IMPORT EXCHANGE RATE PASS-THROUGH AND CREDIT CONSTRAINTS: EVIDENCE FROM CHINA

by

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the thesis examination committee have been made.

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To be finish.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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ABSTRACT

This paper shows the incomplete exchange rate pass-through patterns and its linkage with importers' characteristics. Using Chinese firm-level information and customs records from 2000 to 2007, we find that (1) the average import price pass-through in China is about 35-40%, far below the near complete 95% export price pass-through; (2) for firms in financially more vulnerable industries, both import and export exchange rate pass-through tend to be more complete; (3) higher import source diversity from countries can effectively reduce import price pass-through and offset the effects of credit constraints, while higher productivity does not or even has the opposite effect. Our main innovation is to focus on the role of importers in the determination of international prices. We believe that micro-evidence from import exchange rate pass-through provides a new perspective to study the "exchange rate disconnect" puzzle.

CHAPTER 1

INTRODUCTION

Why did exchange rate fluctuations not result in price changes of the same magnitude? This is one of the core questions among a set of "exchange rate disconnect" puzzles (Obstfeld and Rogoff, 2000 [33]). As price signals in the international trade market, exchange rates appear less informative for firms than expected. Exchange rate pass-through (ERPT), which describes the elasticity of local price changes to exchange rate fluctuations, varies widely across countries, industries, and time. Existing studies generated widely varying estimates of this exchange rate pass-through. Understanding this pricing elasticity is of particular interest to researchers both in the fields of international trade and open macroeconomics to demystify the exchange rate disconnect.

A large body of theoretical and empirical work explores the mechanism of incomplete exchange rate pass-through in prices. Most micro explanations and empirical evidence based on disaggregated data for incomplete exchange rate pass-through focus on the exporter sides. Exporters' productivity (Berman, Martin, and Mayer, 2012 [6]; Li, Ma, and Xu, 2015 [26]) and product quality (Chen and Juvenal, 2016 [12]; Auer, Chaney, and Sauré, 2018 [1]) , as well as their imported inputs (Amiti, Itskhoki, and Konings, 2014 [3]; Wang and Yu, 2021 [35]) and market shares (Auer and Schoenle, 2016 [5]; Devereux, Dong, and Tomlin, 2017 [14]), will all affect the export exchange rate pass-through. Yet the direct role of importers in determining exchange rate pass-through remains a novel field to study.

Financial constraints, discussed in another strand of literature, also demonstrate influence on firms' response in price-setting decisions to exchange rate fluctuations. Strasser (2013) [34] first finds that financially constrained exporters adjust prices in the destination market more sharply when facing exchange rate shocks, implying a more complete exchange rate pass-through. Firms with tighter financial constraints tend to set higher prices due to higher external financing premiums and the resulting higher marginal costs and face higher price elasticity of demand. Thus, with endogenously determined markups, exchange rate depreciation (appreciation) allows firms to increase (decrease) markups,

but credit-constrained firms do so only to a limited extent because they have less space to adjust their profit margins. However, it remains an open question whether importers under financial constraints will behave differently in price negotiation during exchange rate shocks. Therefore, credit constraints provide an innovative entry point for us to study the import exchange rate pass-through.

In this paper, we focus on the role of importers in the determination of exchange rate pass-through and connect it with the importers' financial constraints. This paper tends to fill a gap in the literature by linking both sides of the trade relationship and provides a novel perspective to study the nature of exchange rate disconnect for emerging markets, where firms are more vulnerable to credit constraints due to immature financial markets. In contrast to the conventional framework of exchange rate pass-through where importers are mostly price takers, we contribute to the trade literature by identifying the importers' implicit sourcing power by comparing the heterogeneous capacity to absorb exchange rate shocks. Throughout the paper, we will compare firm-level import exchange rate pass-through with the export pass-through to reflect the similarities and differences between the two. Going a step further, if a country's export and import exchange rate pass-through patterns differ significantly, this may even affect terms of trade as well as current account imbalances.

We estimate the import exchange rate pass-through as the price elasticity of import prices concerning real exchange rates using Chinese firm-level data. Specifically, we merge the Chinese Industrial Enterprises datasets with the China customs data and adopted fixed effects panel regressions with first-order differences to capture the changes in product prices and real exchange rates. The average import exchange rate pass-through is between 35%-40%, which is more incomplete compared to the over 95% export pass-through. Second, we identify the effects of credit constraints on importers' exchange rate pass-through. I use both US measures of sectors' financial vulnerability (Manova, Wei, and Zhang, 2015 [31]) and Chinese measures of credit needs (Fan, Lai, and Li, 2015 [17]). In our baseline results, import prices for firms in sectors with higher financial constraints are more sensitive to exchange rate shocks. Third, we study some potential channels under which credit constraints may affect the import pass-through. We estimate the firm-level markup and total product productivities (TFP) following De Loecker and Warzynski

(2012) [29] and calculate the proxy for an importer's sourcing base. We find that although firm heterogeneity does affect exchange rate pass-through, credit constraints still affect import pass-through significantly even if we control both those firm characteristics.

In robustness checks, we further use alternative measures of credit constraints and alternative subsamples. For credit constraints, we compare sectoral-level measures calculated from China data with those from US data. For subsamples, we divide our subjects into two subsets: two-way traders (simultaneous import and export) and one-way traders (either purely import or purely export). We check our results using only the two-way traders who account for the vast majority of the number of traders and the vast majority of China's trade volume. These results are all significant and robust.

We show that importers' credit constraints do influence price-setting patterns in international trade. We provide evidence for three key findings: (1) average import exchange rate pass-through levels in China are significantly less complete than the export ones; (2) financial constraints will increase both of them to be more complete, and (3) importers who import a certain product from more sources have a less complete pass-through. In other words, financially constrained importers will absorb more price fluctuations caused by exchange rate changes, while financially constrained exporters pass through more exchange rate changes to prices, both compared to those unconstrained firms. This reflects that binding financial constraints will lead to not only narrow margins to adopt pricing-to-market strategies for the sellers but also limited sourcing power for the buyers. Importers with a wider sourcing base could get access to alternative options and avoid bargaining disadvantages in exchange rate fluctuations to some extent.

The remainder of the paper is organized as follows. Section 2 presents a more detailed literature review. Section 3 describes the data we used. Section 4 introduces our empirical strategy and measures of key variables. Section 5 shows the main empirical results about import exchange rate pass-through and credit constraints. Section 6 provides robustness checks and some discussion. Section 7 concludes.

CHAPTER 2

LITERATURE REVIEW

2.1 Incomplete Exchange rate pass-through

First, this paper contributes to a wide literature on the exchange rate disconnect (Obstfeld and Rogoff, 2001 [33]) and particularly on the incomplete pass-through of exchange rate fluctuations into international prices. Campa and Goldberg (2005) [9] document the lack of sensitivity of prices to exchange rate movements and provide estimates of the pass-through of exchange rates into import prices of 23 OECD countries. Berman, Martin, and Mayer (2012) [6] (henceforth, BMM) provide micro-level evidence of firm heterogeneity in response to real exchange rate shocks. Another milestone paper by Amiti, Itskhoki, and Konings (2014) [3] (henceforth, AIK) finds that firms with higher import intensity and market shares have lower exchange rate pass-through. Since then, more studies link the exchange rate elasticity or pass-through to disaggregated firm-level characteristics.

We summarize three major channels leading to incomplete export price pass-through proposed by past literature. The first channel is local currency pricing (LCP). As surveyed by Engel (2002) [15], it means short-run nominal rigidities with prices sticky in the destination currency. Under LCP, the firms that do not adjust prices have zero short-run pass-through. Gopinath and Rigobon (2008) [23] introduce the stickiness and currency of pricing of traded goods into the discussion and provide direct evidence on the extent of LCP in US import and export prices from 1994 to 2005. However, price rigidities can not fully explain the incomplete pass-through as shown in previous empirical results.

The second channel is pricing-to-market (PTM). It is from variable markups in which firms optimally set different prices depending on destination market conditions. Atkeson and Burstein (2008) [4] provide a recent quantitative investigation of the PTM channel and its implication for aggregate prices. BMM (2012) [6] finds that more productive firms respond to exchange rate changes by changing more markup rather than volume, which allows them to pass only a fraction of exchange rate shocks to their terminal prices. Manova

and Zhang (2012) [32] also support that variable mark-ups and product quality across destinations should be considered to explain ERPT patterns. Gopinath, Itskhoki, and Rigobon (2010) [22] about currency choice and Gopinath and Itskhoki (2010) [21] about price adjustment frequency, further combine the above two channels. They show that the PTM and LCP channels of incomplete pass-through interact and reinforce each other, with highly variable-markup firms endogenously choosing to price in local currency as well as adopting longer price durations. If more firms were to adjust prices infrequently, the exchange rate pass-through would decline.

The third channel is the marginal production cost. While local distribution costs could result in incomplete pass-through into consumer prices, the imported inputs channel by AIK (2014) [3] can affect producer factory gate prices. For example, an appreciation of home currency will decrease marginal costs due to cheaper imported inputs, thus partially offsetting the increases in export prices. The linkage between import behaviors and export pass-through helps understand low aggregate exchange rate pass-through and variation in pass-through across exporters. In addition, Chatterjee, Dix-Carneiro, and Vichyanond (2013) [11] study the effect of exchange rate shocks on multi-product firms. They find that the extent of markup adjustments in response to exchange shocks would decline with the firm-product-specific marginal costs. This phenomenon implies the association of the second and third channels mentioned above.

