THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF ECONOMICS

EXCHANGE RATE PASS-THROUGH: EVIDENCE FROM CHINA

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SPRING 2014

A thesis
submitted in partial fulfillment
of the requirements
for baccalaureate degrees
in Economics, Mathematics, and Statistics
with honors in Economics

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Abstract

In this paper, I examine the extent and causes of pass-through for Chinese manufacturing firms using Chinese firm-level and customs data from 2000-2006. While previous work suggests that import intensity and market share should be important predictors of pass-through, I find that this is not the case in China for general trade firms and only sometimes true for processing firms. In particular, I find that for processing firms, market share is only a significant predictor of pass-through when examining a firm's most profitable 4-digit HS category. Additionally, pass-through varies significantly across types of processing firms, with import-and-assembly firms having much higher pass-through than pure-assembly firms.

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Acknowledgments

Thanks to Professor Kala Krishna for absolutely everything: encouraging me to pursue economics when I was a freshman, taking me on as a research assistant, believing in me when I thought some classes were over my head, helping me with my thesis, supporting me in my graduate school decisions, and doing countless other things for me. I would also like to thank Xue Bai, Oleksii Khvastunov, and Lena Sheveleva for answering all my questions about this and various other topics over the past several years. Finally, thanks to Professor Hong Ma for allowing me to use the Chinese data and to Professors Saroj Bhattarai and Jim Tybout for comments on earlier drafts.

1 Introduction

Economists have long been interested in the causes of incomplete exchange rate pass-through. Defined by Goldberg and Knetter (1997) as "the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the importing and exporting countries," exchange rate pass-through can help explain several fundamental questions in international economics. In particular, Goldberg and Knetter note that the extent of exchange rate pass-through can help determine if a nation can improve its balance of trade by devaluing its currency. Economists have studied pass-through for decades but only recently have detailed firm-level and customs data sets become available, enabling us to reexamine and improve upon former studies.

This paper examines the extent and causes of pass-through for Chinese firms, closely following the analysis performed in Amiti, Itskhoki, and Konings (2013). In their paper, Amiti, Itskhoki, and Konings find that import intensity and market share are important predictors of pass-through for Belgian firms. The question this paper attempts to answer is, does this hold for all countries? In particular, I consider the case of China, as the Chinese economy rests on the opposite end of the spectrum from that of Belgium in terms of size and types of goods produced.

In this paper I also look at an issue specific to China and other countries with developing economies: the difference in pass-through between firms participating in general trade and firms participating in processing trade. Processing trade differs from general trade because, as Koopman, Wang, and Wei (2008) state, "[Processing] firms import parts and other intermediate materials from abroad, with tariff exemptions on the imported inputs and other tax preferences from local governments, and, after processing or assembling, export the finished products." Therefore, these firms tend to have a much higher import intensity. This is one of the first papers to look at the determinants of pass-through for processing firms.

The findings in this paper suggest that the results of Amiti et al. (2013) do not generalize to all countries. Through the main empirical specification and the robustness checks, I find that for Chinese firms in general trade, neither import intensity nor market share does a good job at predicting pass-through. On the other hand, import intensity does significantly impact pass-through for Chi-

nese processing firms. Additionally, pass-through varies significantly across types of processing firms. This last fact is likely due to the differences in contracts between types of firms.

The remainder of this paper proceeds as follows. In the next section I describe the previous work in the pass-through literature and the various explanations for incomplete pass-through. Following this, I provide a detailed review of Amiti et al. (2013) before proceeding to my own analysis. After exploring some basic facts about the data, I perform the primary analyses on the data for both general and processing firms and present some extensions. These extensions tend to confirm the statistically insignificant impact of import intensity and market share on pass-through for Chinese firms participating in general trade. I then discuss potential causes and implications of the results and directions for future research.

2 Related Work

The exchange rate pass-through literature is extensive. Goldberg and Knetter (1997) say much of the early literature derived from the desire to explain how devaluing a nation's currency would affect its trade balance. In order for full exchange rate pass-through to occur, firms' markups and marginal costs must either remain constant or change so as to offset each other. Measuring this pass-through was the focus of early research. Kreinin (1977) and others find pass-through to the US to be 50-60%, whereas pass-through to Belgium tends to be higher, at about 90%. Early work attributed the residual to changes in firms' markups since the researchers attempted to control for firms' marginal costs.

The theoretical papers by Dornbusch (1987) and Krugman (1987) are the basis for much of the current theoretical literature. Dornbusch (1987) examines how prices change with fluctuations in exchange rates, holding wages fixed. Krugman (1987) introduces the phrase "pricing-to-market" to describe firms' use of price discrimination in different markets due to exchange rate movements. He concludes that pricing-to-market occurs mainly within the machinery and transport equipment sector and that pricing-to-market is probably best understood in a dynamic model of imperfect competition. He also believes pricing-to-market is best explained by the importance firms place on their reputation and the difficulty in adjusting marketing and distribution when the exchange rate changes.

Atkeson and Burstein (2008) build on Dornbusch (1987) and Krugman (1987). They create a model with imperfect competition, variable markups, and two types of trade costs: a fixed labor cost and an iceberg trade cost. Parameterizing their model with the data creates pricing-to-market, but they show that all three of the above assumptions are necessary for this outcome to occur.

Recent papers on pricing-to-market include Fitzgerald and Haller (2012) and Chatterjee, Dix-Carneiro, and Vichyanond (2013). Fitzgerald and Haller (2012) use monthly data from Irish manufacturing firms that contain the producer prices for both the domestic market and the market in the United Kingdom. They find evidence of pricing-to-market where the ratio of the markup in the UK to the market in Ireland increases (decreases) one for one with a depreciation (appreciation)

in the exchange rate between the home and foreign country. On the other hand, Chatterjee et al. (2013) focus on the effects of exchange rate shocks on multi-product firms. More specifically, they develop a theoretical model in which heterogeneous firms produce a range of products with varying degrees of efficiency and the firms pay local distribution costs. Using Brazilian customs data, they find that a firm's prices and product scope increase with depreciations in the exchange rate, just as their model predicted.

Other explanations of incomplete pass-through include price stickiness and local distribution costs. Engel (2001) and Devereux and Yetman (2003) show that price stickiness explains incomplete pass-through in the short term while Goldberg and Campa (2010) show that distribution costs comprise 32-50% of the cost of goods and play a major role in exchange rate disconnect. Other papers, such as Garetto (2012) and Berman, Martin, and Mayer (2012) focus on heterogeneity between firms and show that pass-through depends on a firm's size and productivity. Amiti, Itskhoki, and Konings (2013) relates to Berman et al. (2012), but instead concentrates on the effects of imported intermediate inputs and market shares. For a more complete literature review on pass-through, see Amiti et al. (2013).

Li, Ma, Xu, and Xiong (2013) combines Amiti et al. (2013) and Berman et al. (2012) to examine pass-through for Chinese firms. The authors find that more productive firms and firms with lower market shares adjust prices more to changes in exchange rates, and that a depreciation of the Yuan increases the probability of export and a firm's product scope. Additionally, after controlling for import intensity, they find that pass-through into destination prices is larger for processing firms. In contrast to Li et al. (2013), my paper focuses more on cross-sectional variation and produces very different results.

3 Summary of Amiti, Itskhoki, Konings (2013)

Attempting to determine the causes of exchange rate disconnect, Amiti et al. (2013) examine the roles import intensity and market share play in firms' export pricing decisions. They present the first empirical study on exchange rate pass-through that connects a firm's imported intermediate goods to incomplete exchange rate pass-through into the firm's export prices. They also argue that changes in the prices of imports due to exchange rate shocks tend to offset changes in export prices. Additionally, since import-intensive firms also tend to be large exporters, they can set high markups and change them as their marginal costs change. Thus, both the imported intermediate inputs and the firms' ability to vary their markups mitigate exchange rate shocks to export prices.

Amiti et al. (2013) first present a theoretical model and then use Belgian firm-level data from 2000-2008 to empirically test this model. They base their model on Atkeson and Burstein (2008) and Halpern, Koren, and Szeidl (2011), so the firms are oligopolies that can vary their markups and strategically decide whether or not to import any intermediate goods. The firms differ exogenously in their import costs, productivity, and product quality. Amiti et al. (2013) simplify their model in several ways. First, they only consider exporting firms and do not include firms' choices to enter and exit markets or decisions to export, instead allowing the export destinations of firms to be exogenous. Finally, they assume firms produce a single product and have some control over their prices.

Using this structure, they draw three main conclusions. First, a firm's markup and markup elasticity increase with its market share. Next, the smaller a firm's fixed costs of importing or the larger a firm's material cost, the higher a firm's import intensity will be within a given sector. Similarly, the "partial elasticity of the marginal cost of the firm with respect to the (import-weighted) exchange rate equals ϕ_i" (the import intensity of the firm). Finally, they conclude that "The first order approximation to the exchange rate pass-through elasticity into producer-currency export prices of the firm is given by

$$\Psi^*_{k,i} := \mathbb{E}\left\{\frac{\mathrm{d}\log P^*_{k,i}}{\mathrm{d}\log \varepsilon_k}\right\} = \alpha_{s,k} + \beta_{s,k}\phi_i + \gamma_{s,k}S_{k,i},$$

where $(\alpha_{s,k}, \beta_{s,k}, \gamma_{s,k})$ are sector-destination specific and depend only on average moments of equilibrium co-movement between aggregate variables common to all firms." Here $P^*_{k,i}$ is the price in the producer's currency of firm i for destination k, ε_k is the exchange rate between the source and destination countries, and $S_{k,i}$ is the market share of firm i in country k.

The data Amiti et al. (2013) use comes from the National Bank of Belgium, Belgian Customs, Intrastat, and the Belgian Business Registry. It includes firms' imports and exports at the 8-digit Combined Nomenclature (CN) level and firm characteristics, such as total variable costs and the number of employees (Note that the first six digits of the CN codes correspond to 6-digit Harmonized System (HS) codes.) Since data on exports to other countries using the Euro is not useful because the exchange rates do not change, the export data they primarily use is that of manufacturing firms to the non-Euro OECD countries. Additionally, they keep only a firm's primary exports, defined by the input-output code in which the firm produced the most over the entire time period (using a Belgian input-output table from 2005).

Prior to analyzing the data, they construct several new variables. The first of these is the change in firm f's unit export value of product i to country k from year $t-1$ to year t:

$$\Delta p^*_{f,i,k,t} := \Delta \log \left(\frac{\text{Export value}_{f,i,k,t}}{\text{Export quantity}_{f,i,k,t}} \right),$$

where the quantity can be either in weight or in units. This change in export value serves as a proxy for the log change in price of the good. Next, the import intensity from outside the Euro zone,

$$\phi_{f,t} := \frac{\text{Total non-Euro import value}_{f,t}}{\text{Total costs}_{f,t}},$$

acts as a proxy for a firm's marginal cost sensitivity. Here total costs equal the sum of the total wage bill and the total material cost. Additionally, ϕ_f is the average of $\phi_{f,t}$ over time. Amiti et al.

