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Abstract

In this paper we investigate the influence of market rivalry on firm-level exchange rate pass-through. Similar to Bloom et al. (2013), we define market rivalry as product market proximity, and expect the cross market spillovers, i.e., through leaked information or reputation, to affect firm-level export price. Using a dataset from comprehensive Chinese exporters during 2000-2007, we find supporting evidence of this influence. Firms that face a high degree of market rivalry are less responsive to exchange rate fluctuations, which suggests a higher exchange rate pass-through. The influence of market rivalry is stronger on firms that export consumption and heterogeneous products, and to developed countries. Our results are robust to different measures of market rivalry and specifications.

Keywords: Market Rivalry, Exchange Rate Pass-through, Cross Markets Spillovers **JEL Classification**: F14, F31, F33, O19

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1. Introduction

It is widely believed that exchange rate fluctuations are crucial in firms' export performance. A considerable number of papers document the impact of exchange rate fluctuations on export prices and volumes (Cushman, 1983; Dell, 1999; Mc Kenzie, 1999; Forbes, 2002; Marquez and Schindler, 2007; Berman et al., 2012; Li et al., 2015; Chen and Juvenal , 2016). Indeed, empirical research typically finds a small effect of exchange rate movements on the prices of international traded goods, which is one of the central puzzles in international macroeconomics. For example, the exchange rate pass-through (ERPT thereafter) is 92% for French exporters (Berman et al., 2012), 96% for Chinese exporters (Li et al., 2015), 79% for Belgian exporters (Amiti et al., 2014), and 77% for Brazilian exporters (Chatterjee et al., 2013).

The availability of firm-level data enables researchers to explore firm-level heterogeneous ERPT, which offers micro-foundations for the high ERPT. Firms that are more productive and export high-quality products usually exhibit a higher ERPT (e.g. Berman et al., 2012; Li et al., 2015; Chen and Juvenal , 2016; Berni-ni and Tomasi, 2015). This is mainly through the channel of local distribution cost. Meanwhile, a seminal paper by Amiti et al. (2014) using Belgian data finds that exporters with high exporting market shares tend to have a lower ERPT. This is because exporters with higher market shares charge higher markups and hence can absorb more exchange rate fluctuations, which leads to a lower ERPT. This is through the competition channel documented by Atkeson and Burstein (2008). However, different markets may be interconnected through supply or demand spillovers (e.g. Whinston, 1990; Erdem, 1998; Gavazza , 2011; Gallant et al., 2016). Whinston (1990) shows that a firm can leverage its market power in one market to affect the competition result in another market. Erdem (1998) and Gavazza (2011) find that consumers' loyalty to particular brands makes umbrella branding strategy profitable for firms that serve several different markets (demand spillovers). In contrast, Gallant et al. (2016) emphasize the learning effect through which a firm can decrease its marginal cost in a product market after serving other

similar product markets (supply spillovers). As such, when firms export to multiple destinations, the firm-level ERPT in any particular destination relies not only on the competition in this market, but also on the competition in other markets. This is because exporters can make use of their experience in other markets to affect the competition in a particular market.

In this paper, we attempt to investigate how cross-market competition, which is referred to as *product market rivalry* or *market rivalry* in Bloom et al. (2013), affects firm-level ERPT. Product market rivalry is defined as the competition a firm faces in all markets it serves.[1] Bloom et al. (e.g. 2013) attributes cross-market competition to information leakage.[2] A firm can leverage its market power from one destination to another (e.g Whinston, 1990). For instance, a representative firm might face severe competition in a particular market if its competitors can make use of the reputation they built in other markets to affect the competition in this market; or the firm leaked information in some markets, which its competitors can use to affect the degree of competition in the particular market. As such, on the one hand, a firm faces a lower degree of market rivalry in a particular market if it has higher market shares in each export destination;[3] on the other hand, if the firm "exposes" more to competitors in each export export destinations, it would face a fiercer competition in the particular market.[4] We expect that a higher degree of market rivalry results in a higher ERPT, since firm-level markups are lower when facing a fiercer competition, which prevents firms from absorbing exchange rate fluctuations and pricing less to markets.

Using a dataset that contains comprehensive Chinese exporters during the 2000-2007 period, we empirically uncover the impact of market rivalry on firm-level ERPT. The results indicate that although firms increase export price in response

[1]The measure of market rivalry will be introduced in detail in the data description parts.

[2]The leaked information in one market could affect competition in another market.

[3] In this case, the representative firm is not afraid of its competitors to leverage their reputation from other markets, as it has a higher market share in every market and hence, can leverage its own reputation to the particular market.

[4]Firm i's degree of exposure to firm j in market m is defined as $\frac{export_{im}}{\sum'_m export_{im'}} \frac{export_{jm}}{\sum'_m export_{jm'}}$. This measure is proposed by Bloom et al. (2013) and measures bilateral firm-level market proximity.

to a domestic currency depreciation, a higher degree of market rivalry weakens the price-increasing incentive. This implies that firms which face a higher degree of market rivalry tend to absorb less exchange rate fluctuations and hence exhibit a higher level of ERPT. Furthermore, we divide the sample into different subsamples to analyze the mechanisms through which market rivalry affects firm-level ERPT. Results demonstrate that (1) market rivalry has a trivial effect on the ERPT of firms that export homogeneous product, while the effect is statistically significant for firms exporting heterogeneous products; (2) market rivalry increases the ERPT of firms that export consumption goods, but it has no effect on firms that export non-consumption goods; (3) Market rivalry is more likely to affect firm-level export price in developed countries while no significant effect has been found on firm-level export price in developing countries.

Our work is closely related to the literature that studies the connection between exchange rate fluctuations and firm-level export performance (Atkeson and Burstein, 2008; Amiti et al., 2014; Berman et al., 2012; Bergsten, 2010; Chen and Juvenal , 2016; Campa and Goldberg, 2005; Gopinath and Rigobon, 2008; Knetter, 1993; Giri, 2012), particularly, the recent and growing literature that explores the heterogeneous impact of exchange rate fluctuations on firm-level pricing-to-market strategy. Berman et al. (2012) and Li et al. (2015), for instance, respectively document that, in France and China, more productive firms adjust their export price more in response to exchange rate fluctuations; Chen and Juvenal (2016) find that French firms that export high-quality wines tend to absorb more exchange rate fluctuations and have a lower level of ERPT. Amiti et al. (2014) emphasize the important role played by firm-level import intensity and market shares in shaping firm-level ERPT.