Recent literature reveals more firm-level evidence on heterogeneous pass-through. Chen and Juvenal (2016) [12] predict more pricing-to-market and a smaller response of export volumes for higher quality goods and provide evidence with expert wine ratings to measure quality. Li, Ma, and Xu (2015) [26] (LMX hereafter) find that the domestic price response of Chinese exporters to exchange rate changes is very weak, even though some more productive exporters price more to the market. Garetto (2016) [20] raises two more arguments: 1) firm-level ERPT is a U-shaped function of firm-level productivity and market share; and 2) producers under incomplete information, such as new entrants, have lower pass-through rates than those under complete information. Likewise, Auer and Schoenle (2016) [5] also find a U-shaped relationship between the response of import prices to exchange rate changes and exporter market share with micro-data. Devereux, Dong, and Tomlin (2017) [14]'s novel features are that ERPT and currency invoicing de-

pend on the market share of both importers (negative) and exporters (U-shaped). It means very small or very large exporters have higher rates of pass-through and tend to invoice in the foreign currency.

2.2 Credit constraints and trade

Another important strand of literature discusses the effects of firms' credit constraints on international trade. This belongs to a broader field linking financial shocks and real economic activities. It is widely believed that exporters rely on extra external capital to pay the entry costs into foreign markets which can not be covered by internal cash flows from operations. Therefore, credit constraints for firms in financially vulnerable sectors and financially underdeveloped markets will largely be responsible for the "missing trade".

Kroszner, Laeven, and Klingebiel (2007) [25] classify firms by industries with varying degrees of external financial dependence when examining the impact of banking crises. Manova (2013) [30] and Chaney (2016) [10] argue that credit constraints caused by financial market imperfections affect trade because only those firms that have sufficient liquidity to finance the additional expenditures for accessing foreign markets are able to export. Feenstra, Li, and Yu (2014) [19], Manova, Wei, and Zhang (2015) [31], and Fan, Lai, and Li (2015) [16] provide theoretical explanations and micro evidence from China about how credit constraints affect exports, through incomplete information, multinational links, and quality, respectively. Large revaluations during exchange rate fluctuations will also change their capacity for pledging collateral because of the unstable relative value of domestic and foreign assets (Kohn, Leibovici, and Szkup, 2020 [24]).

As for credit constraints and exchange rate pass-through, Strasser (2013) [34] uses a firm-level survey to show that financially-constrained firms tend to pass through exchange rate shocks to prices to a more complete extent. He argues that borrowing constraints force firms to keep pricing-to-market (PTM) to a minimum as they do not have enough margin to adjust their markups, while unconstrained firms intentionally absorb more price shocks to maintain their optimal pricing policy. Li, Lan, and Ouyang (2020) [27] find that credit-constrained exporters respond to home currency depreciation by increasing production starting from sectors with lower external financing dependence until their

limited financial resources are exhausted.

This article will directly complement and improve on two recent articles that use evidence from Chinese firms to discuss credit constraints and exchange rate pass-through. Both Dai et al. (2021) [13] and Xu and Guo (2021) [36] verify that more financially constrained firms' exporting activities are more sensitive to exchange rate changes than those of less constrained firms, which is similar to Strasser (2013) [34]. Dai et al. (2021) [13]'s analysis of the effect of access to finance on exports mostly follows the PTM channel while they focus more on aggregate export behaviors rather than the bilateral elasticity of export to each country. In response to the variable markup channel, Xu and Guo (2021) [36] further show that the effect of financial constraints on export value remains robust and significant besides the markup adjustment.

CHAPTER 3

DATA

We conduct our empirical research using various data sources: (1) detailed transaction data from China's Custom Database, (2) the Chinese Industrial Enterprises from the National Bureau of Statistics of China, and (3) country-level macro data from Penn World Table 10.0. In this section, we will introduce the basic information of these datasets.

3.1 Customs transaction records

The main dataset we use is the transaction level records from the General Administration of Customs of China (GACC) as in Manova and Zhang (2012) [32]. The sample in this paper ranges from 2000 to 2011. This dataset includes the most comprehensive information on all Chinese trade transactions including import and export values (denominated in US dollars), quantities, quantity units, product names and codes, source and destination countries, and type of enterprises (e.g., state-owned, private, foreign-invested, and joint ventures), etc. Using these comprehensive high-frequency trade records, we are able to compute firm–product unit values to study export or import price responses to exchange rate shocks.

We separate the full records into export and import parts. In our analysis, each unique transaction refers to a firm-product-country-year consolidation. The categories of products in China's customs trade records are coded according to the Harmonized Coding and Description System (Harmonized System or HS) from World Customs Organization (WCO). The original data is subject to HS 8-digit classification. Since there are two major revisions of the HS system in 2002 and 2007, we aggregate HS8 product-level information to the HS6 level and then use conversion tables from the United Nations Trade Statistics to convert HS 2007 and HS 2002 codes into the older version of HS 1996 as in Fan, Li, and Yeaple (2015) [17].

For later empirical studies, we drop unwanted observations referring to LMX (2015) [26]: (1) products with inconsistent units or missing quantity information; (2) special product categories such as arms (HS2=93), antiques (HS2=97), and special categories (HS2=98,99); (3) export transactions existing for only one year without any change over time. Those outliers only make up a very small part of observations. We will refer to this sample as the "long sample" in subsequent analyses.

3.2 Firm-level data

Our source of Chinese firm-level production and financial information is the Chinese Industrial Enterprises (CIE hereafter) database from the National Bureau of Statistics of China (NBSC). This database covers all state-owned enterprises (SOEs) and above-scale enterprises with annual sales of more than 5 million RMB. Our sample period ranges from 1998 to 2007. The number of firms ranges from about 130,000 in 1998 to 300,000 in 2007. The data provide details about firms' identification, ownership, industry type, and about 80 balance sheet variables. The variables used in this project include the number of employees, total wage payments, the value of fixed assets and corresponding annual depreciation, sales income, total operation inputs, etc.

To merge this firm-level survey data with customs records, we follow the standard procedure to match the identification codes based on the contact information of firms as in Fan, Li, and Yeaple (2015) [17]. Manufacturing firms participating in international trade in the matched sample are uniquely identified by the FRDM codes and year. We drop unsatisfactory observations following the criteria of Brooks, Kaboski, and Li (2021) [8]. This merged sample contains the overlapping time of the two datasets, i.e. from 2000 to 2007, and all indicators are in annual terms. We will refer to this combined dataset as the "matched sample" in the rest of this paper.

The summary statistics of the whole customs records, the firm information dataset, and the final matched sample are shown in Table 3.1.

Table 3.1. Summary Statistics

	#observations	Mean	Median	Std. dev	P10	P90
Panel A: Customs records						
Export Value (USD)	18,581,221	424868	21692	1.04E+07	888	423436
Export Price (RMB)	18,581,221	22007.45	30.10417	2229173	4.564519	556.4724
Annual Export Price Change	11,400,795	0.025908	0.005982	0.665267	-0.50011	5709025
Import Value (USD)	14,172,315	439283	7721	1.98E+07	214	292720
Import Price (RMB)	14,172,315	49519.78	111.0406	1411944	5.159389	10247.12
Annual Import Price Change	8,580,234	0.023625	-0.00207	1.017117	8523061	9388119
Panel B: Firm information						
Sales Income (thousand RMB)	1,745,511	78826.33	17630	714350.5	5318	111319
Employment	1,745,511	262.9454	108	964.6382	30	500
Fixed Asset	1,745,511	27437.2	4043	312024.8	573	36968
Operation Input (thousand RMB)	1,745,511	61682.99	13971	562923.1	4035	168810
Current wage payable	1,745,511	3730.157	1121	28699.16	266	6300
Panel C: Matched sample						
Export Value (USD)	3,168,876	880187.2	33693	4.66E+07	1376	712735
Export Price (RMB)	3,168,876	18326.68	28.31701	1893237	4.995613	398.6719
Annual Export Price Change	1,829,966	0.023539	0.006083	0.682097	-0.48284	0.550056
Import Value (USD)	3,280,928	1120261	11139	2.36E+07	266	529584
Import Price (RMB)	3,280,928	29955.95	76.56041	525990.1	4.966081	5614.432
Annual Import Price Change	1,827,983	-0.08694	-0.00105	1.34694	-1.20575	1.013989

3.3 Country-level macro-data

We obtain annual average bilateral nominal exchange rates and price level of household consumption from the newest Penn World Table (PWT 10.0) (referring to Feenstra, Inklaar, and Timmer, 2015 [18]). From the whole table, we keep 183 countries (or districts) using 136 different fiat currencies, which have full records of exchange rates during the period from 1999 to 2011.

The bilateral nominal exchange rate is defined as the Chinese RMB against the foreign currency of country c. An increase in NER_{ct} means a nominal depreciation of the Chinese RMB. Following LMX (2015) [26], the CPI-based real exchange rate (RER_{ct}) is defined as the nominal exchange rate multiplied by foreign CPI and divided by Chinese CPI, which is

$$RER_{ct} = NER_{ct} \cdot \frac{CPI_{ct}}{CPI_{CHN,t}}.$$

Again, an increase in RER_{ct} means a real depreciation of the Chinese RMB against the foreign country's c currency. In later specifications, we mainly use the first difference of the logarithm of the real exchange rate to represent exchange rate changes.