(2013) then define the change in marginal cost as

$$\Delta mc^*_{f,t} := \sum_{j \in J_{f,t}} \sum_{m \in M_{f,t}} \omega_{f,j,m,t} \Delta \log U^*_{f,j,m,t}.$$

Here $U^*_{f,j,m,t}$ is the unit value in Euros of firm f's imports of intermediate good j from country m at time t and the weights $\omega_{f,j,m,t}$ are the average share of a firm's import values of product j from country m in total costs in years $t-1$ and t. $J_{f,t}$ is the set of all imported goods and $M_{f,t}$ is the set of all import source countries (for a given firm in a given year). Finally, they calculate the market share of firm f in sector s in country k at time t, which serves as a proxy for the markup elasticity, using the following formula:

$$S_{f,s,k,t} := \frac{\text{Export value}_{f,s,k,t}}{\sum_{f' \in F_{s,k,t}} \text{Export value}_{f',s,k,t}}.$$

$f_{s,k,t}$ is set of Belgian exporters to destination k in sector s at time t. Thus, this is a measure of a firm's market share relative to other Belgian firms' market share. Note that the sectors are defined at the 4-digit HS product level.

When analyzing the data, Amiti et al. (2013) uncover several key facts about Belgian manufacturing firms. First, nearly 80% of the exporting firms also import intermediate goods and so firms with zero import intensity account for only 1.4% of exports (by value). The import-intensive exporters (defined to be the firms who are above the 50th percentile in import intensity ϕ_f) have more than twice as many workers, pay slightly more, have a material cost that is more than three times that of the non-import-intensive exporters, and are nearly five times as productive. They also export more than four times as much and tend to import more goods from more countries. Consistent with the theoretical predictions, they find import intensity is positively correlated with market share, total factor productivity, employment, and revenues. They also discover that a firm's import intensity changes little with time and exchange rate changes, and so there is a much higher cross-sectional variation in import intensity.

The main empirical specification is the following:

$$\Delta p^*_{f,i,k,t} = [\alpha_{s,k} + \beta\phi_{f,t-1} + \bar{\gamma}S_{f,s,k,t-1}]\,\Delta e_{k,t} + [\delta_{s,k} + b\phi_{f,t-1} + cS_{f,s,k,t-1}] + \bar{u}_{f,i,k,t}$$

Here p^* denotes the log of the producer price and $e_{k,t}$ is the log of the exchange rate (defined so that if the exchange rate increases, then the Euro depreciates relative to the destination currency). Their final proposition states that "The OLS estimates of β and $\bar{\gamma}$ in [the above equation] identify the weighted averages across sector-destinations of $\beta_{s,k}$ and $\gamma_{s,k} \cdot \mathbf{S}_{s,k,t-1}$ respectively, where $\mathbf{S}_{s,k,t-1}$ is the sector-destination-time-specific cumulative market share of all Belgian exporters and $(\beta_{s,k}, \gamma_{s,k})$ are the theoretical coefficient [*sic*] in the pass-through relationship".

After running this regression with $\phi_{f,t}$ replacing $\phi_{f,t-1}$ and $S_{f,s,k,t}$ replacing $S_{f,s,k,t-1}$, they find that the interaction terms $\Delta e_{k,t}\phi_{f,t}$ and $\Delta e_{k,t}S_{f,s,k,t}$ are strongly significant, thereby agreeing with their prediction. The results show that a firm with zero import intensity and almost zero market share has a pass through of 94%, while a firm with zero import intensity that is at the 95th percentile in market share has a pass-through of 73%, and a firm at the 95th percentile in both import intensity and market share has a pass-through of 55%.

From this specification and many robustness checks, Amiti et al. (2013) conclude that both a firm's import intensity and a firm's market share play a large role in explaining incomplete exchange rate pass-through. Larger exporters tend to import more and have more control over their prices, so both of these channels serve to limit the effects of an exchange rate shock.

4 Analysis

This section discusses the analysis I perform on the Chinese production and customs data in determining the size of pass-through for both general trade and processing trade firms in China, and compares these results to those for Belgian manufacturing firms in Amiti, Itskhoki, and Konings (2013). Note that all of the variables are defined the same way as in Amiti et al. (2013), with the exception of $\phi_{f,t}$, which takes into account all of a firm's imports, rather than just the non-Euro imports. This section first provides a description of the data and next describes some basic facts. It then discusses the main results.

4.1 Data description

For this paper I use Chinese firm-level and customs data from 2000-2006. The data comes from several sources. The firm-level data comes from the Annual Surveys of Production created by the China's National Bureau of Statistics. It includes every state-owned enterprise along with any other firm with at least 5 million RMB in sales. This data provides yearly information about the firms, such as the operating costs, the number of employees, the cost of intermediate inputs, and the value of their exports. There is also a code corresponding to the industry in which most of a firm's products belong. The customs data comes from the Chinese Customs Office and contains information about every international trade transaction. It includes the firm that shipped/received a product, whether the product was imported or exported, an 8-digit HS code for each product, the destination/origin country, and the quantity (usually in kg) and the value (in USD) of the shipment. This data is at the monthly level.

When cleaning the data, I first aggregate firms' imports and exports to yearly totals so then the yearly observations will match the firm-level data. I then convert the industry codes to the more standard ISIC codes in the firm-level data and then merge the firm data with the customs data. Using the ISIC codes, I keep only the firms whose main economic activity is manufacturing and I keep the imports and exports for general trade and processing trade, and save these separately.

Following this, I use the HS-SITC correspondences from the United Nations Statistics Division[1] to convert the 8-digit HS codes to 1-digit SITC codes, and using the SITC codes, I identify and drop exports of non-manufacturing goods. I also drop intermediaries and keep only the products within the firm's most profitable 2-digit HS code. Finally, I merge the data with exchange rates from the World Bank.[2] In order to identify imports that are consumption and capital goods, I download correspondence tables between the Broad Economic Categories and HS codes from the United Nations Statistics Division (see the website cited above). Then, using United Nations (2002), I identify and drop imports corresponding to consumption or capital goods.

One task I do not perform is updating the HS codes. Since the analysis relies on year-to-year price differences, it is essential that the HS codes are updated properly, if at all. Therefore, since there is seemingly no concordance for the 8-digit Chinese HS codes, I decided it was better not to update them.

It is important to note that between 2000 and 2006 the set of exporting firms was not in a steady state. China joined the World Trade Organization in 2001 and so it lowered its tariffs on certain goods and received most-favored-nation status with the other WTO countries. More importantly, China loosened its restrictions on which companies could export directly. In 2000 many firms were required to have at least 5 million RMB in registered capital. As the years progressed, China continued to loosen this requirement until in 2004 any firm could export directly. See, e.g., Table A.1 in Bai, Krishna, and Ma (2013) for more information. This caused an influx of firms in the export market, which is illustrated in Tables A.1 and A.2 in the Appendix. The number of general trade direct exporters increases by over 60% between 2003 and 2004 and also increases every other year. Similarly, the number of processing firms increases by just under 60% between 2003 and 2004 and has an upward trend. Note that the number of processing firms drops by 3.5% from 2005 to 2006, which is consistent with learning-by-exporting (see Bai, Krishna, and Ma (2013)). Thus, this influx of both processing and general trade firms in the export market likely affects firms' pricing decisions.

[1] http://unstats.un.org/unsd/cr/registry/regdnld.asp?Lg=1

[2] http://data.worldbank.org/indicator/PA.NUS.FCRF?page=2

Table 1: Exporter and importer frequencies

	Exporters and/or importers	All exporters
Fraction of all firms	8.93%	7.53%
of them:		
- exporters and importers	19.30%	22.87%
- only exporters	65.07%	77.13%
- only importers	15.63%	–

Note: This table only includes manufacturing firms and takes the average of the yearly number of firms for 2000-2006. Importing and exporting firms are those who import or export directly.

4.2 Basic facts about general trade firms

Unlike in other data, such as the Belgian data used in Amiti et al. (2013), in this Chinese data most general trade firms that export do not simultaneously import goods (at least not directly). As shown in Table 1, of all the firms that either import or export, 19.30% of them are both importers and exporters while 65.07% of them are only exporters. Of the exporting firms (which comprise only 7.53% of all general trade firms), less than 1/4 of them are also importers. With the exception of the first row, the remainder of the values remain fairly constant over time. Table A.1 shows that the percentage of direct exporters more than doubles from 4.49% in 2000 to 9.74% in 2006.

The Chinese data display many regularities found in other studies, which are shown in Table 2. The unit of observation for the table is the firm-year. Import intensity in Table 2 is divided at the median import intensity, 0.00%. However, since nearly 68% of firms have an import intensity of 0, the import-intensive firms consist of only 32% of the total exporters. The non-exporters category consists of firms with at least five employees.

Import-intensive firms tend to be much larger and more productive and they also export more, despite spending only 2.5% more of their total costs on imported goods. Import-intensive firms employ an average of 588 workers, whereas non-import-intensive firms only employ 334 workers. They also pay the average worker 40% more than the workers at non-import-intensive firms and 56% more than workers at non-exporting firms. Import-intensive firms pay over 2.5 times as much for materials as non-import-intensive firms and more than four times as much as non-exporting

Table 2: General trade exporting firm characteristics by import intensity, ϕ_f

	Exporters		Non-exporters
	Import-intensive	Not import-intensive	
Share of total imports in total cost (ϕ_f)	0.025	0.000	0.001
Employment (# full time equiv. workers)	588.0	333.8	172.4
Average wage bill	16.9	12.1	10.8
Material cost (millions of RMB)	139.1	54.0	31.6
Current revenue (millions of RMB)	185.6	71.1	83.5
Total factor productivity (log)	6.99	6.55	
Market share (firm-destination-HS-4)	0.136	0.103	
Export Value	418	335	
# of products exported	2.96	2.82	
# of export destinations	8.02	6.84	
# of export destinations by HS-8	7.14	6.15	
Import value	504	0	
# of import source countries	2.13	0	
# of import source countries by HS-8	1.46	0	
# of HS 8-digit products imported	5.32	0	
# of HS 8-digit-country products imported	6.47	0	

Note: The exporting firms are divided at the median of the import intensity (equal to 0.00%), where import intensity is defined as the fraction of imports of intermediate goods in total costs. Only a firm's products in its most profitable 2-digit HS category are included in the sample. All indirect exporters and intermediaries are omitted from the sample used for this table. The non-exporter sub-sample consists of all non-exporting manufacturing firms with 5 or more employees. Import and export values are in thousands of RMB. Total factor productivity is calculated using the Levinsohn and Petrin (2003) methodology.

firms. Their total factor productivity is slightly higher, at 6.99 compared to 6.55, and their market share is 32% higher. The import-intensive firms export nearly 25% more by value to approximately one more destination, but they do not tend to export many more products. Indeed, most firms only export two or three products. Additionally, import-intensive firms only export on average to one additional destination. They also tend to import 5-6 products from two source countries.