Our study contributes to the ERPT literature by exploring how market rivalry affects exporters' pricing-to-market strategy. In contrast to the seminal paper of Amiti et al. (2014), in which firm-level ERPT to a particular market is only related to the competition (market share) within this market, we underscore the influence

of cross-market competition spillovers on firm-level ERPT.[5] Our findings indicate that firm-level pricing-to-market strategy is influenced by the degree of market rivalry across all markets that the firm serves. In addition, by dividing the sample into different subsamples, we identify the source of cross-market spillovers that affect firm-level pricing-to-market strategy.

The rest of this paper will proceed as follows: in section 2 we characterize the data we use, section 3 introduces the construction of our main empirical variables, section 4 presents the results, and finally section 5 concludes.

2. Data

Our empirical exercises use indicators constructed mainly from three datasets: (1). Customs dataset that contains comprehensive Chinese Exporters; (2). Annual Surveys of Industrial Production dataset that provides firm-level production information; (3). macro-level exchange rate dataset from Economist Intelligence Unit (EIU hereafter).

2.1. Customs transaction level trade data

The Chinese Customs trade dataset provides trade information of all Chinese firms' during 2000-2007. These data are collected by the Chinese General Administration of Customs (GAC). The GAC dataset report firm-product-destination-level trade information at the monthly frequency, i.e., export trade values (in U.S. dollars), and trade volumes at HS 8-digit product category for firms in each transaction, etc. In the empirical analysis, we follow other researchers (e.g. Manova and Zhang, 2012; Tang and Zhang, 2012) to aggregate the customs data at the annual level. This is to make the data frequency consistent with that of the Annual Surveys. The annual firm-product-level export price in destination country j is constructed

[5] Our results show that after controlling for firm-level market share (competition) in a market, the competition that firms face in other markets still significantly affect these firms' ERPT.

as the ratio of export values to export volumes:

$$p_{ikjt} = \frac{Export\ Value_{ikjt}}{Export\ Volume_{ikjt}}$$

where p_{ikjt} denotes firm i's export price of product k in market k at t. Making use of nominal exchange rate information between RMB and U.S. dollar (bilateral nominal exchange rate information is available in the EIU data base, which will be introduced below), we transfer the export price in U.S. dollar to Chinese yuan.[6]

2.2. Annual surveys data

Annual surveys of manufacturing firms collected and maintained by China's National Bureau of Statistics (NBS). This dataset covers all state-owned enterprises (SOEs) and non-SOEs with annual sales of more than RMB 5 million (which is equivalent to around $\$770,000$ according to the current exchange rate). Those surveys contain financial information on individual firms such as value-added labor input, investment, and intermediate inputs. We noticed that a substantial portion of the samples are noisy and hence follow the criteria proposed by Brandt et al. (2012) and Feenstra et al. (2014) to clean the data. Specifically, we delete observations in which key variables are missing and in which the firm reports fewer than 8 employees. Furthermore, we also drop observations with total assets less than liquid assets, or total fixed assets or net value of the fixed assets. The filtered number of observations falls by about 30 percent each year, and the total number of firms ranges from $83,868$ in 2000 to $294,398$ in 2007.

In using firm-level trade and production information, a key step is to match the dataset of annual surveys with the customs dataset. Following Upward et al. (2013), we match the two datasets using firm name and established year. The reason is that firm name is less likely to be missing or to change during the relatively short time period (2000-2007), while the other information may change (e.g.

[6] The export values are recoded in U.S. dollars, and hence, the export price that is calculated as the ratio of export value to export volume is in U.S. dollars.

Upward et al., 2013). Table 1 reports the matching results. The results show that our matched sample, on average, accounts for 43.2% of export firms in the annual surveys dataset and 21.17% of export firms in the customs data.

[Table 1 is to be here]

2.3. Exchange rate data

The exchange rate is the key variable in this paper, which we download from the Economist Intelligence Unit (EIU) database,[7] which provides bilateral nominal exchange rates between US dollars and currencies in more than 200 countries since 1980. These bilateral nominal exchange rates enable us to construct the bilateral nominal exchange rates between China and its trading partners. We drop countries whose bilateral nominal exchange rates are missing during 2000-2007 period, and there remains 185 countries that report bilateral nominal exchange rates to US dollars in the whole sample period. The EIU database also provides other country-level or region-level information, i.e., population, GDP, and CPI. We match the exchange rate information with our previous matched sample using country codes available in both datasets. This match process further decreases our sample size. Detailed matching results are reported in Panel C of Table 2:

[Table 2 is to be here]

The matching results in Table 2 indicate that, after combining the exchange rate information with the previous matched sample, the number of exporting destinations falls from 237 to 175. In contrast, the number of export firms, export varieties, and values demonstrate quite small changes. This implies that those dropped countries are not major trading partners of Chinese firms.

Using bilateral nominal exchange rates and consumer price index (CPI) in each country, we construct the bilateral real exchange rate. We use e_{jt} and E_{jt} to denote

[7] EIU country data are available at: https://eiu.bvdep.com/version-2017213/cgi/template.dll.

the real and nominal exchange rate between China and the foreign country j in time t, respectively. E_{jt} is defined as the price of foreign currency in terms of Chinese yuan, and hence, an increase in E_{jt} or e_{jt} indicates a nominal or real depreciation in Chinese yuan. The bilateral real exchange rate is constructed as:

$$e_{jt} = \frac{E_{jt} \times CPI_{jt}}{CPI_{Ct}} \tag{1}$$

where, CPI_{Ct} and CPI_{jt} denote the CPI in China and foreign country j in year t, respectively.

The RMB was pegged to the U.S. dollar before 2005, and hence the RMB/dollar nominal exchange rate was quite stable before 2005. However, we observe substantial variation in the real exchange rate of the Chinese yuan across markets. In Figure 1, we depict the real and nominal exchange rate of Chinese yuan against the U.S. dollar and the Euro. The figure shows a substantial variation of RMB (especially real exchange rate) against its trading partners. In particular, during the sample period, the real exchange rate of RMB appreciates against the U.S. Dollar, but depreciates in Euros. In addition, we observe striking growth in Chinese exports to the U.S. and Europe. Furthermore, the nominal and real exchange rate of Chinese yuan relative to other Asian currency also exhibit substantial volatility (see Figure 2). Figure 2 indicates that Chinese yuan appreciates against Japan Yen, Taiwan dollar, and appreciate relative to the Korean won and Philippine peso.

