]

In addition, the coefficients of control variables have the expected signs. The positive coefficient of firm-level total import implies that firms use more imported intermediate inputs charge a higher export price. This is in line with the literature (Manova and Zhang, 2012; Bas and Strauss-Kahn, 2015) that firms using more imported intermediates offer higher quality products, and hence, charge a higher price (markup). The coefficient on market share is also positive and significant, which suggests that firms with larger monopolistic powers tend to charge a higher price, which is consistent with Atkeson and Burstein (2008).

[23] Atkeson and Burstein (2008) point out that firms with different market share will charge different export price.

[24] The reason they obtain a smaller figure (0.5%) than ours (2%) is that they compare the average price charged by new entrants along their growth path with continuing firms, but we only compare the price charged by new entrants in the first period with continuing firms. The concavity feature of the value function implies that the price difference between new and continuing exporters diminished with the time new exporters entered in a particular market. Therefore, the price difference reaches its maximum when comparing new entrants and continuing firms. As such, we have a larger figure.

Similarly, column 1 - 2 of Table 5 report the export quantity results using an entry dummy of *entry 1*, while column 3 - 4 contain the results using an entry dummy of *entry 2*. All results demonstrate that new entrants export fewer quantities relative to continuing exporters. Specifically, the results in column 2 and column 4 show that new exporters export $20\% - 25\%$ fewer quantities than continuing exporters after controlling for firm-level characteristics. These results support our demand growth story and in line with Rodrigue and Tan (2016) and Piveteau (2016).

Together with the stylized facts, we have found supporting evidence of Proposition 1: first, new exporters charge a lower price than continuing exporters; second, although new exporters' price is increasing in their exporting age, the increase rate displays a diminishing pattern.

4.2 Response of Export Price and Quantity to Exchange Rate Shocks

In this section, we test Proposition 2 by investigating how new and continuing exporters adjust their export price (quantity) in response to exchange rate shocks. The difference in their price responses to exchange rate shocks is the main focus of this paper. To do so, we estimate the following benchmark specification:

$$\Delta lnx_{ikjt} = \alpha + \beta_1 \Delta exr_{jt} + \beta_2 \Delta exr_{jt} \times entry_{ikjt} + \chi_{ikjt} + \eta_{kjt} + \varepsilon_{ikjt} \tag{19}$$

where similar to regression (18), lnx_{ikjt} denotes the firm-level characteristics including log export price and quantity. exr_{jt} denotes the nominal exchange rate between the home country and country j in the year t. χ_{ikjt} includes firm-level controls: the changes in market share and firm-level total imports. $\eta_{kjt} = \eta_{ikj} + \eta_t$ captures the firm-product-country fixed effects and year fixed effects. Note that we use the first difference of log variables, and hence, the coefficients β_1 and β_2 represent the short-term response of export price and quantity to exchange rate shocks. The results of export price and quantity responses to exchange rate shocks are reported in Panel A of Table 6 and Panel A of Table 7, respectively.

According to the definition of $entry_{ikjt}$, $entry_{ikjt} = 0$ if product k has been consecutively exported to country j by firm i for two or more than two years. It is arguable that

treating a 2-year old firm-product-country pair as continuing exporters are problematic. Although this possible misclassification does not affect the sign of the entry dummy, it brings a downward bias to the magnitude.[25] As such, treating a 2-year old firm as a continuing exporter might downward bias our results.[26] To alleviate this concern, we estimate an alternative specification, in which we substitute the entry dummy in the specification (19) by age defined at firm-product-market level . The benefit of substituting the entry dummy by age is that we can measure the different price and quantity responses of firms at different age groups without distinguishing their entry and continuing status.

$$\Delta lnx_{ikjt} = \alpha + \delta_1 \Delta_1 exr_{jt} + \delta_2 \Delta exr_{jt} \times age_{ikjt} + \delta_3 \Delta exr_{jt} \times age^2_{ikjt} + \gamma \chi_{ikjt} + \eta_{kjt} + \varepsilon_{ikjt} \quad (20)$$

where age_{ikjt} is the number of years a particular product k being exported to country j by firm i until year t. The regression results of specification (20) are reported in Panel B of Table 6 and Table 7, respectively.

[Table 7 it to be here]

[Table 8 is to be here]

In Table 6, the results, in the first row across all columns, indicate that in response to a domestic currency appreciation (an increase in exr) the firm-level export price decrease. Specifically, a 10% appreciation in the domestic currency leads to a $0.9\% - 1.4\%$ export price decreases. This result implies an incomplete ERPT and comparable to the results in Li et al. (2015).[27] More importantly, the coefficients on the interaction terms, $\Delta exr \times Entry_1$ and $\Delta exr \times Entry_2$, are both negative and significant. In particular, in response to an appreciation, although price cut is small for both new and continuing exporters, the price cut by new exporters is about 1.5 time of that cut by continuing exporters.[28]

[25] To make this point clear, recall that a continuing firm does not need to accumulate their future consumer base, but a 2-year old firm might still need to. If a 2-year old firm still need to accumulate its consumer base, according to our model, its price response to exchange rate shocks is larger than "genuine" continuing exporters, although it is smaller than new entrants.