Table 3 details the distribution of import intensities across exporting firms. The majority of firms are concentrated at $\phi_f = 0$. Of the other 32%, nearly all of them have an import intensity between 0 and 0.1. The mass at $\phi_f = 0$ is slightly smaller when looking at the fraction of export value rather than the fraction of firms. By export value, only 59.77% is concentrated at 0 while 38.51%

Table 3: Import intensity distribution across exporters

	# Firms	Fraction of firms	Fraction of export value
$\phi_f = 0$	28,899	68.49%	59.77%
$0 < \phi_f \leq 0.1$	12,531	29.70%	38.51%
$0.1 < \phi_f \leq 0.2$	530	1.26%	1.22%
$0.2 < \phi_f \leq 0.3$	118	0.28%	0.23%
$0.3 < \phi_f \leq 0.4$	53	0.13%	0.10%
$\phi_f \geq 0.4$	64	0.15%	0.17%

Note: Import intensity, ϕ_f, is defined to be the fraction of intermediate inputs imported from abroad in the total costs (wages + material costs) of a firm. The values in the table are averaged over the years 2000-2006.

corresponds to a value of ϕ_f between 0 and 0.1. Estimated cumulative distribution functions of ϕ_f (weighted and unweighted) are depicted in Figure A.1 in the Appendix, alongside estimated cumulative distribution functions for the market shares $S_{f,s,k,t}$ (weighted and unweighted) of the firms.

Table 4 shows the correlation between import intensity and market share, material cost, employment, revenues, and total factor productivity. A positive correlation exists between import intensity and market share, revenues, and total factor productivity. These positive correlations also appear in the Belgian data of Amiti et al. (2013), but the values are not nearly as high. The fact that the material cost is uncorrelated with import intensity contradicts Proposition 2 in Amiti et al. (2013). Also, a negative correlation inexplicably exists between import intensity and employment. Figure A.3 in the Appendix depicts the relationship between employment and import intensity. The variation in the employment level across firms tends to decrease as ϕ_f increases and a very slight downward trend exists. With the exception of market share, the same trend of decreasing variance exists between ϕ_f and the other variables as well.

Next, I explore several characteristics of the import intensity of firms. Regressing the import intensity, $\phi_{f,t}$, on only firm fixed effects yields an R^2 value of 80.3%, suggesting that import intensity is fairly time-invariant. I then regress $\Delta\phi_{f,t}$ on firm fixed effects and the lags of the log change in the import-weighted exchange rates. The current change in the firm-level import-weighted exchange rate is significant at the 1% level with a coefficient of 0.0021. This means

Table 4: Correlation structure of import intensity

	Import Intensity	TFP	Revenues	Employment	Material Cost
Market Share	0.05	0.10	0.13	0.04	0.13
Material Cost	0.00	0.67	0.97	0.68	
Employment	-0.06	0.44	0.70		
Revenues	0.01	0.75			
TFP	0.03				

Note: These correlations are the averages of the firm-level variables over time. Employment, material cost, revenues, and total factor productivity are in logs. Import intensity, ϕ_f, is defined to be the fraction of intermediate inputs imported from abroad in the total costs (wages + material cost) of a firm.

that if the Chinese Yuan depreciates by 10%, then a firm's import intensity will rise on average by 0.021%. None of the lag effects are significant, suggesting that firms mainly consider the change in their import-weighted exchange rate from the previous year when determining how much to import. After this I consider the change in a firm's extensive margin (defined as the number of 8-digit HS products imported each year) when a firm's import-weighted exchange rate changes. Regressing the change in the number of products on firm fixed effects and the log change in a firm's import-weighted exchange rate gives a coefficient of 0.24, which is significant at the 1% level. Thus, if the Yuan depreciates by 10%, a firm will increase the number of products it imports by 2.4%.

The facts above suggest that for Chinese exporters, the decision to import goods may not be a sunk decision. Therefore, I will perform the subsequent regressions using ϕ_f (as Amiti et al. (2013) do) and include results from using $\phi_{f,t-1}$ in the Appendix.

4.3 Basic facts about processing firms

Next, I explore similar statistics for processing firms. Here, similar to the Belgian data used in Amiti, Itskhoki, and Konings (2013), but unlike Chinese firms in general trade, most processing exporters simultaneously import goods. As shown in Table 5, of all the firms that either import or export, 75.79% of them are both importers and exporters while 6.38% of them are only exporters. Of the exporting firms over 92% of them are also importers. The fact that this is not 100% could be

Table 5: Processing trade exporter and importer frequencies

	Exporters and/or importers	All exporters
Exporters and Importers	75.79%	92.23%
Only Exporters	6.38%	7.77%
Only Importers	17.83%	–

Note: This table only includes manufacturing firms and takes the average of the yearly number of firms for 2000-2006. Importing and exporting firms are those who import or export directly.

due to the fact that some of the firms import goods indirectly. These values remain fairly constant over time.

It turns out that processing firms are quite different from firms in general trade, which can be seen in Table 6. In this table, import intensity is divided at the median import intensity for processing firms, 3.79%, but the other details remain the same as in Table 2.

Import-intensive processing firms tend to be smaller and less productive, yet they export more. Import-intensive firms employ an average of 278 workers, whereas non-import-intensive firms employ 389 workers. They also pay the average worker 36% less than the workers at non-import-intensive firms and 12% more than workers at non-exporting firms. Import-intensive firms pay slightly more than half as much for materials as non-import-intensive firms and non-exporting firms. Their total factor productivity is also lower, at 6.17 compared to 6.45 for non-import-intensive firms and their market share is 8% higher. The import-intensive firms export about 3% more by value to about the same number of destinations and they do not tend to export many more products. Indeed, most firms only export three or four products. Additionally, import-intensive firms also export on average to the same number of destinations. They also tend to import 12-13 products from four or five source countries.

In contrast to general trade firms, processing firms tend to have a higher share of total imports in total costs, but have smaller material costs, revenues, total factor productivity, and market shares. Nevertheless, they export more by value and number of products, but to fewer destinations. On average, they also import more products from more source countries.

Table 7 details the distribution of import intensities across exporting firms. The majority of

Table 6: Processing firm characteristics by import intensity, ϕ_f

	Exporters		Non-exporters
	Import-intensive	Not import-intensive	
Share of total imports in total cost (ϕ_f)	0.105	0.014	0.055
Employment (# full time equiv. workers)	277.8	389.1	238.9
Average wage bill (thousands of RMB)	3,250	5,051	2,893
Material cost (millions of RMB)	24.3	41.4	44.5
Current revenue (millions of RMB)	31.8	53.3	56.6
Total factor productivity (log)	6.17	6.45	6.42
Market share (firm-destination-HS-4)	0.146	0.135	
Export Value	434	422	
# of products exported	3.78	3.47	
# of export destinations	4.82	4.92	
# of export destinations by HS-8	4.60	4.62	
Import value	355	119	
# of import source countries	4.84	3.59	
# of import source countries by HS-8	3.15	2.42	
# of HS 8-digit products imported	12.5	11.8	
# of HS 8-digit-country products imported	19.2	17.0	

Note: The exporting firms are divided at the median of the import intensity (equal to 3.79%), where import intensity is defined as the fraction of imports of intermediate goods in total costs. Only a firm's products in its most profitable 2-digit HS category are included in the sample. All indirect exporters and intermediaries are omitted from the sample used for this table. The non-exporter subsample consists of all non-exporting manufacturing firms with 5 or more employees. Import and export values are in thousands of RMB. Total factor productivity is calculated using the Levinsohn and Petrin (2003) methodology.

firms are concentrated at $\phi_f \in (0, 0.1]$: 72.7% of firms fall in this range. Additionally, 12.6% of firms have an import intensity between 0.1 and 0.2. The quantity of firms with $\phi_f \in (0, 0.1]$ is slightly larger when looking at the fraction of export value rather than the fraction of firms; by export value, 76.4% is concentrated in that range, whereas 11.2% corresponds to a value of ϕ_f between 0.1 and 0.2. Estimated cumulative distribution functions of ϕ_f (weighted and unweighted) are depicted in Figure A.2 in the Appendix, alongside estimated cumulative distribution functions of the market shares $S_{f,s,k,t}$ (weighted and unweighted) of the firms.

Table 8 shows the correlation between import intensity and market share, material cost, employment, revenues, and total factor productivity for processing firms. A negative correlation exists

Table 7: Exporting processing firms' import intensity distribution

	# Firms	Fraction of firms	Fraction of export value
$\phi_f = 0$	870	9.51%	5.83%
$0 < \phi_f \leq 0.1$	6,658	72.74%	76.41%
$0.1 < \phi_f \leq 0.2$	1,151	12.58%	11.18%
$0.2 < \phi_f \leq 0.3$	284	3.10%	3.44%
$0.3 < \phi_f \leq 0.4$	104	1.14%	1.73%
$\phi_f \geq 0.4$	86	0.94%	1.42%

Note: Import intensity, ϕ_f, is defined to be the fraction of intermediate inputs imported from abroad in the total costs (wages + material costs) of a firm. The values in the table are averaged over the years 2000-2006.

Table 8: Correlations for processing firms

	Import Intensity	TFP	Revenues	Employment	Material Cost
Market Share	0.02	0.10	0.12	-0.09	0.11
Material Cost	-0.21	0.62	0.94	0.45	
Employment	-0.18	0.31	0.51		
Revenues	-0.19	0.77			
TFP	-0.14				

Note: These correlations are the averages of the firm-level variables over the period 2000-2006. Employment, material cost, revenues, and total factor productivity are in logs. Import intensity, ϕ_f, is defined to be the fraction of intermediate inputs imported from abroad in the total costs (wages + material cost) of a firm.

between import intensity and material cost, employment, revenues, and total factor productivity. The relationships between import intensity and the other variables look very similar to that shown in Figure A.3 for the relationship between employment and import intensity for general trade firms. These correlations contrast with those in the Belgian data of Amiti, Itskhoki, and Konings (2013), which are all positive. The fact that the material cost is negatively correlated with import intensity contradicts Proposition 2 in Amiti, Itskhoki, and Konings (2013). With the exception of the correlation between market share and employment, the remainder of the correlations are positive, as expected.

Similar to before, I explore several characteristics of the import intensity of the processing firms. Regressing the import intensity, $\phi_{f,t}$, on only firm fixed effects yields an R^2 value of 77.5%, suggesting that import intensity is fairly time-invariant. I then regress $\Delta\phi_{f,t}$ on firm fixed effects

and four lags of the log change in the import-weighted exchange rates. The current change in firm-level import-weighted exchange rate is significant at the 1% level with a coefficient of 0.0313. Moreover, the lags are all significant at the 10% level, suggesting that firms do consider the change in their import-weighted exchange rate from previous years when determining how much to import. Next I consider the change in a firm's extensive margin (defined as the number of 8-digit HS products imported each year) when a firm's import-weighted exchange rate changes. Regressing the change in the number of products on firm fixed effects and the log change in a firm's import-weighted exchange rate gives a coefficient of 0.18, which is significant at the 1% level. Thus, if the Yuan depreciates by 10%, a firm will increase the number of products it imports by 1.8%.