We saw substantial variations in RMB exchange rate fluctuations against different countries including its major trading partners during the period as in Figure 1. We could observe that the real exchange rate against the US dollar did not change a lot in 2000-2004 due to the nominal pegging scheme of RMB to US dollars. In July 2005, the peg was lifted to a slight appreciation of RMB against US dollars as a result of the evolution of exchange policy. The currency exchange rates of China's other major trading partners also fluctuated to varying degrees during this period. Changes in nominal and real exchange rates (based on 1999) for these countries are shown in Figures 3.1 and 3.2

In addition to nominal and real exchange rates, we also use the real GDP of the destination countries from PWT 10.0. The real GDP is computed with national-accounts growth rates. The controls of real GDP changes of the destination country, $\Delta RGDP_{ct}$, help us exclude the effect of economic growth on price movements.

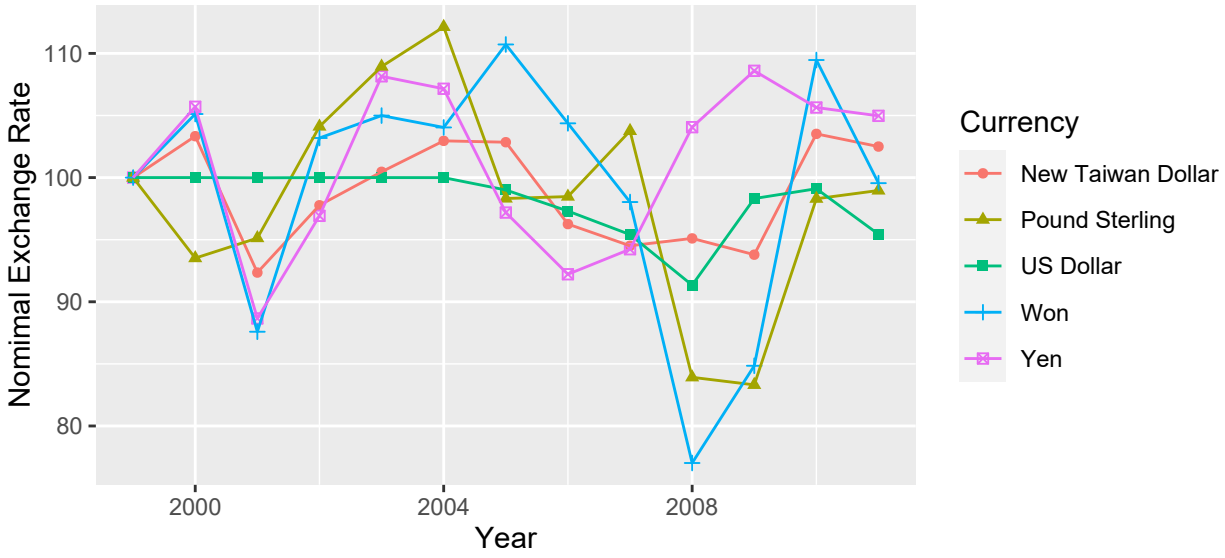

Figure 3.1. Nominal exchange rates of China's major trading partners (1999-2011)

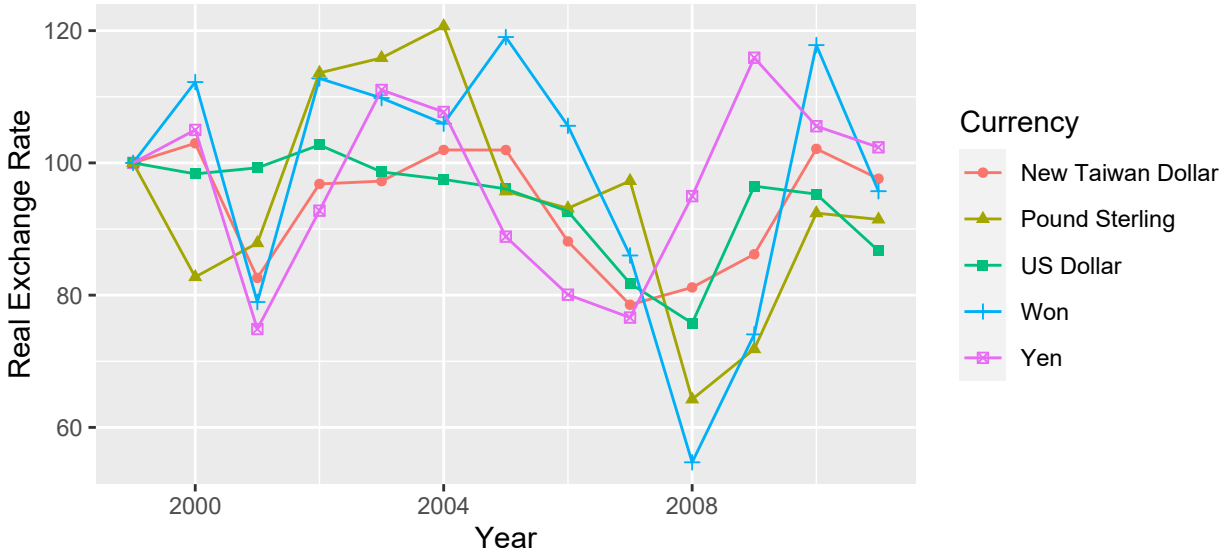

Figure 3.2. Real exchange rates of China's major trading partners (1999-2011)

CHAPTER 4

EMPIRICAL FRAMEWORK

This section describes our econometric specifications and measurements of key variables of interest.

4.1 Estimating equations

4.1.1 Baseline estimations of exchange rate pass-through

Since exchange rate pass-through is not an indicator that can be directly measured, we need to use panel data regression to estimate it. The first step goal is to estimate exchange rate pass-through as the elasticity of unit values to exchange rate changes using the firm-product-country details. Our strategy is based on both fixed effects panel regression and dynamic panel regression. Specifically, we run a regression of import price changes on the bilateral real exchange rate changes between China and the source, controlling for the real GDP of the source country. The baseline equation refers to AIK (2014) [3] and LMX (2015) [26] and is as below:

$$\Delta \ln P^{D}_{ijct} = \alpha + \beta^{D} \Delta \ln RER_{ct} + \gamma \Delta \ln RGDP_{ct} + \xi_{ijc} + \tau_{t} + \varepsilon_{ijct} \tag{4.1}$$

where P_{ijct} represents the import price of the product i bought by firm j from country c during year t, and $D \in$ Import, Export. Therefore, this equation could be used to estimate both import and export exchange rate pass-through with different values of D. RER_{ct} is the bilateral real exchange rate between Chinese RMB and currency in country c, $RGDP_{ct}$ represents real GDP of the source country deflated to the constant price level, which proxy for market demand. ξ_{ijc} denotes the firm-product-country level fixed effects to capture any time-invariant unobserved factors for a combination of firm, product, and destination. The multi-dimensional fixed effects restrict unit value changes to price adjustments, rather

than other changes in corporate trade decisions. τ_t, the year dummies, control for macro-shocks that are common to all exporters.

To deal with possible non-stationarity of the panel sample, we use the first difference of the logarithms for prices $\Delta \ln P^D_{ijct}$, real exchange rates $\Delta \ln RER_{ct}$ and real GDP $\Delta \ln RGDP_{ct}$ to represent their annual rates of change. In this way, we transform the dynamic panel into a fixed effects regression. Therefore, the estimated coefficient of interest β_1 is the elasticity of price changes to exchange rate changes, i.e. the import exchange rate pass-through. We also provide estimations for export exchange rate pass-through which is more common in past literature, where the import prices are now replaced by export prices and the information of sources is replaced by which of destination markets.

The real prices for export and import are always denominated by the Chinese RMB in this paper. Using RMB denominated at both the import and export sides makes the meaning of the coefficients different. The level of coefficient $\beta^{D=Import}$ measures the completeness of import exchange rate pass-through, i.e. a higher β means Chinese importers take more volatile import RMB prices during exchange rate shocks. However, for the export side, $\beta^{D=Export}$ means the "incompleteness" of the export pass-through because a higher β means Chinese exporters pass less exchange rate change to the destination market while having more volatile domestic currency prices. To be noticed, a majority of firms in our sample are both importers and exporters so they will appear in estimations of both exchange rate pass-through.

4.1.2 Estimations of credit constraint effects on exchange rate pass-through

Since our main focus is how firms' credit constraints affect exchange rate pass-through, we then include an interaction term of sectors' financial vulnerability into estimation functions. Intuitively, firms operating in those financially vulnerable industries tend to have less access to enough funds to support their international trade activities, that is, they are subject to tighter credit constraints.