[Figure 1 is to be here]

[Figure 2 is to be here]

3. Market Rivalry

In this section, we describe the way of constructing market rivalry and offer the intuition behind the construction. To formalize, consider an economy with M firms. Each firm $i \in (1, M)$ has a fixed number of sales agents, n_i. These sales

agents are allocated across market $j \in (1, J)$, and we take the allocation of sales agent, n_{ij}, across markets as exogenous with $\sum_j n_{ij} = n_i$. Similar to Bloom et al. (2013), we assume that, when a sales agent in market j from firm i is exposed to other sales agents in the same market, with probability $\omega > 0$ the encounter generates a leakage of information for firm i. Information leakage may take place when two sales agents meet in a coffee shop or a sales agent moves from one firm to another. The leaked information might reveal firm $i's$ pricing strategy, product quality choice, market expansion plan, etc. Competitors of firm i take advantage of the information to compete with firm i in all markets which firm i serves.[8] Therefore, if sales agents from firm i gain more exposure to other sales agents in a particular market j, information leakage is more likely to take place in market j, which will affect firm i's operation in all other markets. A firm's exposure degree is also referred to as product market rivalry or product market proximity (Bloom et al., 2013). A higher degree of exposure implies a higher degree of market rivalry to which a representative firm faces.

We define the vector $F_i = (F_{i1}, ...F_{iJ})$, where $F_{ij} = \frac{n_{ij}}{n_i}$, as the distribution of firm $i's$ sale agents across different markets (export destinations). The measure of product market proximity (market rivalry) between firms i and k is $SIC_{ik} = F_i F_k n_i$, and the product spillover "pool" for firm i is

$$Rivalry_i = \omega \sum_{i \neq k} SIC_{ik} n_k \tag{2}$$

where the measure of market rivalry, $Rivalry_i$, is the weighted sum of the number of sale agents in other firms, where the weights are the "exposure" measure of proximity. The market rivalry measure in equation (2) relies on two components: the competition from any firm k, SIC_{ik}, and the size of the competitors, which is measured by the number of sale agents, n_k. On the one hand, according to the rearangement inequality, SIC_{ik} reaches the maximum when the vectors F_i and F_k

[8]Note that, if firm i's information is leaked in market j, competitors make use of the information to compete with firm i not only in market j but also all other markets in which firm i operates.

have the same ranking. i.e., $F_{i1} > F_{i2} ... > F_{iJ}$ when $F_{k1} > F_{k2} > ... > F_{kJ}$. On the other hand, the market rivalry measure is increasing in n_k. The intuition is straightforward: when firm i and firm k have similar sale skewness across markets, the competition between the two firms is fiercer, which leads to a larger SIC_{ik}. As such, the degree of market rivalry from firm k is larger. Meanwhile, when firm k is more powerful, measured by the total number of firm k's sale agents, it brings an even larger threat to firm i.[9]

In response to the domestic currency depreciation relative to foreign country j, a firm that faces a higher degree of market rivalry is expected to increase their export price to a lesser degree, since the high degree of market rivalry prevents this firm from charging a high markup. As a result, firms that face a higher degree of market rivalry tend to absorb less exchange rate fluctuations. This idea is similar to the work of Amiti et al. (2014): firm-level ERPT to a particular country j is decreasing in the firm's market share (power) in country j, but in our study, market power (advantage) in country j is determined by the market rivalry the firm faces in all markets it serves.

With the matched sample, we follow Bloom et al. (2013) and Jaffe (1986) to construct the measure of market rivalry as follows. First, we compute firm-product-year level $Export_{ikt}$, which denotes firm i's aggregate export volume of product k (at HS6 level) in year t, and firm-product-destination-year level $Export_{ikjt}$, which denotes the export volume of product k to destination j by firm i. Second, we compute the market skewness vector $S_{ik} = (S_{ik1}, S_{ik2}, ..., S_{ikJ})$, where $S_{ikj} = \frac{1}{T}\sum_{t=1}^{T} \frac{Export_{ikjt}}{Export_{ikt}}$.[10] S_{ikj} is the average export share of product k (over year) that is exported by firm i in market j, and the vector S_{ik} contains the export share of product k in different markets; third, the measure of rivalry between firm i and

[9] Larger firms are usually better at making use of the leaked information relative to small firms and making them harder to compete with.

[10] S_{ik} and S_{ikj} are counterparts of F_i and F_{ij}, respectively.

m in product k can be defined as:

$$SIC_{imk} = \frac{S_{ik}S'_{mk}}{(S_{ik}S'_{ik})^{\frac{1}{2}}(S_{mk}S'_{mk})^{\frac{1}{2}}} \tag{3}$$

Finally, market rivalry is a weighted average of SIC_{imk}.

$$Rivalry_{it} = \sum_{m \neq i} SIC_{imk} \frac{Export_{mkt}}{Export_{ikt}} \tag{4}$$

The degree of market rivalry varies significantly across industries. Table 3 reports export sectors that face the highest and lowest degree of market rivalry, respectively. Figures in Table 3 imply that firms that export footwear or textile related products face the highest degree of competition, while firms producing metallic and chemical materials experience trivial competition. Meanwhile, we also depict the trend of average market rivalry faced by Chinese exporters over time in Figure 3. We can observe a clear increasing trend of the market rivalry measure during 2000-2007. The variation of market rivalry measures across industries and over time provides identification for our empirical exercise. Furthermore, the increasing trend of the market rivalry measure faced by Chinese exporters offer an alternative interpretation for the high ERPT of Chinese export firms during the sample period: The increasing competition prevents exporters from charging a high markup, and hence, they only absorb a very small portion of exchange rate fluctuations.[11]

[Table 3 is to be here]

[Figure 3 is to be here]

Before we move to the empirical estimation, several features of the market rivalry measure are worth addressing here. First, Bloom et al. (2013) construct the

[11] Li et al. (2015) find an almost complete ERPT of Chinese exporters during the same period, which is 96%.

measure of market rivalry at the firm level. i.e., they use the firm-level share of sales for different product k, $S_i = (S_{i1}, ...S_{ik})$, to construct the measure of rivalry between any two firms. In contrast, our measure of market rivalry is at the firm-product level. Therefore, while Bloom et al. (2013) emphasize rivalry spillovers across different products, we highlight the rivalry spillovers for the same product across different destinations. Second, the measure of market rivalry defined in equation (4) is comparable with market share. Consider firms that export to a single country, $S_{ik} = (S_{ik1})$, which implies $SIC_{imk} = 1$. Following equation (4), $Rivalry_{it} = \sum_{m \neq i} \frac{Export_{mkt}}{Export_{ikt}}$, which is an inverse of the market share for firm i in sector k. Amiti et al. (2014) show that firms with a larger market share tend to absorb more exchange rate fluctuations, and exhibit a smaller ERPT. We expect that firms that face a high degree of market rivalry (low market share) absorb less exchange rate fluctuations, and exhibit a larger ERPT.