The facts above suggest that for Chinese processing firms, the decision to import goods may be a sunk decision. This would agree with the assumption and supporting evidence of Amiti et al. (2013) that importing goods is indeed a sunk cost. Therefore, I will perform the subsequent regressions using ϕ_f (as Amiti et al. (2013) do).

4.4 Analysis for general trade firms

Recall from Section 3 that the main empirical specification in Amiti et al. (2013) is

$$\Delta p^*_{f,i,k,t} = [\alpha_{s,k} + \beta\phi_{f,t-1} + \bar{\gamma}S_{f,s,k,t-1}]\,\Delta e_{k,t} + [\delta_{s,k} + b\phi_{f,t-1} + cS_{f,s,k,t-1}] + \bar{u}_{f,i,k,t},$$

where $p^*_{f,i,k,t}$ denotes the log of the producer price of good i to country k at time t, $\phi_{f,t-1}$ is the import share of firm f at time $t-1$, $e_{k,t}$ is the log of the exchange rate with respect to *destination k's* currency, and $S_{f,s,k,t-1}$ is the market share of firm f in 2-digit HS sector s in country k at time $t-1$.

Similar to Amiti et al. (2013), I begin by regressing the change in price on the change in the exchange rate and then slowly build up to estimating this final model. I present the results of regressions substituting ϕ_f for $\phi_{f,t-1}$ and $S_{f,s,k,t}$ for $S_{f,s,k,t-1}$ because I find in Section 4.2 that these firm characteristics vary little over time. Additionally, I present the results in this section

only for exports to the OECD countries (and I omit exports to the US).[3]

Table 9 displays the results of these initial regressions. Column 1 displays the result of regressing the price change on the log change in the exchange rate. It shows that the pass-through elasticity into home currency prices is 0.077, i.e., 0.923 (1-0.077) into destination prices since pass-through into home currency prices, $\psi^*_{k,i} := \mathbb{E}\left\{\frac{d\log P^*_{k,i}}{d\log \varepsilon_k}\right\}$. Amiti et al. (2013) call this 92.3% pass-through.

Column 2 adds the interaction between the log change in the exchange rate and the import intensity. This coefficient is negative and lacks statistical significance. The coefficient suggests (despite its size and insignificance) that a firm with a 10% higher import intensity has a 0.4% lower pass-through. More specifically, it says a firm with zero import intensity has a pass-through of 92%. On the other hand, when the exchange rate decreases by 10% a firm at the 95th percentile of import intensity with $\phi_{f,t}$ equal to 0.021 has a pass-through of 90% $(1-(0.077-0.042\cdot 0.021-0.107\cdot \frac{0.021}{-0.10}))$.

The regressions in columns 3 and 4 are meant to check whether import intensity affects pass-through through the marginal cost channel. The coefficient on the marginal cost term in the third column is highly statistically insignificant. However, the addition of the marginal cost term makes the coefficient of the interaction term between the log change in the exchange rate and the import intensity decrease significantly (despite still being statistically insignificant). This suggests that import intensity could be acting through the marginal cost channel.

Column 5 includes another term that interacts the log change in the exchange rate with the market share of a firm. This is meant to serve as a proxy for the markup elasticity. This interaction term is also statistically insignificant. Since both the marginal cost and the markup elasticity (the two channels through which Amiti et al. (2013) claim import intensity act) are controlled for in this regression, the interaction term between the log change in export price and the import intensity should be insignificant. The size of the point estimate, while large, is not statistically significant.

Column 6 reports the results of the main specification. Amiti et al. (2013) claim that two main

[3]I omit exports to the US from the sample because during the given time period the RMB was pegged to the dollar and so the difference in the exchange rates from year to year is negligible.

predictors of exchange rate pass-through are import intensity and market share. However, both of those terms are statistically insignificant in this case and so that may not be true. In fact, the best predictor of a change in price appears to be the market share of a firm. This specification suggests that a firm with zero import intensity and a market share close to zero has a pass-through of 92% while if a firm had a market share of 100% but no imports, it would still have a pass-through of 92%. Even if a firm had 100% market share and had an import intensity of 0.021 (at the 95th percentile) and the exchange rate decreased by 10%, then the pass-through would remain 92%. These values are clearly unreasonable and so it is likely that either omitted variable bias exists, there are errors in the data, or the model is incorrect.

The result from including sector-destination-year fixed effects in column 7 does not change the significance of any coefficients, although it does inflate the magnitude of the coefficient on the interaction term between the log change in the exchange rate and the import intensity.

Table A.3 in the Appendix reports the results using the lag in the yearly import intensity, $\phi_{f,t-1}$, and the lagged market share, $S_{f,s,k,t-1}$. The results in this table are similarly statistically insignificant. The main specification (column 5) again suggests that import intensity and market share are not significant predictors of exchange rate pass-through.

4.4.1 Nonparametric estimation

Table A.4 in the Appendix reports the results of regressions involving import intensity quartiles interacted with the log change in the exchange rate. However, since over 50% of the original observations came from firms with zero import intensity, I only include firms with an import intensity of over 0.0058 (firms above the 90th percentile in import intensity). Figure 1 displays the results of regressions 1, 2, 4, and 5. Clearly the relationship between pass-through and import intensity depicted by these regressions is non-monotonic. However, for each of these four specifications, the pass-through increases from bin 2 to bin 4. The differences between bins 1 and 4 are never significant though. These results could partly be due to a lack of variance in the import intensity of firms.

Table 9: General trade firms: import intensity (ϕ_f), market share, and pass-through

Dependent Variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta e_{k,t}$	0.077	0.077	0.210	0.044	0.099	0.084	
	(0.050)	(0.050)	(0.215)	(0.066)	(0.235)	(0.057)	
$\Delta e_{k,t} \cdot \phi_f$		-0.042	-1.329	2.864	-1.604	-0.012	-1.734
		(2.189)	(4.153)	(3.109)	(3.977)	(2.229)	(2.450)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$					0.356	-0.030	-0.111
					(0.415)	(0.083)	(0.232)
$\Delta mc^*_{f,t}$			-0.335		-0.316		
			(1.269)		(1.269)		
ϕ_f		-0.107	-0.210		-0.210	-0.111	-0.021
		(0.112)	(0.292)		(0.292)	(0.112)	(0.135)
$S_{f,s,k,t}$					-0.005	0.025**	0.060***
					(0.049)	(0.011)	(0.018)
SD,Y FE	yes	yes	yes	no	yes	yes	no
SDY FE	no	no	no	no	no	no	yes
FPY,D FE	no	no	no	yes	no	no	no
R^2	0.081	0.081	0.333	0.452	0.333	0.081	0.270

Note: The observations are at the firm-destination-product-year level (unweighted). The number of observations is 91,344 in regressions (1), (2), (4), (6), and (7) and 7,390 in regressions (3) and (5). Δ signifies yearly changes, while SD,Y stands for sector-destination and year fixed effects, SDY is sector-destination-year fixed effects, and FPY,C is firm-product-year and country fixed effects. ** denotes the 5% significance level while *** denotes the 1% significance level. Standard errors in parentheses are clustered at the country-year level.

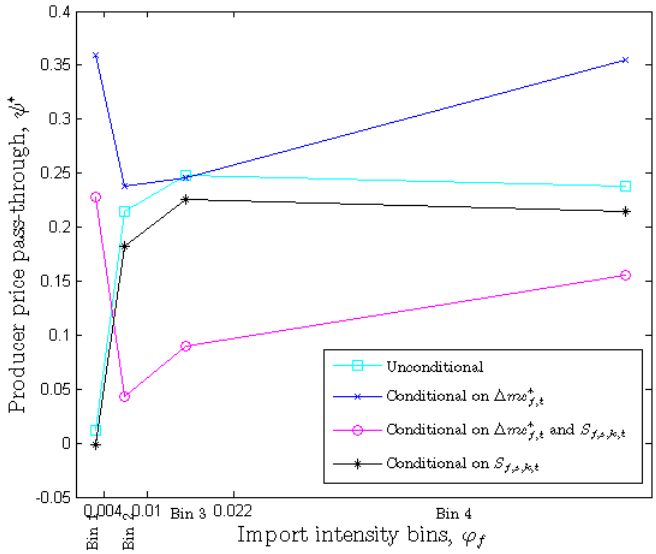

Figure 1: Pass-through by ϕ_f quartile

Note: The results of regressing the change in price (at the firm-product-destination-year level) on quartiles of import intensity interacted with the change in the exchange rate in addition to combinations of the change in marginal cost and the market share are displayed in the figure. These plots correspond to the coefficients of $\Delta e_{l,t} \cdot \delta_{i,f}, i = 1, 2, 3, 4$ from regressions 1-2 and 4-5 from Table A.4 in the Appendix. The observations only include firms that have an import intensity greater than 0.00176 because over 80% of the firms under consideration have an import intensity of 0.

The theory in Amiti et al. (2013) suggests that the marginal cost changes more with respect to the exchange rate as import intensity increases. Column 6 in Table A.4 displays the results of a regression of the change in marginal cost on the log change in the destination-specific bilateral exchange rate interacted with import intensity bins, and column 7 performs the same regression with the import-weighted exchange rate. The two regressions both suggest that, for Chinese firms, marginal cost does not change with respect to the exchange rate as import intensity increases. This could again be partly due to a lack of variance in the import intensity of firms.

A correlation between the destination-specific bilateral exchange rates and the import-weighted exchange rates is a key assumption of Amiti et al. (2013). This is tested in the last column in Table A.4. Even though the ratio of the import-weighted exchange rate to the bilateral exchange rate is quite different between firms in the first bin and the last bin, the two point estimates are not statistically significant and their being equal also cannot be rejected. Therefore, this assumption

Table 10: Pass-through using import intensity and market share bins for general trade firms

	Low import intensity	High import intensity
Low market share	0.044***	0.264
Fraction of observations	40.4%	9.48%
Export share (by value)	20.1%	3.97%
High market share	0.105***	0.078
Fraction of observations	36.6%	13.5%
Export share (by value)	52.5%	23.5%

Note: The above values result from the regression of the change in price, $\Delta p^*_{f,i,k,t}$, on the interaction between the change in the exchange rate, $\Delta e_{k,t}$, (between China and destination k) and the import intensity bins. The bins are split at the median import intensity (0%) and the median market share (5.2%). The coefficients in the high market share bins are significantly different at the 2.1% level while the coefficients in the top left and bottom right bins are significantly different at the 8.3% level. The fraction of observations and the export shares are given within the respective bins at the firm-product-destination level. *** denotes the 1% significance level.

may be reasonable, but it is also possible that with more observations, there would be a significant difference.