Therefore, we study the credit constraint effects on exchange rate pass-through across sectors with the following panel regression:

$$\Delta \ln P^{D}_{ijct} = \alpha + \beta^{D}_{1} \Delta \ln RER_{ct} + \beta^{D}_{2} \Delta \ln RER_{ct} \cdot FV_{j} + \gamma \Delta \ln RGDP_{ct} + \xi_{ijc} + \tau_{t} + \varepsilon_{ijct} \quad (4.2)$$

where the variable FV_j represents the financial vulnerability of the sector to which the firm j belongs and the rest are the same as those in the baseline equation. The interaction coefficient β_2 represents the effect of credit constraints on exchange rate pass-through. Similar to the baseline estimation, a positive β_2^{Import} for importers implies more credit-constrained importers have a more complete import exchange rate pass-through, while a positive β_2^{Export} implies more credit-constrained exporters have a less complete exchange rate pass-through. The overall import ERPT for an importer j is given by $\beta_1^D + \beta_2^{Import} FV_j$ and the export ERPT for an exporter j is $\beta_1^D + \beta_2^{Export} FV_j$.

Through this estimation strategy, we hope to scrutinize how the pricing behavior of Chinese importers in response to the exchange rate is affected by credit constraints and compare it with that of exporters. Although the functional forms for export and import pass-through are similar, the underlying mechanism could be different, which is one of our key innovation points. While credit-constrained exporters' decisions to deal with exchange rate shocks are mainly related to production, the penetration effect of credit constraints on import prices is through a more direct channel, as the shortage of funds directly affects purchasing choices and bargaining.

4.1.3 Estimations with additional factors

After estimating exchange rate pass-through at the firm level and the impact of credit constraints on it, we need to go a step further to explore why. Through what channels will credit constraints affect the ability of importers to cope with exchange rate shocks? What other factors would exacerbate or diminish this effect?

In this part, we explore additional factors that affect firm-level import exchange rate pass-through. To do so, we introduce a vector $\mathbb{Z}_{jt}$ (or its lagged form $\mathbb{Z}_{jt-1}$) to include those additional factors and apply it to both control terms and interaction terms:

$$\Delta \ln P^{D}_{ijct} = \alpha + [\beta^{D}_{1} + \beta^{D}_{2} \cdot FV_{j} + \beta^{D}_{3} \cdot \mathbb{Z}^{D}_{jt-1}{}']\Delta \ln RER_{ct} + \gamma \Delta \ln RGDP_{ct} + \mathbb{Z}^{D}_{jt}{}'\eta + \xi_{ijc} + \tau_{t} + \varepsilon_{ijct}. \tag{4.3}$$

We will then use the estimation strategy of the form Equation 3 to take into account a range of factors that may directly or indirectly affect exchange rate pass-through to verify that the effects of credit constraints are fully explained by some of these channels. Our firm-level data has the merit of containing information on its production, so we could connect the exchange rate pass-through with estimated firm-specific markup and total factor productivity. The coefficient of the interaction term between production factors and real exchange rate movement β_3 represents the direct effects of those factors on the exchange rate pass-through other than through financial constraints.

Market share is one of the most popular proxies for firm size or market power. For example, AIK (2014) [3] uses destination-specific market shares proxying for markup elasticity. When using market share as the additional factor, the above equation becomes the following form:

$$\begin{aligned} \Delta \ln P^{D}_{ijct} =& \alpha + [\beta^{D}_{1} + \beta^{D}_{2} \cdot FV_{j} + \beta^{D}_{3} \cdot S^{D}_{ijct} + \beta^{D}_{4} \cdot S^{D}_{ijct}{}^{2}]\Delta \ln RER_{ct} \\ &+ \gamma \Delta \ln RGDP_{ct} + \eta S^{D}_{ijct} + \xi_{ijc} + \tau_{t} + \varepsilon_{ijct}. \end{aligned} \tag{4.4}$$

The quadratic term for market share is used to test whether there is a non-monotonic relationship between exchange rate pass-through and market shares, such as the U-shape relationship documented by Garetto (2016) [20] and Devereux, Dong, and Tomlin (2017) [14]. In addition to this, controlling for market share improves our estimation accuracy of the effect of credit constraints on exchange rate pass-through.

4.2 Measurements

4.2.1 Unit value as trade price

The customs records contain disaggregated trade values (denominated by US dollars) and quantities for each HS6 product i, each firm j,, from (or to) each country c, in each year

t, V_{ijct}, and Q_{ijct}. We first convert the value of the goods into RMB using the average exchange rate for the year. Then, the import and export prices we use are computed as unit values, defined as

$$P^D_{ijct} = \frac{V^D_{ijct} \cdot NER_{US,t}}{Q^D_{ijct}}$$

where $D \in \{\text{Import, Export}\}$ and $NER_{US,t}$ is the annualized nominal exchange rate of US dollars in terms of RMB in year t. Because product categories are highly subdivided, we believe that the unit value is an ideal proxy for the transaction price.

Similar to real exchange rates, we take the first difference of the logarithm to represent price changes of a certain product across years. We will exclude observations with the annual growth rate of unit value in the top or bottom 1 percentile in the distribution, by HS2 product category and year.

4.2.2 Credit constraints

One of the most critical issues in our empirical strategy is to measure the extent of financial constraints. To deal with potential concurrent endogeneity, our measures of credit constraints are applied to each firm across the whole period. Following a widely recognized literature on the role of credit constraints in international trade (Kroszner, Laeven, and Klingebiel, 2007 [25]; Manova, Wei, and Zhang, 2015 [31]; Fan, Lai, and Li, 2015 [16]), we use multiple financial vulnerability measures at the sector level to proxy for credit needs (demand of outside capital). These measures are designed to reflect the nature of each industry which should be regarded as exogenous for each individual firm. If a firm is in a more financially vulnerable industry, it tends to face a tighter credit constraint.

The first measure we use is external finance dependence ($ExtFin_j$), the share of capital expenditures not financed by operational cash flows for each industry. If external finance dependence is high, the industry is more financially vulnerable and firms in this industry are more credit constrained. The second measure is asset tangibility ($Tang_j$), which describes the share of the net value of tangible assets that firms can pledge as collateral to raise external finance, in its total book value. The third measure is the inventory-to-sales

ratio ($Invent_j$). which measures the production cycle duration and the necessary working capital to maintain inventories and meet demand.

To utilize the U.S. industry-level credit measures, we match the CIC industry code system used in China to the International Standard Industrial Classification (ISIC) system. We first convert the older ISIC Revision 2 3-digit and 4-digit industries in the appendix table of Manova, Wei, and Zhang (2015) to match the newest ISIC Revision 3 codes; then we link the ISIC Revision 3 codes to the adjusted CIC codes in CIE datasets. Finally, we could match firms in the merged sample to those sector-level financial vulnerability measures.

Although we construct three measures of credit constraints as in the literature, we will focus on the external finance dependence and tangibility in our later analysis. One important reason is that their interpretation can be linked to firms' exposure and resistance to financial frictions directly. In contrast, the inventory ratio may be connected to inventory management efficiency rather than liquidity and financial reasons. Following Manova, Wei, and Zhang (2015) [31], we also construct the first principal component of external finance dependence and asset tangibility FPC_j, which increases with the former and falls with the latter. An industry with a higher FPC_j is more financially sensitive if firms in it require more outside funds but own less collateralizable assets. Therefore, we could use FPC_j as an aggregate measure to combine information about financial vulnerability from $ExtFin_j$ and $Tang_j$.

We have two major reasons why we use credit constraint measures based on US data in our main regressions. First, we want to remove the distortion by the limited credit supply in China and focus on the credit demand associated with sectoral characteristics. Second, the U.S. patterns of sectoral credit demand are proved persistent in a cross-country setting in the literature (Kroszner, Laeven, and Klingebiel, 2007 [25]; Manova, Wei, and Zhang, 2015 [31]; Fan, Lai, and Li, 2015 [16]), especially when the industry classification is broadly defined. Intuitively, the financial needs of an industry may differ in level across countries, but the relative ranking between industries is supposed to be the same across countries, due to Technical reasons specific to the industry itself.

Alternatively, we also compute credit needs based on Chinese firm-level information from CIE data. In addition to the already mentioned three measures, external finance de-

pendence ($ExtFin_j$), asset tangibility ($Tang_j$), and inventory ratio ($Invent_j$), we include the fourth measure is R&D intensity (RD_j), defined as the ratio of research and development expenditure to the total sales. Usually, R&D activities are capital-intensive so it requires firms to pay a large fixed cost before production and sales. Therefore, firms in an R&D-intensive industry should be more financially vulnerable. However, since we only have the information on firms' R&D expenditure in and after 2005, which narrows the range of available samples, we will only use R&D intensity as an auxiliary proxy variable.

We adopt the measure of external finance dependence used by Fan, Lai, and Li (2015) [16]. Then we calculate the inventory ratio as the value of inventory over sales income, the asset tangibility as the value of fixed assets over total assets, and the R&D intensity as R&D spending over total sales income. To avoid credit constraints being endogenously affected by other corporate factors, we take the median of the firm-level credit constraint measure in the same CIC 2-digit industry as the industry-level credit constraint measure. The regression results using the Chinese industry measures are provided as robustness checks for our main conclusion.

4.2.3 Markup and TFP

We argue that the "absorptive capacity" of exchange rate shocks may be related to the firm's attributes. In the following work, we will control markup and productivity to test these conjectures concretely. Referring to Brooks, Kaboski, and Li (2021) [8], even without direct measures of prices and marginal cost, we can still estimate the markup and productivity, using the structural assumptions of De Loecker and Warzynski [29] (2012) (DLW hereafter) and GMM estimation method.