4. Estimation and Results

In this section, we empirically estimate the impact of firms faced market rivalry on the firm-level ERPT. Similar to the specification in the ERPT literature (e.g. Berman et al., 2012; Chen and Juvenal , 2016; Amiti et al., 2014), we add an interaction term of real exchange rate and the market rivalry measure in the export price regression as follows:

$$lnp_{ikjt} = \alpha + \beta_1 lnRER_{jt} + \beta_2 lnRER_{jt} \times lnRivalry_{ikt} + \beta_3 lnRivalry_{ikt} + lnGDP_{jt} + \gamma X_{it} + \delta_{kjt} + \varepsilon_{ikjt} \quad (5)$$

where RER_{jt} denotes the bilateral exchange rate between China and destination country j. $Rivalry_{ikt}$ captures the degree of market rivalry faced by firm i in product market k. $lnGDP_{jt}$ is the log GDP of country j in year t. X_{it} contains a series of firm-level characteristics which affect a firm's export price, i.e., firm-level

TFP, average wage.[12] $\delta_{kjt} = \delta_{kj} + \delta_t$, which controls for product-country fixed effects and year fixed effects. Results are reported in Table 4.

[Table 4 is to be here]

Results in columns (1)-(4) of Table 4 are obtained by adding more controls. Results in column (4) first indicates that a 10% domestic currency depreciation leads to a 0.6% export price increase, which implies an almost complete ERPT at 94%. This result is comparable with Li et al. (2015); second, the coefficient on the interaction term $lnRER \times lnRivalry$ is negative and statistically significant. This implies that firms facing a higher degree of market rivalry tend to increase their export price less in response to a domestic depreciation. Specifically, at the $80th$ percentile of the market rivalry measure ($Rivalry_{it}$=5.986), the price increase is 0.036% less in response to a 10% domestic currency depreciation. Although this figure is small, it is statistically significant, which confirms the existence of competition spillovers across different markets.

4.1. Heterogeneous Impact of Market Rivalry on Different Firms

We further study the mechanism through which market rivalry affects firm-level export price. Specifically, we are interested in understanding the heterogenous impact of market rivalry on different exporters.

First, we follow the classification of Broad Economic Category (BEC hereafter) to divide all products into consumption goods and non-consumption goods; second, based on the substitution of elasticity measured by Broda et al. (2006), we classify products into heterogeneous product categories and homogeneous product category;[13] and third, we study firm-level ERPT in developed and developing

[12]Firm-level TFP is estimated using the LP method, while a firm's average wage is computed as the total wage paid divided by the total number of employees.

[13]Broda et al. (2006) estimate the elasticity of substitution at HS 3-digit product level for 73 countries, and most countries report close to 200 HS 3-digit sectors. We make use of their

countries, respectively.[14] All results are reported in Table 5.

[Table 5 is to be here]

Columns (1)-(2) of Table 5 show the results for consumption and non-consumption products, respectively. We find first that, although firms that export consumption and non-consumption products increase the export price in response to a depreciation, the firms exporting consumption products increase their export price more relative to nonconsumption product exporters (0.0906 against 0.0182). Second, market rivalry only affects the ERPT of firms that export consumption products, but the effect on non-consumption products exporters is only statistically significant at the 90% confidence level. Note that non-consumption products are usually intermediate inputs. One possible explanation is that non-consumption product importers are less sensitive to price changes, since these importers require stable intermediates import to stabilize their production, which allows non-consumption exporters to pass more exchange rate fluctuations to these importers (lower coefficient of $lnERE$). As such, the export-import relationship between non-consumption exporters and importers is more stable and less likely to break down due to the competition from other intermediate inputs suppliers. Therefore, the firm-level ERPT for firms that export non-consumption products is trivially affected by the market rivalry they faced. In contrast, consumption product importers may be more sensitive to price and more easily to switch their trade partners. As such, market rivalry has a more significant effect on the pricing strategy of consumption products exporters.

Columns (3)-(4) report the results for homogeneous and heterogeneous products, respectively. While firms that export homogeneous and heterogeneous products exhibit similar degree of ERPT (similar coefficients of $lnERE$), market rivalry only affects the ERPT of firms that export heterogeneous products. In other word-

elasticity of substitution estimates in China to divide products into high and low elasticity of substitution categories.

[14]World bank defines developed countries as countries with per-capita GNIs above $\$9,760$ in 2007 using the Atlas conversation factor, and counties whose GNIs below $\$9,760$ as developing countries.

s, in response to depreciation, homogeneous and heterogeneous product exporters increase their export price, but market rivalry diminishes the price increase for heterogeneous product exporters only. One interpretation is that a possible way market rivalry affect firms' behavior is through information leakage. The leaked information weakens a firm's market power and changes its pricing-to-market strategy (discussed in section 3). For homogeneous product exporters, the high degree of product similarity weakens the usefulness of leaked information, i.e., the similar product quality and price provide limited help for competitors. Therefore, market rivalry has statistically insignificant effect on the ERPT of homogeneous exporters.

Columns (5)-(6) show the results for firms that export to developed countries and developing countries, respectively. First, the results indicate a complete ERPT to developing countries, and an incomplete ERPT to developed country, 84.8% $(1 - 25.2\%)$. Second, market rivalry affects firm-level ERPT to developed countries, while it has a trivial and statistically insignificant influence on the ERPT to developing countries. Intuitively, export competition in developed countries is more intensified (Melitz and Ottaviano, 2008; Manova and Zhang, 2012), and hence firms that export to developed countries are larger and more productive. Li et al. (2015) and Berman et al. (2012) document that more productive firms tend to absorb more exchange rate fluctuations. This leads to a lower ERPT in developed countries than that in developing countries. Following the same logic, competitors in developed countries are stronger and better at of making use of leaked information or reputation spillovers. As a result, the representative firm is more concerned about the degree of market rivalry it faces when it exports to developed countries. As such, market rivalry affects firm-level ERPT to developed countries.

In sum, our results reveal that market rivalry, through cross markets spillovers, affects firms that export consumption products, or heterogeneous products and to developed countries. This implies that leaked information or cross-market reputation spillovers are much more useful for competitors in consumption product or heterogeneous product sectors , and competitors in developed countries are better

at making use of leaked information or cross-markets reputation spillovers.

4.2. Robustness Checks

In this section, we conduct a series of robustness checks to verify our baseline results in Table 3. First, following Berman et al. (2012) and Li et al. (2015), we construct different bins of the market rivalry measures based on its percentile,[15] with the bottom bins as the reference group. These bins are used as alternative market rivalry measure and interact with the real exchange rate.[16] The results are reported in Table 6.

[Table 6 is to be here]

In columns (1)-(2), columns (3)-(4), and column (5)-(6), we report the coefficients for the interaction terms between $lnRER$ and the top 50%, top 25%, and top 10% market rivalry group. All results confirm that firms that face a higher degree of market rivalry are less responsive to exchange rate fluctuations, which leads to a higher ERPT.

