Importer Heterogeneity and Exchange Rate Pass-through

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Background

- The low response of price to exchange rate is one of the most important facts in international finance literature.
- Recently, some papers have started to link the degree of exchange rate pass-through to the characteristics of the exporting firms that are engaged in international trade.
 - Large exporters have higher tendency of price-to-market.
 (Berman et al., 2012; Atkenson and Burstein, 2008)
 - Large exporters also import more foreign intermediate goods. (Amiti et al., 2014)

Background

- One of the key assumption behind these theories is that exporters sell products directly to infinite consumers.
- However, in reality, nearly all products are traded through from the exporting firms to the importing firms, price determination reflects powers from both sides.
- The role of importing firms should also be important to exchange rate pass-through. But the heterogeneity among the importers have been largely ignored.

What we do theoretically?

- In this paper, we investigate how the responses of trade prices to exchange rate movement differ across importers.
- We build a Mortensen-Pissarides type search and match model to show that exchange rate pass through also depends on importer's characteristics.
- The intuition is that larger importers, who receive great surplus from successful matching than smaller importers, bear larger cost if failing to reach an agreement with exporters. To avoid this, larger importers tend to offer higher import prices even with a negative exchange rate shock. The effect is called "individual bargaining effect".
- We next extend the model by allowing both exporter and importer heterogeneity. Larger exporters are matched with less productive firms, thus tends to raise exchange rate pass-through of the large firms, which we call "composition effect" in this paper.

What we do empirically?

- We test the predictions of the model by using a comprehensive Chinese transaction-level customs data that covers the universe of China's importers during 2000-2006.
- We find strong support for the theoretical predictions.
 - Exchange rate pass-through into importers is usually positive.
 - Importers with a large market share have significantly lower exchange rate pass-through.

Literature Review

- Exchange rate pass-through from the exporter side:
 - Berman(2012)
 - Amiti et al.(2014)
- Exchange rate pass-through from the bargaining power perspective
 - Goldberg and Tille (2013) : risk aversion assumption
- Importer heterogeneity in the trade literature:
 - Bernard et al.(2009)
 - Castellani et al.(2010)
 - Muuls and Pisu(2009)

Theory

- A single-matching model
- An extended model with heterogeneous exporters

Single-Matching Model: Basic Setup

- Basic setup:
 - Assume two countries in the world.
 - The exporters bargain with the importers over the trade price.
 - The importers will delegate

The sequence of solving the model

- 1. Calculate the importer and exporter's surplus from successful matching
- 2. Use the exogenous match function to solve the equilibrium bargaining price and quantity
- 3. Importer's optimization problem and exporter's entry condition to solve for the optimal number of delegates for price search.
- 4. First-differentiation to solve for the equilibrium exchange rate pass-through rate.

The Importer's Problem

• Home country firm *i* import from the Foreign country, and turn one unit of imported goods into z_i units of final good.

$$y_i^S = z_i q_i$$

• Importer *i* faces an individual demand function for its product as,

$$y_i^D = \xi_i x_i^{-\psi}$$

The Importer's Problem

- Assume that both z_i and ξ_i are both random variables and the joint distribution function for the two firms is $G(z_i, \xi_i)$. $\Psi(>1)$ represents the elasticity of substitution between any two goods sold in domestic market. x_i is the home price for importer *i*'s product.
- In equilibrium, supply equals demand,

$$x_i = \left(\frac{\xi_i}{z_i q_i}\right)^{\frac{1}{\psi}}$$

• The total surplus from importing $q(z_i)$ goods is,

$$J_i = (x_i - p_i) q_i = \xi_i^{\frac{1}{\psi}} z_i^{-\frac{1}{\psi}} q_i^{1 - \frac{1}{\psi}} - p_i q_i$$

The Exporter's Problem

 Exporters only produce one unit of product, but need to pay a sunk cost, c, to enter the foreign market. Thus, the value of a matched exporter in terms of Home currency is,

$$V_i = p_i - \varepsilon c$$

• Where ε is the Home's real exchange rate. A rise in ε implies a depreciation in the Home currency.