DLW (2012) [29] derives the firm-specific markup as the ratio of an input factor's output elasticities to its firm-specific factor payment shares $\mu_t = \theta_t^X \left(\alpha_t^X\right)^{-1}$, where α_t^X is the share of expenditures on input X in total sales and θ_t^X denotes the output elasticity on an input X. The major difficulty is calculating the firm-specific output elasticity concerning materials, which requires estimating firm-specific production functions. We apply the methodology of Ackerberg, Caves, and Frazer (2015) [2] (hereafter, ACF) to address the endogeneity of inputs, presuming a third-order translog gross output production function

in capital, labor, and materials:

$$y_t = \beta_k k_t + \beta_l l_t + \beta_i m_t + \beta_{k2} k_t^2 + \beta_{l2} l_t^2 + \beta_{m2} m_t^2 + \beta_{kl} k_t l_t + \beta_{km} k_t m_t + \beta_{lm} l_t m_t + \beta_{k3} k_t^3 + \cdots + \omega_t + \epsilon_t.$$

In practice, we need to construct four production variables in log form: real output value y_t, persons engaged l_t, real fixed assets at current value k_t, and real material inputs m_t. Real output values are deflated by output deflators, while real fixed assets and real material inputs are deflated by investment deflators and input deflators, respectively. The deflators are constructed as in Brandt, Van Biesebroeck, and Zhang (2012) [7].

4.2.4 Import sources and export markets

Following the literature about import sourcing, an importer's sourcing diversity could increase its bargaining power in import prices in addition to its production side characteristics. We want to test how importers' sourcing diversity affects exchange rate pass-through. We provide a simple measure of the firm-product-level sourcing diversity $Source_{ijt}$ as the number of source countries from which an importer imports a certain HS6 product type i.

Similarly, for the export side, we count the number of destination countries to which an exporter exports a certain HS6 product type as the firm-product-level selling measure, $Market_{ijt}$. Controlling other variables, the number of export markets for the same product can measure the export network diversity. To control for differences in the firm size, we separately include the total number of HS6 product types imported (or exported) by the firm and the total number of trading partners of the firm in the vector $\mathbb{Z}_{jt}$.

4.2.5 Market share

In addition to the extensive diversity measured by the number of import sources or export markets, we also describe the intensive competitive competitiveness of a firm's share in a specific import or export market.

Following AIK (2014) [3] and Devereux, Dong, and Tomlin (2017) [14], we define import market share as a given firm's share of the import market in terms of value, within

a given HS6 product category. Therefore, a single firm can have multiple import market shares for multiple products. Our definition of import market share is also year specific, and so a firm's import market share can vary over time.

$$S^{D}_{ijct} \equiv \frac{v^{D}_{ijct}}{\sum_{j' \in J_{ict}} v^{D}_{ij'ct}}$$

where $D \in \{\text{Import, Export}\}$. The capital letter J denotes the group of potential competitors in the same product-specific market. The destination-specific export market share proxy is similarly defined as the value share of a firm relative to all Chinese exporters in our sample who export the same product to the same market. Since we only have data from China Customs, our export market share S^{D}_{ijct} is relative to other Chinese firms, and the external competitive stance in a particular sector destinations common for all Chinese exporters.

CHAPTER 5

EMPIRICAL RESULTS

In this section, we will present our major empirical results using the samples described above. First, we show the estimated import exchange rate pass-through is incomplete while the export exchange rate pass-through is very close to complete. Second, we show that both importers and exporters with tighter credit constraints have more complete pass-throughs. Finally, we present the results with firm heterogeneity to explore factors affecting importers' capacity to absorb exchange rate and the role of credit constraints in it.

5.1 Import Pass-through vs Export Pass-through

Past literature on firm-level evidence of exchange rate pass-through mainly focuses on exporter price-setting behaviors. Importers are likely to be more than simple price takers, which gives us a new perspective on exchange rate pass-through. Now we take a closer look at how real exchange rate fluctuations affect import prices and export prices differently in China. The results for import exchange rate pass-through versus export exchange rate pass-through are shown in Table 5.1 using different samples.

We report the baseline estimates of import exchange rate pass-through in panel A. Column (1) shows the import exchange rate pass-through using equation (1) for the long sample from 2000 to 2011, including both firms registered or unregistered in the CIE database. Column (2) shows the results for import exchange rate pass-through for the matched sample (importers registered in the CIE database from 2000 to 2007). The pass-through coefficient in column (2) is larger than the one in column (1), yet both are incomplete. The average import exchange rate pass-through for China is around 40%. This incomplete ERPT means that the import prices denominated in RMB will increase by about 4% during a 10% real depreciation and decrease by the same amount during a 10% appreciation. Column (3) and column (4) report the import pass-through among a subset of the matched sample including only the top 50 and top 20 source countries by import value. The results

Table 5.1. Baseline Estimations of Exchange Rate Pass-Through

	(1)	(2)	(3)	(4)
Panel A		Import		
	Whole	Matched	Top 30	Top 50
$\Delta \ln RER_{ct}$	0.181***	0.389***	0.386***	0.374***
	(0.003)	(0.014)	(0.014)	(0.015)
$\Delta \ln RGDP_{ct}$	-0.107***	0.372***	0.386***	0.440***
	(0.024)	(0.084)	(0.084)	(0.089)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	8409682	1792020	1781946	1684795
Panel B		Export		
	Whole	Matched	Top 30	Top 50
$\Delta \ln RER_{ct}$	0.047***	0.033***	0.040***	0.067***
	(0.002)	(0.005)	(0.006)	(0.008)
$\Delta \ln RGDP_{ct}$	-0.094***	-0.084**	-0.127***	-0.082
	(0.009)	(0.036)	(0.041)	(0.053)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	11173463	1793974	1611407	1251140

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%.

in those subsamples of top partners are slightly less complete than those in column (2), yet the levels are of similar magnitude. These results imply that Chinese importers have to bear less than half but still considerable cost fluctuations due to exchange rate shocks.

Accordingly, estimates of export exchange rate pass-through are recorded in panel B. Similar to which in panel A for imports, column (1) and column (2) in panel B show the export exchange pass-through using the long sample and the matched sample. Column (3) and column (4), in turn, show the export price pass-through to major export destinations. The estimated export pass-through in each column equals one minus the coefficient of $\Delta \ln \mathrm{RER}_{ct}$. The export pass-through ranges from 93.3% for the top 20 countries to 96.6% for the matched sample, which is near complete. The strikingly almost complete ERPT into RMB export price echoes the finding of LMX (2015) [26]. Specifically, 95% export ERPT means that a 10% real appreciation of the RMB concerning a destination market is associated with a 0.5% decrease in the RMB price while a 9.5% increase in foreign currency price. Interestingly, this price increase may be particularly pronounced in Sino-US trade, as the yuan has steadily appreciated against the dollar from 2000 to 2007. Most Chinese exporters have no choice but to pass all exchange rate swings to their destination prices, regardless of potential better monopolistic competition strategies.

From the comparison, it can be seen that the exchange rate-price pass-through in China's import direction is much lower than that in the export direction. That is to say, when the RMB depreciates against the currencies of major trading partners, the export price denominated in RMB will not rise significantly, but the import cost will rise sharply; on the contrary, when the real exchange rate of RMB appreciates, the export price of RMB will decrease only to a limited extent, and their import costs will increase dramatically drop. If we consider a two-way trader in China who simultaneously imports and exports from two groups of countries with strong correlations in exchange rate fluctuations, a devaluation of the local currency will reduce his unit profits, while an appreciation of the local currency will widen his profit margins.

5.2 Effects of Credit Constraints

Another goal of our paper is to assess how importers absorb exchange rate fluctuations when the home currency depreciates or appreciates. We evaluate the consequences of credit constraints on the firms' price responses to exchange rate shocks using equation 4.2 in section 4.1.2. Table 5.2 presents the differences in exchange rate pass-through into import prices and export resulting from the industry-level credit demand heterogeneity. Panel A reports the results for credit constraints and import pass-through and panel B reports the comparing results for the export side.

We are particularly interested in the coefficients of the interaction terms. Note that a larger elasticity coefficient on the import side implies more complete exchange rate-price pass-through, and similarly a positive cross-term coefficient implies that the magnitude of this variable is positively related to exchange rate pass-through. Using the first principal component of external finance dependence and asset tangibility FPC_j to measure financial vulnerability FV_j, we see that import exchange rate pass-through is more complete in financially more vulnerable sectors, relative to financially less vulnerable sectors (column 1, row 3). Columns (2) and (3) separately show the effects of external finance dependence and asset tangibility on importers' exchange rate pass-through. Consistent with the definition that higher external finance dependence implies tighter credit constraints faced by firms while higher asset tangibility can alleviate them, we observe a positive coefficient for the former (row 5) and a negative coefficient for the latter (row 6). When we use the auxiliary measure $Invent_j$, we further observe that the effect on exchange rate pass-through is positive (column 4). The above results support that the coefficient β_2^{Import} of the interaction term $\Delta \ln RER_{ct} \cdot FV_j$ is positive and significant at the 1% level. Our evidence supports the intuition that exchange rate fluctuations are more likely to be reflected in unstable import costs for importers in more financially vulnerable industries because they have weak bargaining power in the international market.