Second, market rivalry measures the degree to which a firm is exposed to the competitors or product market proximity. As discussed in section 3, the measure of market rivalry is correlated with firm-level exports across destinations, and hence, correlate with firm-level export price. Therefore, reverse causality arises. To alleviate this concern, we estimate the specification of equation (5) in two alternative ways: (1) use lagged firm-level market rivalry, i.e., replace $lnRivalry_{it}$ by $lnRivalry_{i,t-1}$ and (2) replace firm-level measure of market rivalry by its mean over time, i.e., replace $lnRivalry_{it}$ by $ln\overline{Rivalry}_i = \frac{1}{T}\sum_{t=1}^{T} lnRialry_{it}$. The results are reported in Table 7.

[Table 7 is to be here]

[15] Berman et al. (2012) and Li et al. (2015) construct bins of the TFP measures based on its percentile.

[16] This is to avoid outliers bias in our estimated results.

Columns (1)-(2) report the lagged market rivalry results and columns (3)-(4) show the mean market rivalry results. All results indicate that market rivalry tends to increase firm-level ERPT (a negative sign on the interaction $lnRER \times lnRivalry$ implies a smaller price adjustment in response to exchange rate fluctuations), no matter what measure we use.

Third, China has changed its exchange rate system from the dollar peg system into a managed floating exchange rate system "with reference to" a currency basket in 2005. The significant exchange rate regime switching of Chinese yuan could systematically change the exchange rate structure between Chinese yuan and currencies, which was pegged to the U.S. dollar. This change increases uncertainties associated with export, which might affect firm-level pricing strategy in countries which are pegged to the U.S. dollar. In order to avoid contaminating our baseline results by exports to these U.S. dollar-pegged countries, we drop all countries that adopt the dollar peg system from our sample and re-estimate equation (5). In addition, new entrants and exits might have different pricing strategies from continuing exporters (e.g. Hu et al., 2016; Tan et al., 2016), and hence their response to exchange rate fluctuations could be different from continuing exporters. For example, Tan and Zhao (2017) show that new exporters need to build their brand reputation, which results in a more aggressive response to exchange rate fluctuations. To alleviate this concern, we follow Li et al. (2015) to drop observations in individual firms' entry year and exit year.[17] All results are reported in Table 8.

[Table 8 is to be here]

Columns (1)-(2) report the estimated results after dropping all countries that adopt the dollar peg system. The results show that the coefficient on $lnRER$ significant increase relative to that in Table 3. This might reflect that the exchange rate fluctuates more in countries adopting floating exchange rate regime, and hence, exporters absorb more exchange rate fluctuations to avoid being overwhelmed by competitors in these countries with more exchange rate uncertainties.

[17] In this way, we also drop firms which only export 1 period and then exit.

Similar to the baseline results, the negative and statistically significant coefficient of the interaction term $lnRER \times lnRivalry$ implies that market rivalry increases firms' ERPT to destinations. Columns (3)-(4) report the results after dropping observations in firms' entry and exit years. Compared with the baseline results, real exchange rate movements have a similar effect on firm-level export price, but market rivalry increases firm-level ERPT to a higher degree (-0.0010 vs. -0.0006). At the $80th$ percentile of the market rivalry measure (market rivalry=5.986), a firm increases the export price by 0.06% less in response to a 10% domestic currency depreciation.

Fourth, firm-level heterogeneities could result in firms' heterogeneous ERPT. For example, firms with higher productivity and higher market share tend to have a lower ERPT (Amiti et al., 2014; Berman et al., 2012; Li et al., 2015). We add more controls to alleviate the concern that our baseline results suffer from missing variable issue. All results are reported in Table 9.

[Table 9 is to be here]

In column (1), we add an interaction of log real exchange rate and log TFP ($lnRER \times lnTFP$) to control for the heterogeneous response of firms with different productivity to exchange rate movements; column (2) adds an interaction of log real exchange rate and log GDP per capital in the destination countries ($lnRER \times lnGDPPC$). This is to control for different ERPT across different destinations; column (3) adds an interaction of log real exchange rate and log market share (($lnRER \times lnShare$) to control for the impact of market share on firm-level export price.[18] Finally, in column (4) we include firm-level average import price to control for the impact of import price on firms' export price.[19] Our results indicate that,

[18]Market rivalry affects firm-level ERPT to a particular country through the competition in country j and other countries. After controlling for firm-level market share in country j, we explore the impact cross-market competition spillovers on firm-level ERPT.

[19]We follow Amiti et al. (2014) to construct firm i's average import price as: $import\_price_{it} = \sum_k \sum_j \omega_{kjt} lnp_{kjt}$, where lnp_{kjt} denotes the import price of intermediate input k from country j in year t, and ω_{kjt} is a weight, which is computed as the revenue ratio of imported intermediate k from j to all inputs.

after control for different firm-level or destination heterogeneities, the coefficient on $lnRER \times lnRivalry$ is still negative and statistically significant. This implies that higher degree of market rivalry a firm faces, the higher ERPT the firm passes to export destinations.

5. Conclusions

In this paper, we investigate how the degree of market rivalry affects firms' export price and hence the firm-level ERPT. Our results demonstrate that firms that face a higher degree of market rivalry (high level of product market proximity) are less responsive to exchange rate fluctuations, which leads to a higher ERPT.

We further explore the possible mechanisms through which market rivalry affect firm-level export pricing strategy. Results show that firms that export consumption and heterogeneous products and to developed countries take into account of market rivalry when adjusting their export price in response to exchange rate fluctuations. In contrast, the export price of firms that export non-consumption products and homogeneous products and to developing countries is insignificantly affected by market rivalry. This implies that exporters are more concerned about their competitors (high market rivalry or product market proximity) when (1) buyers are more likely to switching their purchase (consumption products against non-consumption products), (2) the degree of product heterogeneity is high, which makes the leaked information more useful to competitors (heterogeneous products against homogeneous products), (3) competitors can better make use of leaked information and reputation spillovers (competitors in developed countries against competitors in developing countries).

We conduct a series of robustness checks. All results confirm that market rivalry is an important determinant factor in firm-level export price. When firms export, especially to multiple markets, their export price in a particular destination

is affected by the competition in other destinations.[20] Therefore, we conclude that cross market competition is a key component which shapes firm-level ERPT.

[20]Recall that market rivalry is a measure of the degree of competition in all export destinations.