Table 10 displays the results of regressing the change in price on the change in the exchange rate interacted with bins denoting whether a firm is above or below the median in market share and import intensity. Although the theory suggests high import intensity firms and high market share firms would have lower pass through (and thus higher regression coefficients), this is not what is observed in the data. Instead, low import intensive firms that have high market shares have lower pass-through than high import intensive firms with high market shares.

4.4.2 Extensions

In Table A.5 in the Appendix, I run the main specification using different definitions of import intensity. In columns 1 and 2, I drop consumer imports and capital goods, respectively, as defined in United Nations (2002). Column 3 reports the results from dropping both consumer and capital goods, while column 4 reports the results from dropping observations if a firm imports and exports the same 8-digit HS product in a given year. The coefficients of the log change in the exchange rate remain consistently around 0.05 and are all statistically significant this time. The coefficients on

the interaction terms between the log change in the exchange rate and the import intensity, and the log change in the exchange rate and market share continue to be statistically insignificant, which continues to suggest that import intensity and market share are not good predictors of pass-through.

Table A.6 in the Appendix displays the results of adding destination-industry fixed effects and the fixed effects interacted with the log change in the exchange rate. Industries are defined by the 3-digit SITC code corresponding to each product in columns 1-4 and the 1-digit SITC code corresponding to each product in column 5. The first two regressions correspond to regressions 2 and 3 from Table 9 and regressions 3 and 4 correspond to regressions 5 and 6 in Table 9. The results are not very similar to those in Table 9 (but are still very statistically insignificant), suggesting that pass-through might vary across destinations and industries. This would contradict propositions 3 and 4 in Amiti et al. (2013).

Next, in Table 11 I add additional controls to check whether other variables affect the estimates of pass-through. A firm's number of employees, wage rate, and total factor productivity could also potentially estimate the markup elasticity and marginal cost sensitivity. The coefficients of these terms are all small and insignificant, with the exception of the log change in total factor productivity, which has a coefficient of 0.011 and is significant at the 1% level. Thus, the change in total factor productivity, which is still small, direct affects pass-through, but the others do not. The interaction terms of the log change in the exchange rate with the import intensity and the market share remain statistically insignificant. Thus, it appears as though these additional variables have only a small effect.

Now the question still remains: Is there any sample for which import intensity and market share are significant predictors of pass-through? Table A.7 gives results for the main specification using different samples. The first column reports results using all countries rather than just the OECD subsample. With the exception of the coefficient of $\Delta e_{k,t} \cdot \phi_f$, the coefficients are similar to those in Table 9, and so (excluding the coefficient of $\Delta e_{k,t} \cdot \phi_f$, which is still very imprecisely measured) this regression predicts a given firm in this sample will have slightly higher pass-through. This time, the coefficient on $\Delta e_{k,t}$ is significant at the 5% level. In columns 2 and 3 I examine the

Table 11: General trade firms: Pass-through controlling for employment, wages, and TFP

Dependent variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)
$\Delta e_{k,t}$	0.119	0.115	0.077
	(0.158)	(0.179)	(0.056)
$\Delta e_{k,t} \cdot \phi_f$	−0.131	0.037	0.131
	(2.223)	(2.139)	(2.129)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	−0.030	0.003	0.000
	(0.082)	(0.082)	(0.082)
$\Delta e_{k,t} \cdot \log L_{f,t}$	−0.006		
	(0.026)		
$\Delta e_{k,t} \cdot \log TFP_{f,t}$		−0.005	
		(0.025)	
$\Delta \log TFP_{f,t}$			0.011***
			(0.003)
$\Delta \log W^*_{f,t}$			0.001
			(0.004)
ϕ_f	−0.101	−0.072	−0.048
	(0.111)	(0.107)	(0.110)
$S_{f,s,k,t}$	0.025**	0.022**	0.020*
	(0.011)	(0.011)	(0.011)
R^2	0.081	0.082	0.083

Note: The regressions above correspond to regression 6 in Table 9 but include controls for employment ($L_{f,t}$), the wage rate ($W^*_{f,t}$) and/or total factor productivity ($TFP_{f,t}$). There are 91,317 observations in regression 1, 88,428 observations in regression 2, and 87,122 observations in regression 3. ***, **, and * denote the 1%, 5%, and 10% significance levels, respectively.

outcomes without Japan and with only Japan. The exchange rate between the Yen and the Yuan changed between 2% and 12% each year between 2000 and 2006. Additionally, after the US, Japan was China's top trading partner over this time period. Removing Japan from the sample increases the magnitude of the estimated coefficients, but the effect of import intensity and market share on pass through are still statistically insignificant.

Column 4 includes all firms (not just those that primarily make manufactured goods), but still excludes intermediaries, as the intermediaries are not found in the firm-level data. Column 5 reports the results of the first regression where the coefficient of $\Delta e_{k,t} \cdot \phi_f$ is significant. The data in column 5 includes all types of trade. For this sample period, over 50% of the exports (by value) each year are categorized as processing trade. Since items categorized as processing

trade should have nearly 100% pass-through, the coefficient of $\Delta e_{k,t}$ in the regression should be suppressed in column 5, which appears to be the case. The coefficients in column 6, where all manufacturing products are included in the sample, are again mostly insignificant. The regressions for columns 7 and 8 use only the products in a firm's most profitable 4-digit HS category. The latter regression only keeps these observations if the products in that category for a given firm have a market share of over 50%. The results differ somewhat from the main specification in that the coefficients of $\Delta e_{k,t} \cdot \phi_f$ are large and positive and the magnitude of the coefficient of ϕ_f is much larger. Nevertheless, the coefficients determining the effects of import intensity and market share on pass-through remain statistically insignificant.

If import intensity and market share do not significantly affect pass-through, then what does? At an aggregate level, the year dummies in the regressions (not shown) are a significant predictor of pass-through and pass-through decreases every year through 2005 before dropping to a level between those of 2003 and 2004 in 2006. Perhaps a firm's pass-through is being driven at an aggregate level and is not affected as much by its marginal cost or markup (which have been proxied for using the import intensity and market share) or import intensity and market share do not serve as good proxies. As noted in subsection 4.1, there was a large influx of firms during this time period. Therefore, this may have induced an effect on prices that is not captured in the import intensity or market share variables. On the other hand, it is also possible that so much noise exists in the data that the analysis is giving very imprecise estimates. This noise could come from the fact that the analysis uses unit values rather than true prices, and the fact that firms may misreport their statistics in the Annual Surveys of Production (which is known to occur). Finally, it is possible that the theory from Amiti et al. (2013) does not apply because the Chinese general trade firms obtain most of their intermediate inputs domestically rather than from abroad or because, unlike for the Euro, the Yuan did not appreciate during this entire time period. Next, I examine whether these negative results also apply to processing firms.

4.5 Analysis for processing firms

Again, I begin by regressing the change in price on the change in the exchange rate and then slowly build up to estimating the final model. I present the results of regressions substituting ϕ_f for $\phi_{f,t-1}$ and $S_{f,s,k,t}$ for $S_{f,s,k,t-1}$ because I find in Section 4.2 that these firm characteristics vary little over time. The results in this section are only for exports to the OECD countries (and I omit exports to the US).

Table 12 displays the results of these initial regressions. Column 1 displays the result of regressing the price change on the log change in the exchange rate. It shows that the pass-through elasticity into firms' prices is -0.082, i.e., 1.082 (1+0.082) into destination prices since pass-through into firms' prices, $\psi^*_{k,i} := \mathbb{E}\left\{\frac{d\log P^*_{k,i}}{d\log \varepsilon_k}\right\}$. Amiti, Itskhoki, and Konings (2013) call this 108.2% pass-through.

Column 2 adds the interaction between the log change in the exchange rate and the import intensity. This coefficient is large and statistically significant. It suggests that a firm with a 10% higher import intensity has a 17.4% lower pass-through. More specifically, it says a firm with zero import intensity has a pass-through of 118.7%. On the other hand, when the exchange rate decreases by 10% a firm at the 95th percentile of import intensity with $\phi_{f,t}$ equal to 0.175 has a pass-through of 86.5% $(1 - (-0.187 + 1.740 \cdot 0.175 - 0.010 \cdot \frac{0.175}{-0.10}))$. These regressions fail to make intuitive sense because we would not expect pass-through to be over 100% for many firms, or even as high as it is for firms in the 95th percentile. The coefficient on the log change in the exchange rate is surprising because, unlike for general trade firms and other results in the literature, it is significantly negative and remains so for the rest of the regressions.

The regressions in columns 3 and 4 are meant to check whether import intensity affects pass-through through the marginal cost channel. The coefficient on the marginal cost term in column 3 is not statistically significant. Also, the addition of the marginal cost term made the coefficient of the interaction term between the log change in the exchange rate and the import intensity increase. This suggests that import intensity might not be acting through the marginal cost channel. Including firm-product-year fixed effects in column 4 washes out the effects of $\Delta e_{k,t}$ and $\Delta e_{k,t} \cdot \phi_f$.

Column 5 includes another term that interacts the log change in the exchange rate with the market share of a firm. This is meant to serve as a proxy for the markup elasticity. Since both the marginal cost and the markup elasticity (the two channels through which Amiti, Itskhoki, and Konings (2012) claim import intensity act) are controlled for in this regression, the interaction term between the log change in export price and the import intensity should be insignificant. However, this interaction term is significant while the interaction between the log change in the exchange rate and the market share is statistically insignificant.

Column 6 reports the results of the main specification. Amiti, Itskhoki, and Konings (2013) claim that two main predictors of exchange rate pass-through are import intensity and market share. However, the market share term remains statistically insignificant in this case and so that may not be true. Instead, the best predictors of a change in price appear to be the log change in the exchange rate and the interaction of the log change in price with import intensity. This specification suggests that a firm with zero import intensity and a market share close to zero has a pass-through of 119% while if a firm had a market share of 100% but no imports, it would have a pass-through of 117%. Finally, if a firm had 100% market share and had an import intensity of 0.175 (at the 95th percentile) and the exchange rate decreased by 10%, then the firm would have a pass-through of 84%. These values are clearly unreasonable and so it is possible that the model is incorrect. Using sector-destination-year fixed effects in column 7 does not change the significance of any coefficients and the results remain pretty much the same.

Table A.8 in the Appendix reports the results using the lag in the yearly import intensity, $\phi_{f,t-1}$, and the lagged market share, $S_{f,s,k,t-1}$. The results in this table are mostly statistically insignificant, although the coefficient on the log change in the exchange rate is closer to what was expected. This may be due to the fact that the sample size for these regressions is too small.