By substituting the superscript D in equation 4.2 for exports from imports, we obtain a comparative result of the effect of credit constraints on export price pass-through. Estimates in columns (1), (2), and (4) all show significantly negative coefficients on interaction terms while column (3) shows a negative significant coefficient. The estimates suggest that

Table 5.2. Estimations of Credit Constraints on Exchange Rate Pass-Through

	(1)	(2)	(3)	(4)
Panel A		Import		
	FPC	External Finance	Tangibility	Inventory
$\Delta \ln RER_{ct}$	0.150***	0.238***	1.152***	-0.517***
	(0.015)	(0.015)	(0.030)	(0.064)
$\Delta \ln RGDR_{ct}$	0.419***	0.432***	0.389***	0.379***
	(0.084)	(0.084)	(0.084)	(0.084)
$\Delta \ln RER_{ct}$*FPC_{jt}	0.376***			
	(0.009)			
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$		1.202***		
		(0.027)		
$\Delta \ln RER_{ct}$*$Tang_{jt}$			-3.096***	
			(0.108)	
$\Delta \ln RER_{ct}$*$Inventory_{jt}$				5.209***
				(0.360)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	1792020	1792020	1792020	1792020
Panel B		Export		
	FPC	External Finance	Tangibility	Inventory
$\Delta \ln RER_{ct}$	0.042***	0.037***	-0.035***	0.108***
	(0.006)	(0.005)	(0.015)	(0.029)
$\Delta \ln RGDP_{ct}$	-0.085***	-0.084**	-0.086***	-0.085
	(0.036)	(0.036)	(0.036)	(0.036)
$\Delta \ln RER_{ct}$*FPC_{jt}	-0.020***			
	(0.004)			
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$		-0.045***		
		(0.013)		
$\Delta \ln RER_{ct}$*$Tang_{jt}$			0.258***	
			(0.052)	
$\Delta \ln RER_{ct}$*$Inventory_{jt}$				-0.433***
				(0.167)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	1793974	1793974	1793974	1793974

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data.

financial constraints lead export exchange rate pass-through to a more complete degree, although the original result was close to complete. These results verified the conclusion of Strasser (2013) [34] who argues that financially constrained firms have higher export price pass-through compared to unconstrained firms. That is to say, credit constraints restrict exporters from absorbing exchange rate shocks, potentially because firms need external finance to apply pricing-to-market strategies in foreign markets.

Comparing panel A and panel B, although the import ERPT is still much lower than export ERPT, we can reach a consistent conclusion that credit constraints steer both of them toward a more complete direction. Following the analysis in section 5.1, credit constraints expose Chinese manufacturing firms to greater exchange rate risk in international trade. Exporters with more vulnerable credit were forced to sharply lower destination prices when RMB depreciated compared to those with unrestricted credit, while RMB income remained relatively unchanged, and importers' costs rose more significantly; in contrast, when the RMB appreciates, restricted exporters will increase destination prices more, even if it means losing their competitive advantages, and importers' costs will be reduced at this time. For credit-constrained two-way traders, given import sources and export markets cannot be adjusted quickly, the unit profit margin is more sensitive to exchange rate fluctuations.

Nonetheless, the direction in which credit constraints affect the exchange rate pass-through on the export side and the import side is the same, the underlying channels may work differently. Following Strasser (2013) [34], a higher external finance premium causes higher marginal costs. Thus, firms with binding financial constraints have no choice but set higher prices and face a higher price elasticity of demand. When there is an exchange rate shock, the optimal choice is to adjust their markups but credit-constrained firms can do so only to a limited extent because they have narrower profit margins. However, for import ERPT, credit constraints can directly affect how buyers pay. Adequate credit or cash reserves give importers a better bargaining chip, for example, by allowing them to negotiate longer-term purchase agreements, where exchange rate fluctuations will be more borne by international sellers.

5.3 Effects of Productivity and Markup

Given that credit constraints play an important role in China's import exchange rate pass-through, we proceed to analyze how different factors participate in determining import exchange rate pass-through, and whether they interact with credit constraints in them. One major argument in the literature is that firms with heterogeneous productivity may have heterogeneous responses to exchange rate shocks as suggested by BMM (2012) [6] and LMX (2015) [26]. This logic could also affect import exchange rate pass-through. Besides, Li, Liao, and Zhao (2018) [28] provide microeconomic evidence that both internal finance and external credit supply significantly promote firm productivity and productivity growth rates. Following the empirical framework in section 4.1.3, we add productivity and markup into interactions, and the results are shown in 5.3.

Panel A show how markup and total factor productivity affect import ERPT in addition to credit constraints and panel B shows the comparison results for export ERPT. In each panel, column (1) shows the direct effects of firm-level markup on exchange rate pass-through. Columns (2) and (3) add external finance dependence and asset tangibility to the regression respectively. Columns (4), (5), and (6) replicate the first three columns while replacing markup with estimated TFP.

From the coefficients of interaction terms in panel A, firms with higher markup have lower degrees of import pass-through while firms with higher productivity have more complete import pass-through. The effects of financial constraints are still significant and robust as in section 5.2 after controlling markup and TFP. In contrast, the coefficients in panel B A.1 imply a similar conclusion. Exporters with higher markup have lower export pass-through while exporters with higher productivity have more complete export pass-through. In other words, the effects of higher markup on the exchange rate pass-through work in the same direction with tighter credit constraints, but which of higher productivity work against the effect of credit constraints.

The "fragility effect" of productivity on import exchange pass-through is somehow against intuition and its explanation seems more complicated than which for export ERPT. BMM (2012) [6] documents that more productive firms react to depreciation (or appreciation) by adjusting more markup and less export volume, keeping local market prices

Table 5.3. Effects of Productivity and Markup on Import Exchange Rate Pass-through

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A			Import			
	Markup	Markup+ External Finance	Markup+ Tangibility	TFP	TFP+ External Finance	TFP+ Tangibility
$\Delta \ln RER_{ct}$	0.552***	0.518***	1.485***	0.082***	0.078***	0.125***
	(0.042)	(0.042)	(0.053)	(0.018)	(0.018)	(0.044)
$\Delta \ln RGDP_{ct}$	0.449***	0.503***	0.462***	0.450***	0.472***	0.451***
	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)	(0.099)
$\Delta \ln RER_{ct}$*$Markup_{jt-1}$	-0.119***	-0.220***	-0.158***			
	(0.028)	(0.028)	(0.028)			
$\Delta \ln RER_{ct}$*TFP_{jt-1}				0.834***	0.684***	0.824***
				(0.017)	(0.021)	(0.019)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$		1.312***			0.457***	
		(0.031)			(0.040)	
$\Delta \ln RER_{ct}$*$Tang_{jt}$			-3.602***			-0.160***
			(0.128)			(0.150)
$Markup_{jt-1}$	0.012**	0.004	0.010**			
	(0.005)	(0.005)	(0.005)			
TFP_{jt-1}				-0.002	-0.007	-0.002
				(0.007)	(0.007)	(0.007)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1411116	1411116	1411116	1411116	1411116	1411116

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data. Panel B is shown in Appendix A.1.

relatively stable, which means a less complete pass-through. This explanation hinges on endogenous markup over marginal costs where less elastic demand allows them to adjust markups more extensively during currency fluctuations. However, for Chinese firms, higher productivity does not necessarily mean greater bargaining power on imports. For example, a company with a more advanced production technology may be more reliant on certain imported intermediate inputs provided upstream in the supply chain, so it would rather accept greater price fluctuations to ensure a stable supply. In any case, the effects of credit constraints are not offset or replaced by those production and sales factors, so the conclusions in section 5.2 remain valid.

5.4 Effects of Sourcing Diversity

Apart from the differences on the production side, we hope to further study the factors that directly affect the purchasing side. As emerged in an intuitive guess, a potential mechanism through which financial constraints affect an importer's bargaining power with foreign suppliers is its outside sourcing options.

Therefore, we employ the 4.3 again to include the number of import sources described in section 4.2.4. The estimation results are reported in Table 5 and confirm the empirical relevance of differences in sourcing diversity across firms. Similar to before, results for sales diversity on the export side are provided in panel B as a comparison.

The estimates for intersection terms between import sources and real exchange rate changes are displayed in columns (1), (2), and (3). We find that importers who import from more countries or import more products in total will have a slightly more complete pass-through, but those who import a certain product from more sources will have a less complete pass-through. This is consistent with our hypothesis that importers with more alternative sourcing options will have less complete pass-through. Interestingly, exporters who export more products in total will have a less complete pass-through, but those who export to more destinations (both for a certain product or in total) will have a more complete pass-through. In other words, the diversity of import sources for the same product can significantly enhance the stability of import prices, but the diversity of export markets does not.