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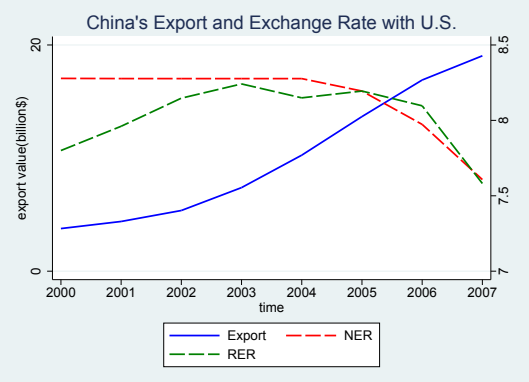
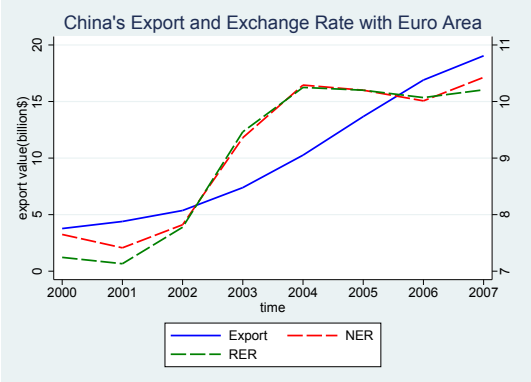
Appendix (Figures and Tables)



China's Export and Exchange Rate with U.S.



China's Export and Exchange Rate with Euro Area

Figure 1

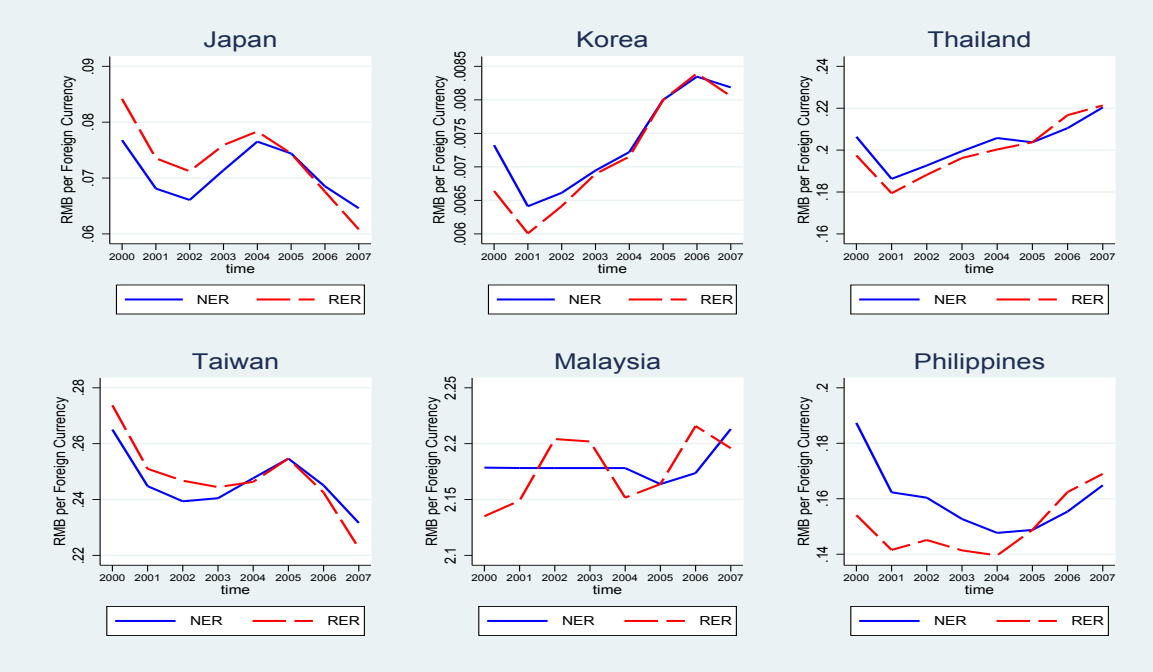


Figure 2: China's Real and Nominal Exchange Rate with Asian Countries

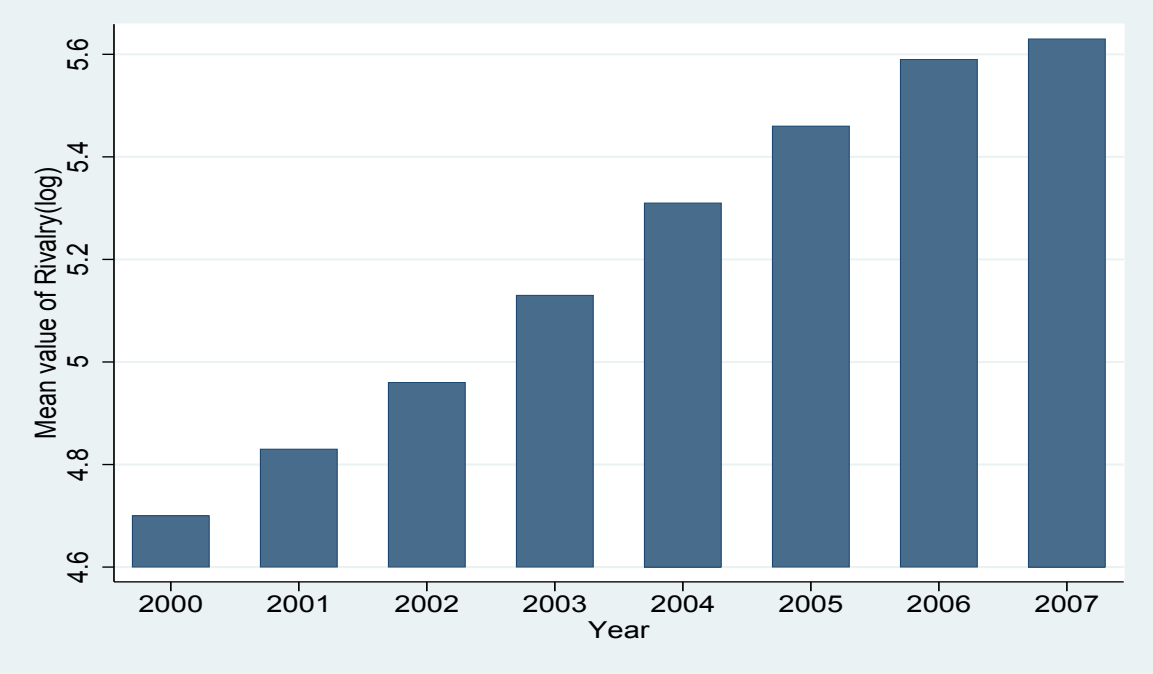


Figure 3: The Time Trend of the Market Rivalry Measure

Table 1: The Matched Sample during 2000-2007

	Annual Surveys Data		Customs Data	Matched Data
Year	Num of Firms	Num of Exporters	Num of Exporters	Num of Exporters
2000	121,722	32,947	62,771	11,360
2001	132,066	36,637	68,487	13,701
2002	144,157	41,163	78,612	16,292
2003	162,838	47,267	95,688	19,955
2004	234,618	71,347	120,590	28,626
2005	23,594	70,874	144,030	31,388
2006	261,472	74,627	171,205	34,425
2007	298,992	759,530	193,567	46,604

Notes: Data Source: authors own calculation based on the original datasets and the matched dataset.