Now, the question remains as to why the results from processing firms differ so much from those of general trade firms and, more specifically, why the coefficients on the log change in the exchange rate terms are negative. To investigate this further, examine Table 13, which is Table A.8 with an added interaction term between the type of processing firm and the log change in the

Table 12: Processing firms: import intensity (ϕ_f), market share, and pass-through

Dependent Variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta e_{k,t}$	-0.082	-0.187*	-0.221**	-0.044	-0.238**	-0.193*	
	(0.077)	(0.096)	(0.099)	(0.154)	(0.107)	(0.103)	
$\Delta e_{k,t} \cdot \phi_f$		1.740**	1.881***	-0.146	1.905***	1.752**	1.783*
		(0.763)	(0.674)	(1.805)	(0.683)	(0.773)	(0.980)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$					0.060	0.019	-0.052
					(0.103)	(0.099)	(0.307)
$\Delta mc^*_{f,t}$			0.603***		0.609***		
			(0.110)		(0.112)		
ϕ_f		-0.010	-0.043		-0.044	-0.012	0.027
		(0.074)	(0.074)		(0.074)	(0.073)	(0.070)
$S_{f,s,k,t}$					0.071***	0.069***	0.112***
					(0.014)	(0.014)	(0.025)
SD,Y FE	yes	yes	yes	no	yes	yes	no
SDY FE	no	no	no	no	no	no	yes
FPY,D FE	no	no	no	yes	no	no	no
R^2	0.094	0.095	0.098	0.451	0.099	0.096	0.267

Note: The observations are at the firm-destination-product-year level (unweighted). The number of observations is 21,887 in regressions (1), (2), (4), (6), and (7) and 20,609 in regressions (3) and (5). Δ signifies yearly changes, while SD,Y stands for sector-destination and year fixed effects, SDY is sector-destination-year fixed effects, and FPY,C is firm-product-year and country fixed effects. * denotes the 10% significance level while *** denotes the 1% significance level. Standard errors in parentheses are clustered at the country-year level.

exchange rate. By adding an interaction term of the type of processing trade with the log change in the exchange rate, we see that in the main specification (specification 6), Δe is now 0.110 (albeit statistically insignificant) for pure assembly and -0.215 (and significant at the 10% level) for import and assembly. Additionally, the coefficient on $\Delta e_{k,t} \cdot \phi_f$ remains significant at the 10% level.

Several key differences exist between the pure-assembly and import-and-assembly regimes. As described in Feenstra and Hanson (2005), processing with assembly occurs when a foreign firm contracts with a Chinese firm to assemble products. The foreign firm pays for and retains possession of the imported inputs and the Chinese firm is simply paid a fee for assembling them and shipping the assembled products back to the firm that hired them. On the other hand, import-and-assembly firms purchase their own imported intermediate inputs and can contract with multiple firms in various countries to which they export their finished products. These distinctions in the processing firms' contracts make it unsurprising that the results for the two types of processing firms differ.

One possible explanation for the difference in results is that the change in the exchange rates between China and the destination countries does not positively correlate with the change in import-weighted exchange rates. Amiti et al. (2013) found that such a positive correlation existed for Belgian firms. However, suppose this assumption does not hold and consider the following heuristic argument. Without loss of generality, assume (as is the case more often than not for import-and-assembly firms in China) that $\Delta e_{k,t}$ decreases. Then the price in the producer currency will tend to decrease, as the producer currency appreciated. However, by the initial assumption, the import-weighted exchange rate increased. This suggests that the price in the producer currency will tend to increase. Therefore, depending on which effect dominates, the price in the producer currency could either rise or fall.

Some evidence of this possibility exists in the data. Indeed, the correlation between the exchange rates between China and the destination countries and the change in import-weighted exchange rates is -0.0181 for import-and-assembly firms and -0.0065 for pure-assembly firms (and 0.038 for general trade firms). Dropping more of the outliers (the top and bottom percentiles) gives

correlations of -0.0909 and 0.0438 for import-and-assembly and pure-assembly firms, respectively.

Finally, consider Table A.9, the equivalent of Table A.7 for processing firms. In this table, the coefficient on $\Delta e_{k,t}$ for processing firms continues to be significant most of the time and negative. Moreover, the coefficient on $\Delta e_{k,t} \cdot \phi_f$ is also significant in the regressions with larger sample sizes. Interestingly, the interaction between the log change in the exchange rate and the market share is only significant in the columns that keep the products in a firm's most profitable 4-digit HS category. This last fact suggests that market share only significantly affects pass-through for processing firms' most profitable products.

5 Conclusion

Throughout this paper I show that many of the propositions and conclusions of Amiti et al. (2013) do not hold for Chinese firms in general trade between 2000 and 2006. First, Table 4 shows that material cost and import intensity are uncorrelated. This result contradicts Proposition 2 and at least partially serves to explain the results from the main specification. The results from Table 9 and nearly all of the other regressions suggest that import intensity is not a statistically significant predictor of pass-through for firms in general trade. Although import intensity is meant to serve as a proxy for marginal cost, it does not fill this role for general trade firms in this data. Additionally, the coefficient of the interaction term between the log change in the exchange rate and the market share is nearly always statistically insignificant, suggesting that market share is not a good predictor of pass-through either.

The results for processing firms are more significant, yet still surprising because the coefficient on the log change in the exchange rate is negative, suggesting some firms have over 100% pass-through. These results differ across types of processing firms, suggesting that the differences in contracts could be one explanation for these unexpected results. Indeed, it appears as though for import-and-assembly firms, the change in the exchange rates between China and the destination countries does not positively correlate with the change in import-weighted exchange rates, which

Table 13: Processing firms: import intensity (ϕ_f), market share, and pass-through

Dependent Variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta e_{k,t}$	0.284*	0.110	0.002	0.237	-0.008	0.110
	(0.159)	(0.182)	(0.172)	(0.490)	(0.178)	(0.185)
$\Delta e_{k,t}$· I&A	-0.398**	-0.306*	-0.229	-0.287	-0.238	-0.315*
	(0.162)	(0.162)	(0.155)	(0.451)	(0.156)	(0.163)
$\Delta e_{k,t} \cdot \phi_f$		1.456*	1.665**	-0.261	1.679**	1.460*
		(0.802)	(0.690)	(1.843)	(0.701)	(0.814)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$					0.068	0.030
					(0.103)	(0.100)
$\Delta mc^*_{f,t}$			0.559***		0.566***	
			(0.109)		(0.110)	
ϕ_f		-0.025	-0.051		-0.052	-0.025
		(0.076)	(0.076)		(0.076)	(0.076)
$S_{f,s,k,t}$					0.071***	0.069***
					(0.014)	(0.014)
I&A	-0.017	-0.019	-0.016	-0.011	-0.015	-0.019
	(0.017)	(0.017)	(0.017)	(0.032)	(0.017)	(0.017)
SD,Y FE	yes	yes	yes	no	yes	yes
SDY FE	no	no	no	no	no	no
FPY,D FE	no	no	no	yes	no	no
R^2	0.095	0.095	0.098	0.451	0.099	0.096

Note: I&A is an indicator variable for import-and-assembly firms. The observations are at the firm-destination-product-year level (unweighted). The number of observations is 21,885 in regressions (1), (2), (4), and (6), and 20,607 in regressions (3) and (5). Δ signifies yearly changes, while SD,Y stands for sector-destination and year fixed effects, SDY is sector-destination-year fixed effects, and FPY,C is firm-product-year and country fixed effects. * denotes the 10% significance level while *** denotes the 1% significance level. Standard errors in parentheses are clustered at the country-year level.

could explain these results. For processing firms, it appears as though import intensity is a significant predictor of pass-through, while market share is only significant when considering a firm's most profitable products.

The findings in this paper for general trade firms suggest that either there are problems with the data, there is omitted variable bias, or the model is incorrect. Part of the problem might also lie in the fact that most of the general trade firms have an import intensity very close to zero. However, removing these very low import intensity firms and repeating the analysis yields similar results. Another possibility is that the Chinese firms were heavily influenced by new legislation following China's entry into the WTO. It is also possible that the differences are caused by how the exchange rates moved during this period for Belgium and China. For Belgium, the exchange rates were increasing, while for China this was not the case. Future research could focus more on what is causing these different results and could include trying a different model for pricing-to-market.

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Appendix

Table A.1: General trade direct exporters from 2000-2006

Year	Direct Exporters	All firms
2000	5,608	124,830
	4.49%	100%
2001	6,995	130,912
	5.34%	100%
2002	8,454	140,093
	6.03%	100%
2003	10,906	154,409
	7.07%	100%
2004	17,734	218,502
	8.12%	100%
2005	19,902	213,950
	8.93%	100%
2006	23,308	239,370
	9.74%	100%

Note: This table only includes manufacturing firms. The first row for each year represents the frequencies and the second row is the percentages. Direct exporters are defined as firms who report a positive export value in the firm-level data and who appear as exporters in the customs data.

Table A.2: Processing trade exporters from 2000-2006

Year	Exporters	All firms
2000	2,153	2,564
	83.98%	100%
2001	2,188	2,622
	83.45%	100%
2002	2,165	2,620
	82.64%	100%
2003	2,263	2,742
	82.54%	100%
2004	3,596	4,449
	80.83%	100%
2005	3,719	4,535
	82.01%	100%
2006	3,588	4,408
	81.39%	100%

Note: This table only includes manufacturing firms. The first row for each year represents the frequencies and the second row is the percentages. Direct exporters are defined as firms who report a positive export value in the firm-level data and who appear as exporters in the customs data.

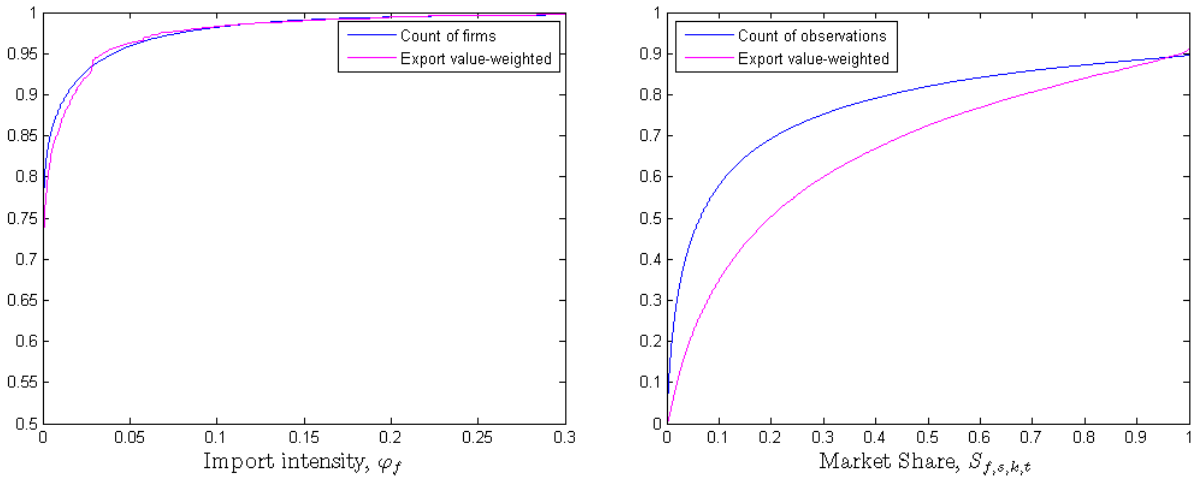

Figure A.1: Estimated cumulative distribution functions of import intensity, ϕ_f, and market share, $S_{f,s,k,t}$ for general trade firms

Note: The figure on the left depicts the estimated cumulative distribution function for the import intensity, ϕ_f, of firms. I calculate the blue line using the number of firms and the magenta line using the export values as weights for the firm observations. There is a mass point of 68% located at $\phi_f = 0$ in the blue cdf and this mass point only lowers slightly to 60% in the second cdf. The figure on the right depicts the estimated cumulative distribution function for the market share, $S_{f,s,k,t}$. There is a lot of mass near 0 in the unweighted cdf, which corresponds to exports to the most popular destinations in the largest sectors. Similarly, there is a mass point at 1 for both cdfs, which corresponds to exports to the least popular destinations in the smallest sectors.