Table 5.4. Effects of Import Sources on Import Exchange Rate Pass-through

	(1)	(2)	(3)	(4)	(5)
Panel A			Import		
	#Countries	#Products	#Sources	#Sources+ External Finance	#Sources+ Tangibility
$\Delta \ln RER_{ct}$	0.036**	-0.176***	0.531***	0.349***	1.400***
	(0.018)	(0.017)	(0.016)	(0.017)	(0.037)
$\Delta \ln RGDR_{ct}$	0.465***	0.466***	0.350***	0.396***	0.365***
	(0.084)	(0.083)	(0.084)	(0.084)	(0.084)
$\#Countries_{jt}$	0.032***				
	(0.001)				
$\#Products_{jt}$		0.006***			
		(0.000)			
$\#Sources_{ijt}$			-0.049***	-0.041***	-0.069***
			(0.003)	(0.003)	(0.007)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$				-0.068***	
*$\#Sources_{ijt}$				(0.006)	
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$				1.465***	
				(0.034)	
$\Delta \ln RER_{ct}$ *$Tang_{jt}$					0.064**
*$\#Sources_{ijt}$					(0.031)
$\Delta \ln RER_{ct}$*$Tang_{jt}$					-3.463***
					(0.138)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes
Observations	1792020	1792020	1792020	1792020	1792020

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data. Panel B is shown in Appendix A.2

In columns (4) and (5), after adding the interaction with financial constraints, we find a wider sourcing base will mitigate the effects of credit constraints, in addition to its effect on pass-through. We continue to observe that this triple interaction effect only works for the import side in panel A but not for the export side in panel B (attached in table A.2). The opposing effects of credit constraints and purchasing diversity on exchange rate pass-through confirm our conjecture about the bargaining power of importers. If a firm can import the same product from more sources, it has more flexibility in the face of bilateral exchange rate shocks in individual markets. The company can either switch from one source to another to reduce costs (trade diversion effect), or make a more credible threat to negotiate a more stable price.

5.5 Effects of Market Share

In this section, we first provide the regression results of equation 4.4 in section 4.1.3 with the market share and its square term constructed in section 4.2.5. The results are presented in Table 5.5. The coefficient estimates for β_3 and β_4 can be used to map out the ERPT–import market share relationship.

In columns (1) and (2), we add the primary and quadratic terms of market share to the baseline estimation of ERPT in turn. In columns (3)-(4), we further include the effects of external finance dependence and asset tangibility on top of which in column (2). Panel B shows the results for export side. We find that there is evidence of a negative relationship between import pass-through and market share; however, the coefficient for the linear interaction term is positive, while the strong negative effect lies on the squared interaction term, suggesting some curvature in the relationship. The effect of market share on export ERPT is not significant.

In addition, we also perform group regressions by market share quartile and report the results in table 5.6. Columns (1)-(4) show the import exchange rate pass-through for importers within each quartile of the market share distribution, respectively. Panel B in turn shows the results for exporters within different quartiles in the market share distribution. Results for each quartile group with interaction terms of credit constraints are not provided here but are available upon request. Roughly speaking, the import exchange

Table 5.5. Effects of Market Share on Import Exchange Rate Pass-Through

	(1)	(2)	(3)	(4)
Panel A	Import			
	MS	MS^2	External Finance	Inventory
$\Delta \ln RER_{ct}$	0.411***	0.394***	0.223***	1.145***
	(0.015)	(0.015)	(0.016)	(0.030)
$\Delta \ln RGDP_{ct}$	0.366***	0.372***	0.441***	0.395***
	(0.084)	(0.084)	(0.084)	(0.084)
$\Delta \ln RER_{ct}$*MS_{ijct}	-0.192***	0.507***	0.847***	0.799***
	(0.037)	(0.134)	(0.134)	(0.135)
$\Delta \ln RER_{ct}$*MS^2_{ijct}		-0.807***	-1.053***	-1.041***
		(0.149)	(0.149)	(0.149)
$\Delta \ln RER_{ct}$*$ExtFin_jt$			1.205***	
			(0.027)	
$\Delta \ln RER_{ct}$*$Tang_jt$				-3.107***
				(0.108)
MS_{ijct}	-0.046***	-0.044***	-0.040***	-0.040***
	(0.007)	(0.007)	(0.007)	(0.007)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	1792020	1792020	1792020	1792020

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data. Panel B is shown in Appendix A.3.

rate pass-through and market share show a hump-shaped (inverted U-shaped) relationship, and the export exchange rate pass-through coefficient (weakly) decreases with the market share (towards complete price pass-through in upper quartiles).

Compared with the literature, Auer and Schoenle (2016) [5] suggest that the direct response of import prices to an exchange rate shock is U-shaped in exporter market share while Devereux, Dong, and Tomlin (2017) [14] supplement it by arguing that the market share of the importing firm is negatively correlated with pass-through and positively with local currency pricing (LCP). The insignificant relationship we find between export exchange rate pass-through and market share may be because China's original export exchange rate pass-through is nearly complete. Yet, the hump-shaped relationship for Chinese importers is interesting and worthy of further discussion.

Table 5.6. Estimations of Exchange Rate Pass-Through by Market Share Quartile

	(1)	(2)	(3)	(4)
Panel A		Import		
	1st	2nd	3rd	4th
$\Delta \ln RER_{ct}$	0.323***	0.479***	0.466***	0.328***
	(0.047)	(0.037)	(0.030)	(0.021)
$\Delta \ln RGDR_{ct}$	-0.066	0.594***	0.504***	0.100
	(0.270)	(0.210)	(0.169)	(0.134)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	372335	450846	492031	476808
Panel B		Export		
	1st	2nd	3rd	4th
$\Delta \ln RER_{ct}$	0.101***	0.096***	0.032***	0.007
	(0.023)	(0.014)	(0.010)	(0.008)
$\Delta \ln RGDR_{ct}$	-0.207	0.068	-0.115*	-0.009
	(0.153)	(0.093)	(0.069)	(0.054)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	367530	464825	508733	452886

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Results for each quartile group with interaction terms of credit constraints are not provided here but are available upon request.

CHAPTER 6

ROBUSTNESS AND DISCUSSION

6.1 Alternative Measures of Credit Constraints

As the first robustness test to further verify our baseline results, we use alternative credit constraint measures from CIE database. The details of constructing these Chinese variables are detailed in section 4.2.2. Although Chinese financial market is less mature than that of the US, the rankings of industries in credit constraints are comparable. Our results are reported in Table 6.1 which can be easily compared with the results using US measures.

Columns 1-4 of panel A of Table 6.1 present the import-side results for external finance dependence, tangibility, inventory ratio, and R&D intensity, respectively. Panel B report the export-side results for the same variables. Nevertheless, most of the interaction term coefficients exhibit the same signs as above, confirming the validity of our baseline findings of the effects of credit constraints on exchange rate pass-through. We can still conclude that financially more constrained firms have a more complete export exchange rate pass-through than those less constrained.

6.2 Alternative Subsample: Two-way traders

Since most of China's imports go through two-way traders, who conduct both export and import simultaneously, import exchange rate pass-through is likely to be related to export behaviors. Specifically, importers who also export may pass part of the price fluctuations of imported intermediate goods caused by exchange rate shocks to their export destination to buffer the impact of exchange rate risks.

To test whether the pattern of China's import pass-through is mainly dominated by two-way traders, we use the sub-sample consisting only of two-way traders for a robustness check. Table 10 presents the results for this restricted sample.

Table 6.1. Alternative Estimations with Chinese Measures of Credit Constraints

	(1)	(2)	(3)	(4)
Panel A		Import		
	External Finance	Tangibility	Inventory	R&D Intensity
$\Delta \ln RER_{ct}$	0.561***	2.109***	-0.854***	0.051***
	(0.016)	(0.049)	(0.040)	(0.017)
$\Delta \ln RGDP_{ct}$	0.356***	0.346***	0.442***	0.412***
	(0.084)	(0.084)	(0.084)	(0.084)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$	0.263***			
	(0.013)			
$\Delta \ln RER_{ct}$*$Tang_{jt}$		-5.946***		
		(0.162)		
$\Delta \ln RER_{ct}$*$Inventory_{jt}$			10.913***	
			(0.324)	
$\Delta \ln RER_{ct}$*$R\&D_{jt}$				17.462***
				(0.526)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	1792020	1792020	1792020	1792020
Panel B		Export		
	External Finance	Tangibility	Inventory	R&D Intensity
$\Delta \ln RER_{ct}$	0.016**	-0.142***	0.089***	0.043***
	(0.007)	(0.022)	(0.018)	(0.007)
$\Delta \ln RGDP_{ct}$	-0.083**	-0.083**	-0.083**	-0.084**
	(0.036)	(0.036)	(0.036)	(0.036)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$	-0.024***			
	(0.007)			
$\Delta \ln RER_{ct}$*$Tang_{jt}$		0.587***		
		(0.072)		
$\Delta \ln RER_{ct}$*$Inventory_{jt}$			-0.512***	
			(0.159)	
$\Delta \ln RER_{ct}$*$R\&D_{jt}$				-0.516**
				(0.236)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	1793974	1793974	1793974	1793974

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%.

Table 6.2. Alternative Estimations with Two-way Traders

	(1)	(2)	(3)	(4)
Panel A		Import (Two-way traders)		
	Baseline	FPC	External Finance	Tangibility
$\Delta \ln RER_{ct}$	0.394***	0.136***	0.231***	1.158***
	(0.015)	(0.016)	(0.015)	(0.031)
$\Delta \ln RGDP_{ct}$	0.406***	0.459***	0.469***	0.427***
	(0.086)	(0.086)	(0.086)	(0.086)
$\Delta \ln RER_{ct}$*FPC		0.388***		
		(0.009)		
$\Delta \ln RER_{ct}$*ExtFin			1.246***	
			(0.028)	
$\Delta \ln RER_{ct}$*Tang				-3.138***
				(0.112)
Year FE		Yes	Yes	Yes
Firm-product-country FE		Yes	Yes	Yes
Observations	1712289	1712289	1712289	1712289
Panel B		Export (Two-way traders)		
	Baseline	FPC	External Finance	Tangibility
$\Delta \ln RER_{ct}$	0.040***	0.051***	0.044***	-0.034**
	(0.006)	(0.006)	(0.006)	(0.016)
$\Delta \ln RGDP_{ct}$	-0.144***	-0.145***	-0.144***	-0.147***
	(0.041)	(0.041)	(0.041)	(0.041)
$\Delta \ln RER_{ct}$*FPC		-0.022***		
		(0.005)		
$\Delta \ln RER_{ct}$*ExtFin			-0.048***	
			(0.015)	
$\Delta \ln RER_{ct}$*Tang				0.284***
				(0.059)
$\Delta \ln RER_{ct}$*Inventory				
Year FE		Yes	Yes	Yes
Firm-product-country FE		Yes	Yes	Yes
Observations	1415415	1415415	1415415	1415415

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%.