Table 2: The descriptive statistics of the sample

Panel A: Customs Data				
	Export			
	Firms	Countries	Products	Value
Total	241,709	240	4,546	369,123
Average	97,904	227	4,359	46,140
Panel B: Merged with ASPI				
	Export			
	Firms	Countries	Products	Value
Total	72,811	237	4,415	209,627
Average	33,036	222	3,957	26,203
Panel C: Merged with IFS				
	Export			
	Firms	Countries	Products	Value
Total	67,812	175	4,266	113,336
Average	30,365	173	3,790	14,167

Notes: Data Source: authors own calculation based on three datasets. Note: (1)When calculating the total number of firms, countries and export products, we combined the data over years, and only count each variable once when it first time appears. When calculating the average variables, we average them over years. (2) the unit of the traded value is billion.

Table 3: Market Rivalry Measure Variation across Export Sectors

HS6	Export Sector	Market Rivalry (log)
Panel A: Top 10 competitive export sectors		
640230	Other footwear, incorporating a protective metal toe-cap	6.845
851910	Coin or disc-operated recorded-players	6.797
640330	Footwear made on a base or platform of wood, not having an inner sole or a protective metal toe-ca	6.741
852190	Video recording or reproducing apparatus, whether or not incorporating a video tuner - Other	6.739
611030	Jerseys, pullovers, cardigans, waist-coats and similar articles, knitted or crocheted.- Of man-made fibres	6.516
420212	satchels, spectacle cases, – With outer surface of plastics or of textile materials	6.489
852713	Other apparatus combined with sound recording or reproducing apparatus	6.438
620462	Women's or girls' suits, ensembles, jackets, blazers, dresses, skirts, divided skirts, trousers, – Of cotton	6.411
420310	Articles of apparel	6.333
611020	Jerseys, pullovers, cardigans, waist-coats and similar articles, knitted or crocheted.- Of cotton	6.328
Panel A: Bottom 10 competitive export sectors		
284120	Chromates of zinc or of lead	0.001
450110	Natural cork, raw or simply prepared Printing machinery used for printing by means of the printing type,	0.012
844312	blocks, plates, cylinders and ot –Sheet fed, office type (sheet size not exceeding 22 x 36 cm)	0.017
261390	Molybdenum ores and concentrates - Other	0.025
401130	New pneumatic tyres, of rubber - Of a kind used on aircraft	0.025
844090	Book- Binding machinery, including book-sewing machines - Parts Photocopying apparatus incorporating an optical system or of the contact	0.032
900911	type and thermo-copying app– Operating by reproducing the original image directly onto the copy (direct process)	0.033
847220	Addressing machines and address plate embossing machines	0.038
870331	Motor cars and other motor vehicles principally designed for the transport of persons – Of a cylinder capacity not exceeding 1,500 cc	0.047
330113	Essential oils (terpeneless or not), including concretes and absolutes; resinoids; extracted oleores– Of lemon	0.047

Notes: We have excluded export sectors where the number of export firms is fewer than 10. These sectors tend to have a 0 degree of market rivalry measure.

Table 4: The Impact of Market Rivalry on Firms' Export Price

	(1)	(2)	(3)	(4)
$lnRER$	0.0553^{***}	0.0584^{***}	0.0637^{***}	0.0614^{***}
	(0.0064)	*(0.0064)*	*(0.0063)*	*(0.0063)*
$lnRER \times lnRivalry$		-0.0007^{***}	-0.0006^{***}	-0.0006^{***}
		(0.0001)	*(0.0001)*	*(0.0001)*
$lnRivalry$		-0.0354^{***}	-0.0233^{***}	-0.0233^{***}
		(0.0003)	*(0.0003)*	*(0.0003)*
$lnTFP$			0.0764^{***}	0.0764^{***}
			(0.0007)	*(0.0007)*
$lnWage$			0.2725^{***}	0.2724^{***}
			(0.0015)	*(0.0015)*
$lnGDP$				0.1657^{***}
				(0.0170)
Prod-Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Obs	3,504,827	3,504,827	3,504,827	3,504,827
R^2	0.594	0.595	0.604	0.604

Notes: $*$, $**$ and $***$ denote the significance level at 10%, 5% and 1%, respectively. The standard error in the parenthesis.

Table 5: Heterogeneous Effect

	Consumption	Non-Consumption	Homogeneous	Heterogeneous	OECD	Non-OECD
	(1)	(2)	(3)	(4)	(5)	(6)
$lnRER$	0.0906^{***}	0.0182^{***}	0.0505^{***}	0.0680^{***}	0.2520^{***}	-0.0032
	(0.0082)	*(0.0089)*	*(0.0074)*	*(0.0103)*	*(0.0129)*	*(0.0079)*
$lnRER \times lnRivalry$	-0.0011^{***}	-0.0004^{*}	-0.0002	-0.0010^{***}	-0.0011^{***}	-0.0002
	(0.0001)	*(0.0002)*	*(0.0002)*	*(0.0002)*	*(0.0002)*	*(0.0003)*
$lnRivalry$	-0.0198^{***}	0.0290^{***}	-0.0194^{***}	-0.0277^{***}	-0.0233^{***}	-0.0229^{***}
	(0.0004)	*(0.0006)*	*(0.0004)*	*(0.0005)*	*(0.0004)*	*(0.0006)*
$lnTFP$	0.0836^{***}	0.0657^{***}	0.0659^{***}	0.0882^{***}	0.0705^{***}	0.0829^{***}
	(0.0008)	*(0.0011)*	*(0.0009)*	*(0.0012)*	*(0.0009)*	*(0.0012)*
$lnWage$	0.1672^{***}	0.3716^{***}	0.2393^{***}	0.3092^{***}	0.2513^{***}	0.2985^{***}
	(0.0016)	*(0.0024)*	*(0.0018)*	*(0.0024)*	*(0.0019)*	*(0.0024)*
$lnGDP$	0.3177^{***}	-0.0883^{***}	0.2297^{***}	0.0948^{***}	-0.0571	0.0215
	(0.0185)	*(0.0281)*	*(0.0202)*	*(0.0282)*	*(0.0478)*	*(0.0284)*
Prod-Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1,697,589	1,804,785	1,848,344	1,654,030	195,624	1,545,750
R^2	0.611	0.611	0.619	0.591	0.546	0.650

Notes: $*$, $**$ and $***$ denote the significance level at 10%, 5% and 1%, respectively. The standard error in the parenthesis.