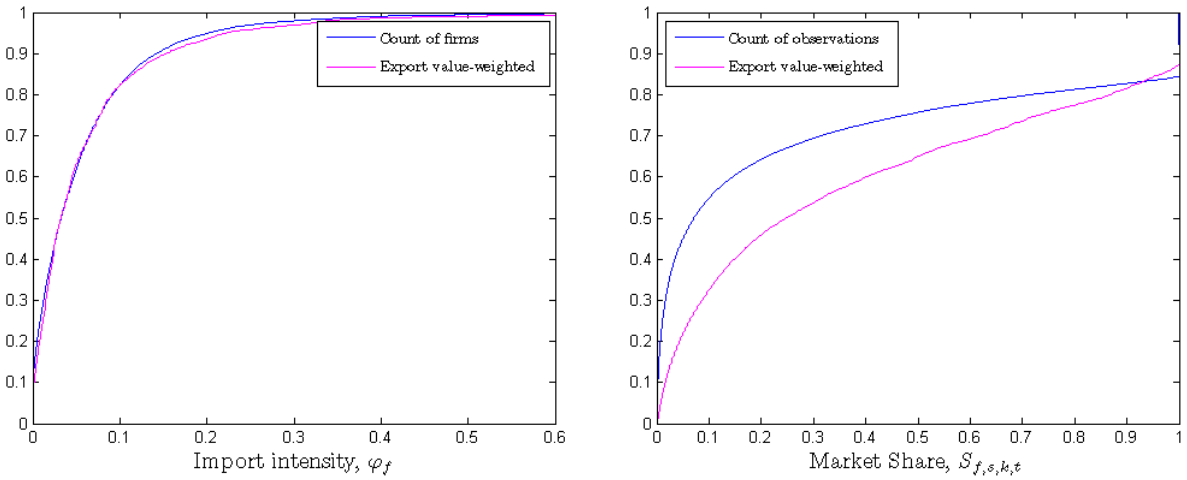

Figure A.2: Estimated cumulative distribution functions of import intensity, ϕ_f, and market share, $S_{f,s,k,t}$ for processing firms

Note: The figure on the left depicts the estimated cumulative distribution function for the import intensity, ϕ_f, of firms. I calculate the blue line using the number of firms and the magenta line using the export values as weights for the firm observations. There is a mass point of 9.51% located at $\phi_f = 0$ in the blue cdf and this mass point lowers slightly to 5.83% in the second cdf. The figure on the right depicts the estimated cumulative distribution function for the market share, $S_{f,s,k,t}$. There is a lot of mass near 0 in the unweighted cdf, which corresponds to exports to the most popular destinations in the largest sectors. Similarly, there is a mass point at 1 for both cdfs, which corresponds to exports to the least popular destinations in the smallest sectors.

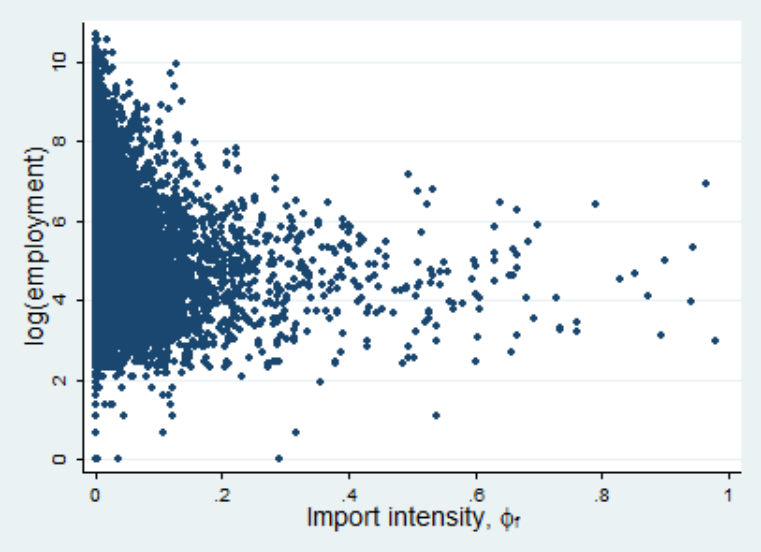

Figure A.3: Correlation between employment and import intensity, ϕ_f, for general trade firms
Note: Firm-year level observations. Import intensity, ϕ_f, is defined to be the fraction of intermediate inputs imported from abroad in the total costs (wages + material costs) of a firm.

Table A.3: General trade firms: Lagged import intensity ($\phi_{f,t-1}$), market share, and pass-through

Dependent Variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta e_{k,t}$	0.077	0.035	-0.030	0.025	0.074	
	(0.050)	(0.091)	(0.891)	(0.768)	(0.105)	
$\Delta e_{k,t} \cdot \phi_{f,t-1}$		2.328	12.458	12.174	2.351	4.692
		(3.132)	(13.364)	(13.242)	(3.157)	(10.541)
$\Delta e_{k,t} \cdot S_{f,s,k,t-1}$				-0.174	-0.157	-0.616
				(1.436)	(0.260)	(0.534)
$\Delta mc^*_{f,t}$			-1.288	-1.278		
			(3.011)	(3.034)		
$\phi_{f,t-1}$		-0.186	-0.799	-0.798	-0.188	-0.008
		(0.225)	(0.894)	(0.911)	(0.225)	(0.627)
$S_{f,s,k,t-1}$				-0.030	-0.010	-0.047
				(0.139)	(0.025)	(0.043)
SD,Y FE	yes	yes	yes	no	yes	yes
SDY FE	no	no	no	no	no	no
FPY,D FE	no	no	no	yes	no	no
R^2	0.081	0.277	0.693	0.693	0.277	0.588

Note: The observations are at the firm-destination-product-year level (unweighted). The number of observations is 91,344 in regression (1), 15,355 in (2), (5), and (6), and 1,329 in regressions (3) and (4). Δ signifies yearly changes, while SD,Y stands for sector-destination and year fixed effects, SDY is sector-destination-year fixed effects, and FPY,C is firm-product-year and country fixed effects. * denotes the 10% significance level while *** denotes the 1% significance level. Standard errors in parentheses are clustered at the country-year level.

Table A.4: General trade firms: import intensity quartiles and pass-through

Dependent Variable:	$\Delta p^*_{f,i,k,t}$					$\Delta mc^*_{f,t}$		$\Delta e^M_{f,t}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta e_{l,t} \cdot \delta_{1,f}$	0.012	0.359*	−0.177	0.228	−0.001	−0.002	0.000	1.898
	(0.157)	(0.196)	(0.370)	(0.220)	(0.160)	(0.001)	(0.000)	(1.321)
$\Delta e_{l,t} \cdot \delta_{2,f}$	0.214*	0.238	0.175	0.043	0.182	−0.002	0.000	2.217*
	(0.129)	(0.158)	(0.222)	(0.204)	(0.161)	(0.002)	(0.000)	(1.339)
$\Delta e_{l,t} \cdot \delta_{3,f}$	0.248*	0.246	0.078	0.090	0.226	−0.002	0.000	0.396
	(0.141)	(0.220)	(0.205)	(0.234)	(0.145)	(0.001)	(0.000)	(0.759)
$\Delta e_{l,t} \cdot \delta_{4,f}$	0.238	0.355*	0.239	0.155	0.215	0.006	0.001	−0.061
	(0.157)	(0.190)	(0.236)	(0.209)	(0.202)	(0.004)	(0.001)	(0.707)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$				0.479*	0.048			
				(0.285)	(0.202)			
$\Delta mc^*_{f,t}$		−0.465		−0.460				
		(1.015)		(0.998)				
$S_{f,s,k,t}$				0.023	0.028			
				(0.024)	(0.019)			
FPY FE	no	no	yes	no	no	no	no	no
p-value Bin 1 vs. 4	0.408	0.989	0.388	0.783	0.436	0.039	0.153	0.210
R^2	0.001	0.001	0.000	0.002	0.001	0.001	0.004	0.004

Note: The observations are at the firm-destination-product-year level (unweighted) and only contain firms with import intensity greater than 0.00176 (firms above the 90th percentile) because over 80% of the firms have an import intensity equal to zero. The number of observations is 8,438 in regressions 1, 3, and 5, 5,525 in regressions 2 and 4, 11,272 in regression 6, 1,680 in regression 7, and 2,057 in regression 8. $\Delta e_{l,t}$ signifies the yearly change in the log of the destination-specific bilateral exchange rate in regressions 1-6 and 8 and the yearly change in the import-weighted exchange rate, $\Delta e^M_{f,t}$, in regression 7. $\delta_{j,f}$ signifies that the import intensity for the given observation is in quartile j. All regressions include country fixed effects with the exception of regression 3, which has firm-product-year fixed effects. * denotes the 10% significance level. Standard errors in parentheses are clustered at the country-year level.

Table A.5: General trade firms: Pass-through with redefining import intensity

Dependent variable: $\Delta p^*_{f,i,k,t}$	Drop consumer imports (1)	Drop capital goods (2)	Drop consumer imports and capital goods (3)	Drop Re-exports (4)
$\Delta e_{k,t}$	0.051**	0.048*	0.048*	0.051**
	(0.025)	(0.025)	(0.025)	(0.023)
$\Delta e_{k,t} \cdot \phi_f$	−0.513	0.379	0.264	0.143
	(0.623)	(0.616)	(0.580)	(1.881)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	−0.036	−0.034	−0.035	−0.041
	(0.048)	(0.049)	(0.049)	(0.041)
ϕ_f	−0.101	−0.099	−0.099	−0.094
	(0.072)	(0.072)	(0.072)	(0.084)
$S_{f,s,k,t}$	0.045***	0.045***	0.045***	0.045***
	(0.007)	(0.007)	(0.007)	(0.007)
R^2	0.093	0.093	0.093	0.096

Note: There are 221,165 observations in columns 1-3 and 211,229 observations in column 4. Consumer products are the goods with BEC codes 112, 122, 522, 61, 62, and 63. Capital goods are goods with BEC codes 41 or 521. The regressions have sector-destination and year fixed effects and the standard errors are clustered at the country-year level. ***, **, and * correspond to the 1%, 5%, and 10% significance levels, respectively.