[26] However, due to the concavity of the value function in past sales, the comparison between new entrants and 2-year old exporters would still give us a negative coefficient of the intersection. As the concavity feature leads to a smaller ERPT for new entrants relative to 2-year exporters.

[27] Li et al. (2015) use China's firm-level export data during 2000-2006, and find that with a 10% appreciation of RMB, export price drops by 0.35%. Our results are higher than theirs's estimation due to the following reasons: (1) our sample is from 2000 to 2009, unlike their sample in 2000 to 2006, and it covers a longer period after the China's exchange rate reform in July 2005. (2) our sample only contains 40 major export destinations, rather than overall destinations appearing in the customs dataset.

[28] The calculation is based on the results in column 4 of Table 7: $\frac{0.049+0.095}{0.095} = 1.52$.

Similarly, the coefficients on the interaction term, $\Delta exr \times age$, is positive and significant. This implies that firm-product-country pairs with an older age tend to adjust their price less in response to an exchange rate shock. This result is in line with our results using entry dummies. Furthermore, the coefficient on $\Delta exr \times age^2$ is negative and significant. This means that in response to an appreciation the firm-level export price is decreasing in age, but at a diminishing rate. This result is also consistent with our model: the concavity of the value function defined in equation (8) predicts that firm-level price response to exchange rate shocks is decreasing in firm age, and when a firm grow to be a continuing exporter, its price response to exchange rate shocks does not rely on its age anymore.

The results in Table 7 convey the information that with a 10% appreciation of RMB, the firm-level export quantities decrease by $3.34\% - 7.57\%$ (column 4 and column 8). The coefficients of $\Delta exr \times Entry_1$ and $\Delta exr \times Entry_2$ are both positive and significant (column 1 - column 4), and the coefficient of $\Delta exr \times age$ is negative and significant. These results indicate that the export quantity decreases more for continuing exporters in response to an appreciation of the domestic currency. This is because that new exporters cut their export price more in response to the appreciation. These results are consistent with Proposition 2.

Interestingly, we notice that the interaction term, $\Delta exr \times Entry$ has a larger coefficient, in terms of absolute value, than the coefficient of Δexr. This implies that while an appreciation of RMB decreases the exports of continuing exporters, it increases exports of *survived* new exporters. One possible explanation is that new exporters start exporting at a small amount, and their export growth heavily relies whether they can overwhelm the other new entrants to build their consumer base. As such, different from the continuing exporters, which have a stable consumer base, the new exporters' growth mainly determined by competition from other new exporters. Although an appreciation decreases exports of new exporters, it also discourages entry (Berman et al., 2012; Greenaway et al., 2008). As such, the demand grows faster for survived new exporters due to less competition. In contrast, The continuing firms have stable demand and their export quantities are less likely to be affected by competition from new entrants.

4.3 Robustness Checks

A substantially large portion of exporters in China export multi products. 76.5% of exporting firms in China produce more than one product during 2000-2009. Note that continuing exporters are normally large in their size and market demand (Foster et al., 2015; Aw et al., 2000) and be able to cover the fixed export cost to export multi products (Bernard et al., 2010). On the contrast, new entrants tend to be small and exporting single product. Chatterjee et al. (2013) and Bernard et al. (2011) find that multi-product firms disproportionally adjust markups across their products in response to exchange rate changes. Mayer et al. (2015) document that multi-product firms frequently switch their export mix, which causes a *cannibalization effect*. This effect will result in price and quantity internal adjustments within a multi-product firm. As such, the different export price (quantity) responses to exchange rate shocks might just reveal the different price strategy between multi-product and single-product firms. To alleviate the concern, we keep all firms exporting single product and estimate the benchmark specification (19). The exclusion of multi-product firms leads our sample size to reduce from $10,348,740$ to $1,413,051$, which accounts for 13.7% of the overall sample. The results are reported in Table 8.

[Table 8 is to be here]

The price results in column 1 - 4 of Table 8 exhibit similar patterns as our benchmark regression results in Table 6. The negative and significant coefficients of the interactions, $\Delta exr \times Entry1$ and $\Delta exr \times Entry2$, show that new exporters tend to adjust their export prices more aggressively relative to continuing exporters. The export quantity results are reported in column 5 - column 8 of Table 8. These results are comparable to the results in Table 7: in response to an (a) appreciation (depreciation) of RMB, export quantities increase (decrease) for new single-product exporters, while export quantities decrease (increase) for continuing single-product exporters.

Another concern arises from export market switching or expanding. To make this point clear, consider a firm i export product k to country j, in response to exchange rate shocks, firm i can switch its export of k from country j to country j' or export k to both j and j'. No matter which happens, firm i is a new exporter in country j'. However, the exporting experience of exporting k to country j might help firm i to build

consumer base in the country j' through spillover effect.[29] To avoid exporting destination switching or expanding to bias our results, we further exclude the firm-product pairs which have been exported to multiple destinations from our single exporter subsample. In this way, we construct a subsample containing firms which export a single product to only 1 destination. This further deceases the observations to $362,724$, which accounts for 25.7% of the major product sample. We estimate specification (19) with our single-product-country subsample. The results are reported in Table 9.