Table 6: Alternative Market Rivalry Measures and Specifications

	(1)	(2)	(3)	(4)	(5)	(6)
$lnRER$		0.0598^{***}		0.0616^{***}		0.0643^{***}
		(0.0063)		*(0.0063)*		*(0.0063)*
$lnRER \times Top50\%$	-0.0031^{***}	-0.0032^{***}				
	(0.0001)	*(0.0001)*				
$lnRER \times Top25\%$			-0.0052^{***}	-0.0055^{***}		
			(0.0008)	*(0.0009)*		
$lnRER \times Top10\%$					-0.0069^{***}	-0.0065^{***}
					(0.0013)	*(0.0012)*
$lnTFP$	0.0786^{***}	0.0768^{***}	0.0777^{***}	0.0759^{***}	0.0778^{***}	0.0759^{***}
	(0.0008)	*(0.0007)*	*(0.0008)*	*(0.0007)*	*(0.0008)*	*(0.0007)*
$lnWage$	0.2759^{***}	0.2733^{***}	0.2745^{***}	0.2719^{***}	0.2743^{***}	0.2717^{***}
	(0.0015)	*(0.0016)*	*(0.0016)*	*(0.0015)*	*(0.0016)*	*(0.0015)*
$lnGDP$		0.1646^{***}		0.1636^{***}		0.1664^{***}
		(0.0170)		*(0.0170)*		*(0.0170)*
Prod-Country FE	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes
Prod-Country-Year FE	Yes	No	Yes	No	Yes	No
Obs	3,504,827	3,504,827	3,504,827	3,504,827	3,504,827	3,504,827
R^2	0.603	0.604	0.603	0.604	0.603	0.604

Notes: $*$, $**$ and $***$ denote the significance level at 10%, 5% and 1%, respectively. The standard error in the parenthesis.

Table 7: Different Market Rivalry Measures

	(1)	(2)	(3)	(4)
$lnRER$	0.0678^{***}	0.0727^{***}	0.0604^{***}	0.0629^{***}
	(0.0109)	*(0.0107)*	*(0.0064)*	*(0.0063)*
$lnRER \times lnRivalry$	-0.0007^{***}	-0.0007^{***}	-0.0004^{***}	-0.0005^{***}
	(0.0002)	*(0.0002)*	*(0.0002)*	*(0.0002)*
$lnRivalry$	-0.0470^{***}	-0.0331^{***}	-0.0608^{***}	-0.0426^{***}
	(0.0005)	*(0.0005)*	*(0.0004)*	*(0.0004)*
$lnTFP$		0.0849^{***}		0.0711^{***}
		(0.0011)		*(0.0007)*
$lnWage$		0.2960^{***}		0.2691^{***}
		(0.0023)		*(0.0015)*
$lnGDP$		0.1986^{***}		0.1658^{***}
		(0.0269)		*(0.0170)*
Prod-Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Obs	1,496,197	1,496,197	3,504,827	3,504,827
R^2	0.605	0.615	0.597	0.604

Notes: $*$, $**$ and $***$ denote the significance level at 10%, 5% and 1%, respectively. The standard error in the parenthesis.

Table 8: Different Subsamples

	(1)	(2)	(3)	(4)
$lnRER$	0.1678^{***}	0.1449^{***}	0.0530^{***}	0.0617^{***}
	(0.0087)	*(0.0088)*	*(0.0103)*	*(0.0102)*
$lnRER \times lnRivalry$	-0.0007^{***}	-0.0006^{***}	-0.0010^{***}	-0.0010^{***}
	(0.0001)	*(0.0001)*	*(0.0002)*	*(0.0002)*
$lnRivalry$	-0.0368^{***}	-0.0249^{***}	-0.0378^{***}	-0.0248^{***}
	(0.0004)	*(0.0004)*	*(0.0004)*	*(0.0004)*
$lnTFP$		0.0708^{***}		0.0896^{***}
		(0.0008)		*(0.0010)*
$lnWage$		0.2721^{***}		0.3123^{***}
		(0.0016)		*(0.0021)*
$lnGDP$		0.1153^{***}		0.2365^{***}
		(0.0194)		*(0.0267)*
Prod-Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Obs	2,987,970	2,987,970	2,060,290	2,060,290
R^2	0.595	0.603	0.593	0.603

Notes: $*$, $**$ and $***$ denote the significance level at 10%, 5% and 1%, respectively. The standard error in the parenthesis.

Table 9: The Impact of Market Rivalry on Firms' Export Price-More Controls

	(1)	(2)	(3)	(4)
$lnRER$	0.0424^{***}	0.1711^{***}	0.0674^{***}	0.0694^{***}
	(0.0067)	*(0.0208)*	*(0.0063)*	*(0.0079)*
$lnRER \times lnRivalry$	-0.0004^{***}	-0.0007^{***}	-0.0006^{***}	-0.0017^{***}
	(0.0001)	*(0.0001)*	*(0.0001)*	*(0.0002)*
$lnRivalry$	-0.0233^{***}	-0.0233^{***}	-0.0228^{***}	-0.0235^{***}
	(0.0003)	*(0.0003)*	*(0.0003)*	*(0.0004)*
$lnTFP$	0.0765^{***}	0.0764^{***}	0.0757^{***}	0.0898^{***}
	(0.0007)	*(0.0007)*	*(0.0007)*	*(0.0009)*
$lnWage$	0.2724^{***}	0.2724^{***}	0.2720^{***}	0.2978^{***}
	(0.0015)	*(0.0015)*	*(0.0015)*	*(0.0018)*
$lnGDP$	0.1692^{***}	0.1212^{***}	0.1844^{***}	0.1502^{***}
	(0.0170)	*(0.0394)*	*(0.0170)*	*(0.0204)*
$lnRER \times lnTFP$	0.0024^{***}			
	(0.0003)			
$lnRER \times lnGDPPC$		0.0276^{***}		
		(0.0024)		
$lnRER \times lnShare$			0.0083^{***}	
			(0.0026)	
$Import\_Price$				0.0695^{***}
				(0.0026)
Prod-Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Obs	3,502,374	3,502,374	3,502,374	3,502,374
R^2	0.604	0.604	0.603	0.604

Notes: $*$, $**$ and $***$ denote the significance level at 10%, 5% and 1%, respectively. The standard error in the parenthesis.