Table A.6: General trade firms: Pass-through with destination-industry effects

Dependent variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)
$\Delta e_{k,t}$	0.126	−0.237	−0.336	0.124	0.281
	(0.165)	(0.261)	(0.260)	(0.166)	(0.326)
$\Delta e_{k,t} \cdot \phi_f$	−0.460	−1.067	−1.429	−0.497	−0.564
	(2.195)	(3.989)	(3.864)	(2.217)	(1.964)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$			0.675	0.012	−0.065
			(0.473)	(0.086)	(0.093)
$\Delta mc^*_{f,t}$		−0.581	−0.546		
		(1.318)	(1.320)		
ϕ_f	−0.099	−0.255	−0.259	−0.102	−0.125
	(0.109)	(0.297)	(0.296)	(0.109)	(0.111)
$S_{f,s,k,t}$			−0.001	0.025**	0.027**
			(0.052)	(0.011)	(0.011)
Fixed effect interactions:					
$\Delta e_{k,t}$ · country · SITC-1d	yes	yes	yes	yes	no
$\Delta e_{k,t}$ · SITC-3d	no	no	no	no	yes
Number of industries	4	4	4	4	259
R^2	0.082	0.348	0.349	0.083	0.083

Note: Regressions 1 and 2 correspond to regressions 2 and 3 in Table 9 while regressions 3 and 4 correspond to regressions 5 and 6 in Table 9, but each of these regressions has country-industry fixed effects and includes the fixed effect interaction of the log change in the exchange rate with the country-industry fixed effect. Regression 5 still has the country-industry fixed effects but instead has an interaction term between the log change in the exchange rate and the 3-digit SITC code. There are 91,344 observations in regressions 1, 4, and 5, and 7,930 in regressions 2 and 3.

Table A.7: Pass-through with different countries, firms, and products

	Countries			All firms,		Products		
	all countries	without Japan	only Japan	excluding intermediaries	All types of trade	all products	HS 4-digit major	HS 4-digit major*
Dependent variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta e_{k,t}$	0.049**	0.071	0.704***	0.085*	0.025	0.035	0.042	0.045
	(0.025)	(0.060)	(0.038)	(0.046)	(0.021)	(0.048)	(0.055)	(0.056)
$\Delta e_{k,t} \cdot \phi_f$	0.340	1.837	−4.632	1.085	0.583***	0.815	0.789	3.449
	(1.699)	(2.574)	(2.483)	(1.813)	(0.131)	(1.208)	(1.364)	(2.576)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	−0.036	−0.031	−0.131	−0.012	−0.006	0.014	0.059	0.052
	(0.049)	(0.089)	(0.151)	(0.079)	(0.051)	(0.079)	(0.071)	(0.072)
ϕ_f	−0.097	−0.211*	−0.082	−0.254**	−0.024*	−0.090	−0.177	−0.615**
	(0.077)	(0.122)	(0.195)	(0.128)	(0.013)	(0.105)	(0.122)	(0.262)
$S_{f,s,k,t}$	0.045***	0.032***	−0.043	0.035***	0.051***	0.033***	−0.006	−0.004
	(0.007)	(0.011)	(0.030)	(0.010)	(0.007)	(0.011)	(0.007)	(0.007)
Number of observations:	221,165	80,931	10,413	118,666	586,456	110,591	76,970	75,376
Number of countries:	193	28	1	29	29	29	29	29
R^2	0.093	0.086	0.044	0.071	0.020	0.074	0.002	0.002

Note: With the exception of specification 5, all specifications only include general trade firms. Specification 7 only keeps products in a firm's most profitable 4-digit HS category and specification 8 only keeps the goods in the most profitable 4-digit HS category and includes only the products in that category that have a market share of over 50%. The regressions have sector-destination and year fixed effects and the standard errors are clustered at the country-year level. ***, **, and * signify the 1%, 5%, and 10% significance levels, respectively.

Table A.8: Processing firms: Lagged import intensity ($\phi_{f,t}$), market share, and pass-through

Dependent Variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta e_{k,t}$	-0.082	0.267	0.200	0.071	0.160	
	(0.077)	(0.272)	(0.292)	(0.306)	(0.290)	
$\Delta e_{k,t} \cdot \phi_{f,t-1}$		1.379	1.207	1.260	1.422	2.629
		(2.028)	(2.079)	(2.066)	(1.996)	(3.881)
$\Delta e_{k,t} \cdot S_{f,s,k,t-1}$				0.555	0.417	0.027
				(0.413)	(0.384)	(0.893)
$\Delta mc^*_{f,t}$			0.604	0.609		
			(1.464)	(1.472)		
$\phi_{f,t-1}$		0.123	0.071	0.070	0.123	0.130
		(0.174)	(0.186)	(0.186)	(0.173)	(0.295)
$S_{f,s,k,t-1}$				-0.054	-0.056	-0.079
				(0.042)	(0.038)	(0.086)
SD,Y FE	yes	yes	yes	yes	yes	no
SDY FE	no	no	no	no	no	yes
R^2	0.094	0.333	0.337	0.338	0.334	0.639

Note: The observations are at the firm-destination-product-year level (unweighted). The number of observations is 21,887 in regression (1), 2,688 in regressions (2), (5), and (6), and 2,407 in regressions (3) and (4). Δ signifies yearly changes. All regressions include sector-destination fixed effects. None of the estimated values are significant. Standard errors in parentheses are clustered at the country-year level.

Table A.9: Processing Trade: Pass-through with different countries, firms, and products

	Countries			All firms,	Products		
	all	without	only	excluding	all	HS 4-digit	
	countries	Japan	Japan	intermediaries	products	major	major*
Dependent variable: $\Delta p^*_{f,i,k,t}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta e_{k,t}$	0.096	−0.346	−0.378*	0.126	−0.035	0.062	0.053
	(0.161)	(0.220)	(0.176)	(0.187)	(0.195)	(0.184)	(0.220)
$\Delta e_{k,t}$· I&A	−0.249*	0.130	−0.767**	−0.333**	−0.158	−0.277*	−0.167
	(0.150)	(0.221)	(0.237)	(0.164)	(0.170)	(0.156)	(0.195)
$\Delta e_{k,t} \cdot \phi_f$	1.489**	1.959*	−0.027	1.544*	1.299*	1.245*	−0.204
	(0.662)	(1.023)	(0.836)	(0.832)	(0.742)	(0.693)	(0.790)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	−0.018	0.077	−0.167	0.026	0.054	0.191**	0.207*
	(0.073)	(0.110)	(0.220)	(0.101)	(0.105)	(0.092)	(0.109)
ϕ_f	−0.057	−0.037	0.035	−0.019	−0.041	−0.012	−0.136**
	(0.044)	(0.100)	(0.105)	(0.075)	(0.070)	(0.043)	(0.059)
$S_{f,s,k,t}$	0.063***	0.063***	0.100**	0.071***	0.059***	−0.003	0.018*
	(0.011)	(0.015)	(0.031)	(0.014)	(0.015)	(0.008)	(0.009)
I&A	−0.021*	−0.051**	0.008	−0.019	−0.015	−0.005	−0.014
	(0.012)	(0.020)	(0.031)	(0.017)	(0.017)	(0.015)	(0.016)
Number of observations:	56,513	18,060	3,825	21,884	25,638	17,408	13,168
Number of countries:	193	28	1	29	29	29	29
R^2	0.086	0.105	0.050	0.096	0.094	0.006	0.009

Note: I&A is an indicator variable for import-and-assembly firms. Specification 5 includes all types of firms (not just manufacturing). Specification 6 only keeps products in a firm's most profitable 4-digit HS category and specification 7 only keeps the goods in the most profitable 4-digit HS category and includes only the products in that category that have a market share of over 50%. The regressions have sector-destination and year fixed effects and the standard errors are clustered at the country-year level. ***, **, and * signify the 1%, 5%, and 10% significance levels, respectively.

Academic Vita

Corinne Jones

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EDUCATION

- Schreyer Honors College, The Pennsylvania State University, University Park, PA
  - Master of Arts in Economics
  - Bachelor of Science in Mathematics (Graduate Studies Option)
  - Bachelor of Science in Statistics (Graduate Studies Option)
  - Bachelor of Science in Economics
- Expected graduation date: May 2014

HONORS

- Student Marshal, Department of Economics
- Evan Pugh Scholar Award
- Jabir Shibley Memorial Award for outstanding achievement in mathematics
- Monroe Newman Award for outstanding junior major in economics
- Department of Economics Undergraduate Award
- Phi Beta Kappa
- President's Freshman Award

EXPERIENCE

- Mathematics Department, The Pennsylvania State University Fall 2012-Present
  - Learning Assistant for Calculus I (Fall) and Calculus II (Spring)
  - Lead review sessions prior to the students' exams
- Oak Ridge National Laboratory June-August 2013
  - Intern in the Cyberspace Sciences and Information Intelligence Research Group
  - Used natural language processing to analyze text for timely discovery of cyber security concepts
  - Contributed to a working paper:

    R. A. Bridges, C. L. Jones, M. D. Iannacone, and J. R. Goodall.

    Automatic labeling for entity extraction in cyber security, 2013. arXiv:1308.4941
  - Presented my research to the project manager
- Bates White Economic Consulting May-June 2013
  - Intern in the Mergers and Monopolization practice and the Finance practice
  - Analyzed data and reviewed documents
- Economics Department, The Pennsylvania State University Spring 2013
  - Research Assistant for Professors Michal Fabinger and Saroj Bhattarai
  - Gathered and analyzed financial data
- Penn State Research Experience for Undergraduates Summer 2011 and Summer 2012
  - Research assistant for Economics Professor Kala Krishna
  - Analyzed Chinese production and customs data and Turkish college entrance exam data
- Mathematics Department, The Pennsylvania State University Fall 2010
  - Graded homework for two sections of Ordinary and Partial Differential Equations

CONFERENCES

- Presented a poster titled "Text Analysis for Timely Discovery of Cyber Security Concepts" at the:
  - Women in Science Poster Session at Oak Ridge National Laboratory 8/1/2013
  - Summer Research Participant Poster Session at Oak Ridge National Laboratory 8/8/2013
  - MAA Undergraduate Student Poster Session 1/17/2014

SKILLS

- Programming: C++, Fortran, HTML, Mathematica, MATLAB, Python
- Statistical Software: Minitab, SAS, Stata
- Other: Microsoft Access, Excel, LaTeX