[Table 9 is to be here]

The export price and quantity results are reported in column 1 - 4 and column 5 - 8 of Table 9, respectively. All results indicate that after excluding market switching or expanding exporters, our benchmark results still hold.

Lastly, according to Rauch (1999) we divide our sample into firms exporting homogeneous and heterogeneous products. We regress the two subsamples using specification (19). The export price and quantity results are respectively reported in Table 10 and Table 11.

[Table 10 is to be here]

[Table 11 is to be here]

Most results in Table 10 and Table 11 reveal very similar patterns with our benchmark results, but the export price responses of homogeneous exporters. Interestingly, we find that in Panel A of Table 10 the coefficients of interaction terms, $\Delta exr \times Entry1$ and $\Delta exr \times Entry2$, although are negative, only significant at 90% level. Therefore, we cannot rule out the possibility that the coefficients of intersection terms equal to zero. This result is of economic interpretations: elasticity of substitution across different varieties in homogeneous sectors is larger than that in heterogeneous sectors. Due to the product similarity feature, new entrants exporting homogeneous product can easily attract consumers from their older counterparts. As such firms exporting homogeneous products have a lower incentive, relative to firms exporting heterogeneous products, to accumulate consumer base as their products are highly standardized.

[29] This is more likely to happen when country j' and j are closely related, such as the two countries are adjacent, speaking the same language, has small cultural distance, etc.

5 ERPT and New Exporters

In the above sections, we have documented the fact that new exporters have different ERPT from continuing exporters. In particular, in response to exchange rate shocks, new exporters adjust their price 1.5 times more than that of continuing exporters (based on the results in column 2 of Table 6: -0.145 V.S. -0.091). The empirical results imply that the average ERPT level depend on the entry ratio. In Table 12, based on our baseline estimates (column 2 of Table 6) we calculate the average ERPT level at different entry ratios. We use x to denote entry ratio and the calculation is according to the following equation.

$$ave\_ERPT = [10\% - 1.45\% \cdot x - 0.91\% \cdot (1 - x)]/10\%$$

[Table 12 is to be here]

Table 12 reports the average ERPT at entry ratios equal to 10%, 25%, 50%, 75% and 95% , respectively. The results demonstrate that the average ERPT level is decreasing in the entry ratios: a larger proportion the new exporters accounting for, the lower the average ERPT is. In particular, the ERPT exhibits 5 percentage difference when new exporters account for 10% and 95% of total exports. Although the difference is small, it is helpful to interpret the heterogeneous ERPT across countries: it can be partly attributed to the different export entry ratios across countries. The pattern also provides a hint that the globalization trend in past two decades, which brings a surge of new entrants into international market, may play a role in explaining the declining ERPT phenomenon.

6 Conclusions

In this paper, we compare the ERPT between new and continuing exporters. We find that new exporters tend to have a smaller ERPT as they adjust their price more aggressively in response to exchange rate shocks.

We develop a dynamic model in which firm-level future demand depends on their current sales. For continuing exporters, since their reputation has been well established, they have little incentive to cut their current export price to further increase their reputation and future demand stock. As such, they maximize their current profits instead

of the long-run profits. In contrast, new exporters have strong incentive to grow their future demand by cutting their current price and increase their current sales. As such, they need to maximize their long-run profit. The model predicts that in response to an appreciation of the domestic currency, the new exporters cut their price more aggressively than continuing exporters. This is because the accumulation of consumer base become more difficult during appreciation period, and new exporters need to cut their price more to increase current sales.

Using a detailed micro firm-product data from China during 2000-2009, we test the model's predictions. We find that although new exporters charge a lower export price than continuing exporters, their exports are fewer than their continuing counterparts. This is a proof of reputation effect. In addition, relative to continuing exporters, new exporters adjust their price more aggressively in response to an exchange rate shock. Our results are consistent with the model's predictions and robust to different specifications.

To move further, this different ERPT between new and continuing exporters shed light on the different ERPT across countries. All other things equal, countries with a larger share of new exporters, tend to have a lower ERPT.

Appendix (Figures and Tables)