Table **??** shows that the results for the subset of two-way traders are highly similar to the results for the entire matched sample, indicating that the exchange rate pass-through pattern of two-way traders dominates China's imports and exports.

6.3 Discussion on import-export linkage

Following the analysis of two-way traders, we discuss the potential relationship between import and export pass-through here in more detail. On the one hand, for two-way traders, export exchange rate pass-through could act as a "pressure-reducing valve" for import price pass-through. When a firm has the ability to pass more exchange rate fluctuations to destination prices, it has more room to absorb price fluctuations of imported inputs. In other words, the firm-level export pass-through will have a positive effect on all product-level import pass-throughs of the same firm.

On the other hand, big importers are also big exporters (AIK, 2014 [3]). Therefore, advantages in some firm characteristics, either explicit ones such as size, market share, or productivity, or implicit ones like foreign networks may lead them to have greater bargaining power on both the import side and the export side and thus cause lower export and import price pass-through at the same time.

To study whether and how those two channels affect the import exchange rate pass-through, ideally we need to control export price pass-through when calculating import price pass-through for all two-way traders. However, it is not available to estimate the price pass-through of each individual firm. We could only check potential influential factors individually using current strategies. However, this provides a future direction for studies to determine the factors of import pass-through.

6.4 Discussion on the trend of China's Exchange Rate Pass-through

In this article, we focus on the horizontal comparison of import and export exchange rate pass-through and its causes. In the future, we can extend our methodology to reveal the time-series trend by varying periods. Actually, in our preliminary research, we found

that China's export exchange rate pass-through has shown an overall downward trend (to be more incomplete) during the 2000s while the trend of China's import pass-through is vague. However, a more detailed investigation requires a longer panel with more information from recent years.

Devereux, Dong, and Tomlin (2017) [14] attempt to explore how changes in import market shares over time may be related to changes in aggregate pass-through over time. They run weighted rolling regressions on 12-month windows moving up by month covering 70 months. Although they find no perfect coincidence of the increase in import market share of large importers and the decrease in pass-through, the general trend does show that the aggregate pass-through is low when the import market share of large importers is large. Therefore, we have reason to suspect that the evolution in China's exchange rate pass-through over time may also be due to the concentration of market share, that is, large exporters and importers occupy more market shares and may thus have stronger bargaining power.

To further ask whether the trend of exchange rate pass-through could be at least partially affected by credit constraints, there are two possible channels to discuss. First, the credit constraints on Chinese exporters are gradually loosening. It may be because of the decreasing credit needs of Chinese exporters or the improvement of the immature financial market in China. Second, China's exports switch from more credit-constrained to less-constrained industries. Credit-constrained firms find it harder to survive in export markets (extensive margin) or export less in value (intensive margin).

CHAPTER 7

CONCLUSION

In this paper, we provide evidence at a highly disaggregated level for the incomplete import exchange rate pass-through in China. Our research contributes to the international trade literature by revealing how importers' characteristics, especially the degree of financial constraints that they face, affect exchange rate price pass-through patterns. Utilizing unit value information from Chinese Customs and comparing imports with exports, we find that (1) the average import price pass-through in China is around 35-40%, far below the 95% export price pass-through; (2) for firms in industries with more stringent credit constraints, both import and export exchange rate pass-through tend to be more complete; (3) import source diversity can effectively reduce import price pass-through and offset the effects of credit constraints, while higher productivity may not or even have the opposite effect. The main novelty of our empirical strategy is to focus on the role of importers. We believe that micro import price pass-through measures China's ability to withstand risks in the international trade market from a new perspective.

There are several directions for future improvement. First, we need to explore the underlying mechanism by which credit constraints affect exchange rate pass-through. We only verify this effect based on a reduced-form approach at this stage. Even after controlling for some potential channels claimed by literature, we are not yet clear about how the remaining effects of credit constraints work. Future work should build a structural model to identify the detailed channels. Second, we should study how a firm's import and export behaviors influence each other. The dominance of two-way traders in China's international trade volume is a key fact that we cannot ignore. Adjustments on the import side and export side are two sides of the same coin for companies to face exchange rate shocks. Third, we should pay attention to the trend of China's exchange rate pass-through over time. The trend may reflect changing market power of Chinese firms and their patterns of pricing to market behaviors. Ideally, we expect to distinguish the contribution of each factor to the trend in exchange rate pass-through.

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APPENDIX A

EXTRA TABLES

Table A.1. Effects of Productivity and Markup on Export Exchange Rate Pass-through

Panel B	Export					
	Markup	Markup+ External Finance	Markup+ Tangibility	TFP	TFP+ External Finance	TFP+ Tangibility
$\Delta \ln RER_{ct}$	-0.042**	-0.045**	-0.116***	0.046***	0.046***	-0.001
	(0.021)	(0.021)	(0.027)	(0.006)	(0.006)	(0.019)
$\Delta \ln RGDP_{ct}$	-0.078*	-0.080*	-0.081*	-0.080*	-0.081*	-0.081*
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
$\Delta \ln RER_{ct}$*$Markup_{jt-1}$	0.060***	0.066***	0.062***			
	(0.015)	(0.015)	(0.015)			
$\Delta \ln RER_{ct}$*TFP_{jt-1}				-0.045***	-0.037***	-0.035***
				(0.009)	(0.009)	(0.009)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$		-0.064***			-0.035**	
		(0.015)			(0.017)	
$\Delta \ln RER_{ct}$*$Tang_{jt}$			0.271***			0.170**
			(0.061)			(0.067)
$Markup_{jt-1}$	-0.005*	-0.004	-0.005*			
	(0.003)	(0.003)	(0.003)			
TFP_{jt-1}				-0.014***	-0.014***	-0.014***
				(0.004)	(0.004)	(0.004)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1418443	1418443	1418443	1418443	1418443	1418443

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data. Panel A is shown in Appendix 5.3.

Table A.2. Effects of Export Markets on Export Exchange Rate Pass-through

	(1)	(2)	(3)	(4)	(5)
Panel B			Export		
	#Countries	#Products	#Sources	#Sources+ External Finance	#Sources+ Tangibility
$\Delta \ln RER_{ct}$	0.067***	0.021***	0.057***	0.059***	0.006
	(0.008)	(0.006)	(0.007)	(0.007)	(0.020)
$\Delta \ln RGDR_{ct}$	-0.079**	-0.085**	-0.080**	-0.080**	-0.082**
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
$\#Countries_{jt}$	-0.001***				
	(0.000)				
$\#Products_{jt}$		0.001***			
		(0.000)			
$\#Markets_{ijt}$			-0.001***	-0.001***	-0.002***
			(0.000)	(0.000)	(0.001)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$				-0.000	
*$\#Markets_{ijt}$				(0.001)	
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$				-0.040**	
				(0.019)	
$\Delta \ln RER_{ct}$*Tang					0.003
*$\#Markets_{ijt}$					(0.003)
$\Delta \ln RER_{ct}$*Tang					0.192***
					(0.073)
Year FE	Yes	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes
Observations	1793974	1793974	1793974	1793974	1793974

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data. Panel A is shown in 5.4

Table A.3. Effects of Market Share on Export Exchange Rate Pass-Through

	(1)	(2)	(3)	(4)
Panel B	Export			
	MS	MS^2	External Finance	Inventory
$\Delta \ln RER_{ct}$	0.034***	0.032***	0.034***	-0.034**
	(0.006)	(0.007)	(0.007)	(0.015)
$\Delta \ln RGDP_{ct}$	-0.083**	-0.084**	-0.084**	-0.084**
	(0.036)	(0.036)	(0.036)	(0.036)
$\Delta \ln RER_{ct}$*MS_{ijct}	-0.002	0.040	0.043	0.028
	(0.011)	(0.044)	(0.044)	(0.044)
$\Delta \ln RER_{ct}$*MS^2_{ijct}		-0.044	-0.046	-0.037
		(0.046)	(0.046)	(0.046)
$\Delta \ln RER_{ct}$*$ExtFin_{jt}$			-0.046***	
			(0.013)	
$\Delta \ln RER_{ct}$*$Tang_{jt}$				0.256***
				(0.052)
MS_{ijct}	0.022***	0.022***	0.022***	0.022***
	(0.003)	(0.003)	(0.003)	(0.003)
Year FE	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes
Observations	1793974	1793974	1793974	1793974

* Robust standard errors clustered at firm level; * significant at 5%; ** significant at 1%. Measures of credit constraints are calculated using U.S. data. Panel A is shown in 5.5