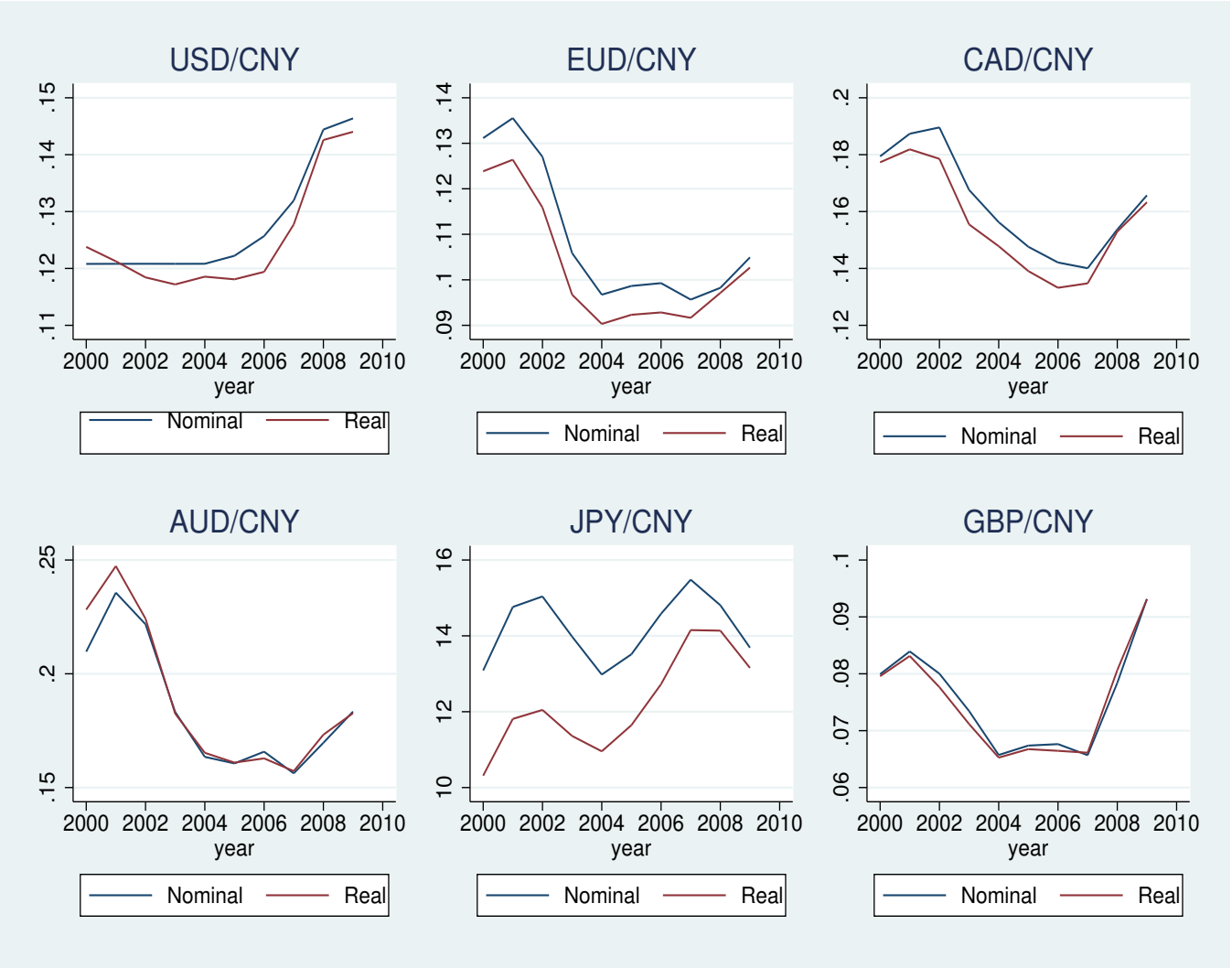
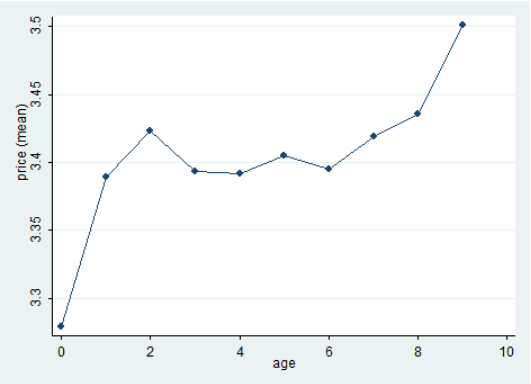
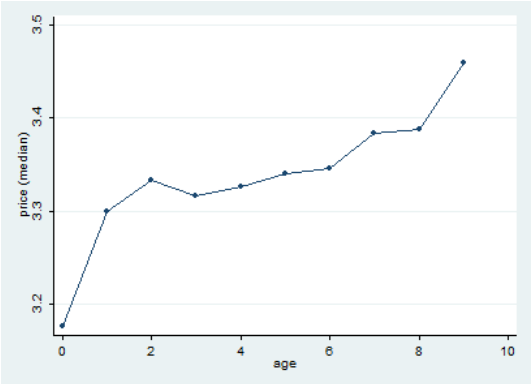


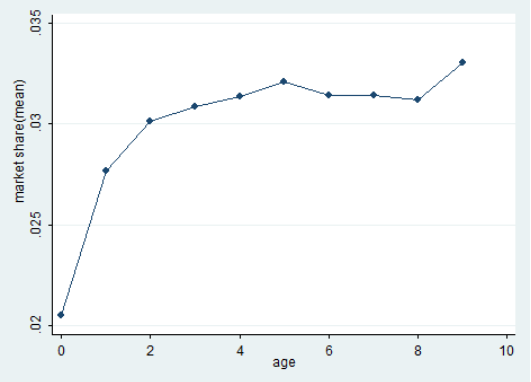
Figure 1: Nominal Exchange Rate and Real Exchange Rate



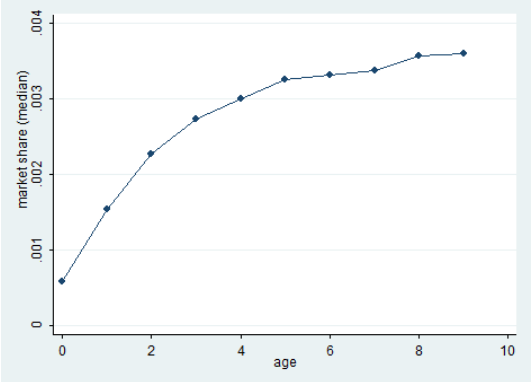
(a) Figure 1: Mean Price Levels and Ages



(b) Figure 2: Median Price Levels and Ages



(c) Figure 3: Mean Market Shares Levels and Ages



(d) Figure 4: Median Market Shares Levels and Ages

Table 1: Stylized Summary Statistics

Variables	(1) Obs	(2) Mean	(3) Std. Dev.	(4) Mini.	(5) Max.
Logarithm Export price	10348740	1.28	1.83	-10.18	17.74
Logarithm of export quantity	10348740	7.76	2.84	0	21.84
Import quantity	10347070	1.63	2.04	0	19.62
Number of destinations a firm exports	250374	4.66	2.13	1	17
Number of products a firm exports	250374	3.43	2.60	1	8

Table 2: Price levels and Market Share with Firm's Ages

Dependent Variable	Price			Market share		
	(1)	(2)	(3)	(4)	(5)	(6)
age	0.077***	0.079***	0.073***	0.011***	0.009***	0.010***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
age^2	-0.009***	-0.009***	-0.008***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
market share			0.397***			
			(0.005)			
total import						0.000***
						(0.000)
Product fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	10348740	10348740	10348740	10348740	10348740	10348740
R^2	0.578	0.563	0.578	0.441	0.310	0.452

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Columns 1–3 use price level for each "firm-product-country" bundle within an year as dependent variable, while columns 4–6 adopt the market share for dependent variables.

Table 3: Price levels and Market Share with Firm's Ages

Dependent Variable	Price			Market share		
	(1)	(2)	(3)	(4)	(5)	(6)
age	0.110***	0.111***	0.105***	0.014***	0.012***	0.013***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
age^2	-0.015***	-0.015***	-0.015***	-0.002***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
market share			0.399***			
			(0.005)			
total import						0.000***
						(0.000)
Product fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	6974958	6974958	6974958	6974958	6974958	6974958
R^2	0.572	0.556	0.572	0.440	0.328	0.453

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. This robustness check deleting all firms which has appeared in sample of year 2000. Columns 1–3 use price level for each "firm-product-country" bundle within an year as dependent variable, while columns 4–6 adopt the market share for each firm export a certain product at HS6 level to specific country within the year as dependent variables.

Table 4: Price levels Regression with Entry Dummies

	Dependent variable= log(price)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
entry1	-0.134***	-0.122***	-0.033***	-0.021***				
	(0.001)	(0.001)	(0.001)	(0.001)				
entry2					-0.147***	-0.135***	-0.044***	-0.031***
					(0.001)	(0.001)	(0.001)	(0.001)
total import		0.228***		0.159***		0.226***		0.154***
		(0.001)		(0.001)		(0.001)		(0.001)
market share		0.332***		0.152***		0.327***		0.154***
		(0.005)		(0.005)		(0.005)		(0.005)
country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
product fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
firm fixed effect	No	No	Yes	Yes	No	No	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10348740	10347070	10348740	10347070	10348740	10347070	10348740	10347070
R^2	0.575	0.576	0.958	0.958	0.575	0.577	0.958	0.958

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Dependent variable is unit price for each export bundle at "firm country-product" level. Entry dummy is defined at firm-product-country pair. *entry*1 takes value 1 if a firm-product-country pair appears in year t but did not in year $t-1$, 0 otherwise. *entry*1 take value 1 if a firm-product-country pair appears in year t but did not in year $t-1$ and $t-2$, 0 otherwise.

Table 5: Export Quantity Regression with Entry Dummies

	Dependent variable=log(quantity)			
	(1)	(2)	(3)	(4)
entry1	-1.197***	-0.249***		
	(0.001)	(0.001)		
			(0.001)	(0.001)
total import	0.002	0.266***	-0.002	0.265***
	(0.002)	(0.003)	(0.002)	(0.003)
market share	7.159***	5.645***	7.234***	5.660***
	(0.009)	(0.009)	(0.012)	(0.012)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
N	10348740	10347070	10348740	10347070
R^2	0.413	0.409	0.902	0.902

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Dependent variable is export quantity for each export bundle at "firm country-product" level. Entry dummy is defined at firm-product-country pair. *entry*1 takes value 1 if a firm-product-country pair appears in year t but did not in year $t-1$, 0 otherwise. *entry*1 take value 1 if a firm-product-country pair appears in year t but did not in year $t-1$ and $t-2$, 0 otherwise.

Table 6: Export Price with Exchange Rate Changes

	Dependent variable=log(price)							
	Panel A: Entry				Panel B: Age			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δexr	-0.093***	-0.091***	-0.097***	-0.095***	-0.138***	-0.136***	-0.142***	-0.141***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
$\Delta exr \times Entry1$	-0.054***	-0.054***						
	(0.010)	(0.010)						
$\Delta exr \times Entry2$			-0.048***	-0.049***				
			(0.010)	(0.010)				
$\Delta exr \times age$					0.017***	0.016***	0.029***	0.030***
					(0.003)	(0.003)	(0.008)	(0.008)
$\Delta exr \times age^2$							-0.003*	-0.003*
							(0.001)	(0.001)
total import		-0.006***		-0.006***		-0.006***		-0.006***
		(0.002)		(0.002)		(0.002)		(0.002)
$\Delta Marketshare$		-0.070***		-0.070***		-0.070***		-0.070***
		(0.005)		(0.005)		(0.005)		(0.005)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3525076	3524501	3525076	3524501	3525076	3524501	3525076	3524501
R^2	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Dependent variable is export price for each export bundle at "firm country-product" level.

Table 7: Export Quantity with Exchange Rate Changes

	Dependent variable=log(quantity)							
	Panel A: Entry				Panel B: Age			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δexr	-0.866***	-0.828***	-0.796***	-0.757***	-0.312***	-0.281***	-0.293***	-0.334***
	(0.021)	(0.022)	(0.021)	(0.021)	(0.035)	(0.036)	(0.039)	(0.039)
$\Delta exr \times Entry1$	1.320***	1.312***						
	(0.024)	(0.024)						
$\Delta exr \times Entry2$			1.274***	1.262***				
			(0.024)	(0.024)				
$\Delta exr \times age$					-0.051***	-0.039***	-1.071***	-1.071***
					(0.012)	(0.012)	(0.030)	(0.030)
$\Delta exr \times age^2$							0.183***	0.185***
							(0.005)	(0.005)
total import		-0.100***		-0.100***		-0.188***		-0.194***
		(0.004)		(0.004)		(0.007)		(0.007)
$\Delta Marketshare$		-1.104***		-1.103***		-1.311***		-1.310***
		(0.012)		(0.012)		(0.015)		(0.015)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3525076	3524501	3525076	3524501	3525076	3524501	3525076	3524501
R^2	0.012	0.015	0.012	0.015	0.471	0.474	0.472	0.474

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Dependent variable is export quantity for each export bundle at "firm country-product" level.

Table 8: Major Product: Export price and quantity with Exchange Rate Changes

	Panel A: Export Price				Panel B: Export Quantity			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δexr	-0.098***	-0.090***	-0.101***	-0.093***	-0.963***	-0.901***	-0.899***	-0.836***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.040)	(0.040)	(0.039)	(0.039)
$\Delta exr \times Entry1$	-0.068***	-0.067***			1.901***	1.915***		
	(0.016)	(0.016)			(0.045)	(0.045)		
$\Delta exr \times Entry2$			-0.067***	-0.065***			1.880***	1.892***
			(0.016)	(0.016)			(0.046)	(0.046)
total import		-0.019***		-0.019***		-0.147***		-0.147***
		(0.003)		(0.003)		(0.008)		(0.008)
$\Delta Marketshare$		-0.034***		-0.034***		-0.272***		-0.270***
		(0.004)		(0.004)		(0.011)		(0.011)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	749903	749709	749903	749709	749903	749709	749903	749709
R^2	0.040	0.040	0.040	0.040	0.038	0.039	0.038	0.039

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Dependent variable is export quantity for each export bundle at "firm country-product" level. The sample is restrained to the major product (with maximum export value in the year) for each individual firm.

Table 9: Single Product-Country: Export quantity with Exchange Rate Changes

	Panel A: Export Price				Panel A: Export Quantity			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δexr	-0.162***	-0.159***	-0.161***	-0.158***	-1.594***	-1.533***	-1.563***	-1.502***
	(0.027)	(0.027)	(0.026)	(0.026)	(0.079)	(0.079)	(0.078)	(0.078)
$\Delta exr \times Entry1$	-0.056*	-0.052			2.753***	2.788***		
	(0.032)	(0.032)			(0.094)	(0.094)		
$\Delta exr \times Entry2$			-0.059*	-0.055*			2.797***	2.833***
			(0.032)	(0.032)			(0.094)	(0.095)
total import		-0.016***		-0.016***		-0.173***		-0.174***
		(0.005)		(0.005)		(0.016)		(0.016)
Δ market share		-0.044***		-0.044***		-0.235***		-0.233***
		(0.008)		(0.008)		(0.024)		(0.024)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	175626	175529	175626	175529	175626	175529	175626	175529
R^2	0.091	0.091	0.091	0.091	0.098	0.099	0.098	0.099

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Dependent variable is export quantity for each export bundle at "firm country-product" level. The sample is restrained to the single product-country exporting bundle for each individual firm.

Table 10: Homogeneous and Heterogeneous Export Price with Exchange Rate Changes

Dependent variable	Panel A: Homogeneous				Panel B: Heterogeneous			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δexr	-0.068***	-0.056***	-0.071***	-0.059***	-0.100***	-0.102***	-0.104***	-0.107***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.010)	(0.010)	(0.009)	(0.009)
$\Delta exr \times Entry1$	-0.044*	-0.043*			-0.056***	-0.057***		
	(0.023)	(0.023)			(0.010)	(0.010)	(0.009)	(0.009)
$\Delta exr \times Entry2$			-0.041*	-0.039*			-0.050***	-0.052***
			(0.023)	(0.023)			(0.010)	(0.010)
total import		-0.041***		-0.041***		0.003*		0.003*
		(0.003)		(0.003)		(0.002)		(0.002)
$\Delta Marketshare$		-0.051***		-0.051***		-0.087***		-0.087***
		(0.007)		(0.007)		(0.006)		(0.006)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	438447	437940	438447	437940	3086629	3086561	3086561	3086561
R^2	0.022	0.022	0.022	0.022	0.014	0.014	0.014	0.014

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Column 1-4 report the results for homogeneous products at "firm country-product" level; while column 5-8 report the results for heterogeneous products.

Table 11: Homogeneous and Heterogeneous Export Quantity with Exchange Rate Changes

Dependent variable	Panel A: Homogenous				Heterogeneous			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δexr	-0.449***	-0.423***	-0.429***	-0.399***	-0.932***	-0.896***	-0.854***	-0.817***
	(0.055)	(0.055)	(0.054)	(0.054)	(0.023)	(0.023)	(0.023)	(0.023)
$\Delta exr \times Entry1$	0.869***	0.857***			1.389***	1.379***		
	(0.063)	(0.063)			(0.026)	(0.026)		
$\Delta exr \times Entry2$			0.886***	0.866***			1.333***	1.319***
			(0.063)	(0.063)			(0.025)	(0.025)
total import		-0.139***		-0.139***		-0.090***		-0.091***
		(0.008)		(0.008)		(0.004)		(0.004)
$\Delta Marketshare$		-0.799***		-0.797***		-1.270***		-1.269***
		(0.020)		(0.020)		(0.015)		(0.015)
Firm-Prod-Ctry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	438447	437940	438447	438447	3086629	3086629	3086629	3086561
R^2	0.022	0.022	0.022	0.022	0.011	0.013	0.011	0.013

Notes: * p<0.10, ** p<0.05, *** p<0.01. Robust standard errors in parentheses. Constants are included in all regressions. Column 1-4 report the results for homogeneous products at "firm country-product" level; while column 5-8 report the results for heterogeneous products.

Table 12: ERPT at Different Entry Ratios

	entry ratio	ERPT
1	10%	90.36%
2	25%	89.55%
3	50%	88.20%
4	75%	86.85%
5	95%	85.77%

Notes: All figures are based on authors' own calculation.

Table 13: Entry Ratio by Year

year	entry ratio1	entry ratio2	number of firms
2000	-	-	459216
2001	0.640	0.640	519,680
2002	0.643	0.607	636,052
2003	0.628	0.594	773,773
2004	0.656	0.624	896,960
2005	0.593	0.556	977,038
2006	0.687	0.653	1,335,420
2007	0.718	0.680	1,518,846
2008	0.604	0.573	1,584,144
2009	0.607	0.564	1,647,611

Notes: All figures are based on authors' own calculation, and the data source is from the Chinese General Administration of Customs.

Proof

Lemma 1

Proof. In order to establish the proposition we compare $V(q_{ij,t-1})$ and $V(q'_{ij,t-1})$ when $q_{ij,t-1} < q'_{ij,t-1}$. Denote the optimal price sequence as $\{p_{ijt}\}_t$ when past market share is $q_{ij,t-1}$. Observe that if the past sale is $q'_{ij,t-1}$ and the firm follow the same sequence of price choices $\{p_{ijt}\}_t$, then in any period $t > 0$ the current profit of the firm with the past sale $q'_{ij,t-1}$ would be greater than that of the firm with the past sale $q_{ij,t-1}$. This implies:

$$\begin{aligned} &\pi(q_{ij,t^*-1}) < \pi(q'_{ij,t^*-1}) \\ &\pi(q_{ij,t^*-1}) = A_{jt^*}\theta(q_{ij,t^*-1})^{\sigma-1}[p_{ijt^*}\tau_j e_{jt^*} + \eta_j w_j]^{-\sigma}(p_{ijt^*} - c_{it}) \\ &\pi(q'_{ij,t^*-1}) = A_{jt^*}\theta(q'_{ij,t^*-1})^{\sigma-1}[p_{ijt^*}\tau_j e_{jt^*} + \eta_j w_j]^{-\sigma}(p_{ijt^*} - c_{it}) \end{aligned} \tag{A1}$$

where the $t^* > t-1$ and $q_{ij,t^*-1} < q'_{ij,t^*-1}$. Since, θ and hence current demand, is strictly increasing in past market share, $q_{ij,t-1}$, a firm can achieve a greater long-run profit relative to an identical firm but with a smaller past sales by choosing the same price sequence even if it is not optimal. As such $V(q'_{ij,t-1}) > V(q_{ij,t-1})$ for any $q'_{ij,t-1} > q_{ij,t-1}$. Therefore, $V(q_{ij,t-1})' > 0$.

$\boldsymbol{p^e_{ijt}\tau_{jt} + \tau_{jt}\, e_{jt}\frac{\partial p^e_{ijt}}{\partial e_{jt}} > 0}$

Proof. We show the inequality by contradiction. Suppose $p^e_{ijt}\tau_{jt} + \tau_{jt}e_{jt}\frac{\partial p^e_{ijt}}{\partial e_{jt}} < 0$, due to the concavity of $V''_{11}(M_{ijt}, f_{ij,t+1}, e_{j,t+1})$, the second term in inequality (11) is positive. This implies $\frac{\partial p^e_{ijt}}{\partial e_{jt}} > \frac{\partial p^c_{ijt}}{\partial e_{jt}}$. However, according to inequality (10), $\frac{\partial p^c_{ijt}}{\partial e_{jt}} = -\frac{\eta_{jt} w_{jt}}{(\sigma-1)\tau_{jt}}$. As such,

$$\begin{aligned} p^e_{ijt}\tau_{jt} + \tau_{jt}e_{jt}\frac{\partial p^e_{ijt}}{\partial e_{jt}} &> p^e_{ijt}\tau_{jt} + \tau_j e_{jt}\frac{\partial p^c_{ijt}}{\partial e_{jt}} \\ &= \frac{\sigma}{\sigma-1}c_{it}\tau_{jt} - \frac{\sigma}{\sigma-1}\rho E V'_1(M_{ijt}, f_{ij,t+1}, e_{j,t+1}) \\ &\geq 0 \end{aligned}$$

The last inequality is because that any new exporters must earn at least non-negative profits in order to be active. This is a contradiction.

Proposition 2 under serial correlated exchange rate shocks

If the random shocks to exchange rate are serial correlated, we show a sufficient condition with wihch Proposition 2 still hold. Suppose $\varepsilon_{jt} = \beta\varepsilon_{j,t-1} + u_{it}$, where β capture the serial correlation between ε_{jt} and $\varepsilon_{j,t-1}$, u_{it} is and i.i.d error term with mean 0. Since the shocks to exchange rate are serial correlated, a shock in period t will affect the exchange rate expectation in period $t+1$. Therefore, when we take derivative to the export price of new exporters, inequality (13) becomes

$$\frac{\partial p^e_{ijt}}{\partial \varepsilon_{jt}} = -\frac{\eta_{jt} w_{jt}}{(\sigma-1)\tau_{jt}} \frac{1}{e^2_{jt}} - \frac{\sigma\rho}{(\sigma-1)} EV''_{11}(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) \frac{\partial q^e_{ijt}}{\partial \varepsilon_{jtjt}} - \frac{\sigma\rho\beta}{(\sigma-1)} EV''_{13}(q_{ijt}, f_{ij,t+1}, e_{j,t+1}) \tag{A2}$$

When the second term on the RHS of (A2) is negative, the third term on the RHS of (A2) is positive. A sufficient condition to make inequality (15) continue to hold is that the serial correlation between exchange rate shocks is sufficiently weak, a smaller β.The second term on the RHS of (A2) will dominate the third term on the RHS of (A2). The economic interpretation for the ambiguous relatioship casued by the the serial correlation is that the consumer base accumulation becomes more difficult in response to a positive exchange rate shock (an appreciation in the domestic currency) as current sales decreases. On the one hand, new exporters need to decrease their price more in order to accumulate their consumer base. On the other hand, because of the serial correlation, a positive exchange rate shock increases the expectation of the future exchange rate, which lowers the future values.[30] As such, new exporters have lower incentive to lower their current price to grow their consumer base and future demand. The sufficient condition says that if the current exchange rate shock does not affect the expectation of future exchange rate much, then the first mechanism makes new exporters to decrease their price more.

Stationary Equilibrium

We restrict our attention to stationary equilibria. A stationary equilibrium is a collection of value function, firm's price rule, firms' productivity (marginal production cost).

1. All consumers optimally choose to consumption of differentiated goods based on their brand reputation, θ_{ij}. All firms optimally make entry and pricing decision

[30] $\frac{\partial V(q_{ijt}, f_{ij,t+1}, e_{j,t+!})}{\partial \varepsilon_{jt}} < 0$, this is because that $\frac{\partial \pi_{ij,t+1}}{\partial \varepsilon_{jt}} < 0$.

to maximize profit function (6)(for continuing exporters) or value function (8) (for new entrants).

2. Free Entry: The expected value of entry for a new firm is zero

$$V_j^E = \int_{\epsilon_{ijt}} \int_{\varepsilon_{jt}} \int_{c_{it}} V(0, f_j + \epsilon_{ijt}, e_j + \varepsilon_{jt}) G^{\epsilon}(\epsilon_{ijt}) G^{\varepsilon}(\varepsilon_{jt}) G^{c}(c_{it}) d\epsilon d\varepsilon dc - F_j = 0$$

where F_j is the entry cost in country j.

3. Zero Cutoff: Active firms earn at least non-negative profits.

$$V(M_{ij,t-1}, f_{ijt}, e_{jt}) \geq 0; \textit{ for any new entrant } i$$

$$\pi(M_{ij,t-1}, f_{ijt}, e_{jt}) \geq 0; \textit{for any continuing firm } i;$$

4. Stationary: For each year and cohort, a cohort of age a in year t replicates the previous cohort of age a in year $t-1$.

$$Dis^a_{ij,t-1}(c) = Dis^a_{ijt}(c)$$

where $Dis^a_{ijt}(c)$ denotes the marginal production cost distribution of a cohort of age a in year t.

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