Match Function

- Importer *i* will send out b_i delegates to search for exporters of one unit of goods.
- Assume a quadratic search cost, $\kappa b_i^2/2$.
- Let s_i denotes the measure of exporters that go to importer i, and $m(b_i, s_i)$ denote the matching function between importers and exporters, which takes the following form:

$$m(b_i, s_i) = \chi b_i^{\beta} s_i^{1-\beta}$$
, where $\chi > 0$ and $\beta \in (0, 1)$

• We define $\theta_i = b_i/s_i$ as the market tightness as in standard DMP literature.

Solve the Match Function

• Importers and exporters bargain over their surpluses. By Stole and Zwiebel(1996), *p_i* solves the problem

$$\frac{\partial J_i}{\partial q_i} = V_i \Rightarrow \frac{\partial \left(\xi_i^{\frac{1}{\psi}} z_i^{1-\frac{1}{\psi}} q_i^{1-\frac{1}{\psi}} - p_i q_i\right)}{\partial q_i} = p_i - \varepsilon c$$

• It can be shown that

$$p_z = A_i q_i^{-\frac{1}{\psi}} + \frac{\varepsilon c}{2}$$

• Take the match function in to the pricing function, we can get

$$p_{i} = A_{i} \chi^{-\frac{1}{\psi}} \theta_{i}^{-\frac{\beta}{\psi}} s_{i}^{-\frac{1}{\psi}} + \frac{\varepsilon c}{2} \quad \text{with} \quad A = z_{i}^{1-\frac{1}{\psi}} \xi_{i}^{\frac{1}{\psi}}$$

The Optimization of the Importing Firm

• Given s_i the importer maximizes its profit,

$$\max_{\theta_i} A_i q_i^{1-\frac{1}{\psi}} - p_i q_i - \frac{\kappa}{2} \left(\theta_i s_i\right)^2$$

• The FOC is,

$$p_i - \varepsilon c = \frac{\kappa}{\beta \chi} \theta_i^{2-\beta} s_i$$

• For exporters who are searching for importers, they are indifferent between going to importer *i* and *j* in equilibrium,

$$s_i\theta_i^2 = s_j\theta_j^2$$

Entry Condition

• The exporters need to pay sunk cost prior to entry,

$$\chi \theta_i^\beta \left(p_i - \varepsilon c \right) - f = 0$$

• Therefore,

$$\frac{\kappa}{\beta}\Lambda = \varepsilon f \Rightarrow \Lambda = \frac{\beta f}{\kappa}$$

Lemma 1

• Lemma 1: For two importers *i* and *j*,

 $p_i q_i > p_j q_j \Leftrightarrow A_i > A_j$

• Hence, if importer *i* has a larger import market share than importer *j*, we have either $z_i > z_j$ or $\xi_i > \xi_j$.

Exchange Rate Pass-through

• Based on the previous results it is straightforward to obtain,

$$\Delta_i \equiv \frac{d\log p_i}{d\log \varepsilon} = \frac{1}{p_i} \left(\frac{\varepsilon c}{2} - \frac{A_i}{\psi} q_i^{-\frac{1}{\psi}} \frac{d\log q_i}{d\log \varepsilon} \right)$$

Proposition 1

• Proposition 1: An importer with a larger import share is associated with lower exchange rate pass-through in its import price.

- Assume that exporters differ in their marginal cost of production. They draw marginal cost *c*∈(0,∞) with distribution F(·).
- Let $s_i(c)$ denote the number of *c*-type exporters, $\theta_i(c)$ denote the market tightness that importer *i* choose to match with the *c*-type exporters.
- To be more specific, assume that the total search cost for importer *i* is,

 $\int_{0}^{\overline{c}_{i}} \frac{\kappa}{2} b_{i}\left(c\right)^{2} dF\left(c\right)$

• Importer *i* importing from a c-type exporter to produce a consumption good faces the demand curve,

$$y_i^D(c) = \xi_i x_i(c)^{-\psi}$$

• The import price can be shown to be

$$p_i = A_i q_i \left(c\right)^{-\frac{1}{\psi}} + \frac{\varepsilon c}{2}$$

- Now the optimal decision of importer *i* is, $\max_{\theta_{i}^{c}} (x_{i}(c) - p_{i}(c)) q_{i}(c) - \frac{\kappa}{2} b_{i}(c)^{2}$
- FOC:

$$p_{i}(c) - \varepsilon c = \frac{\kappa}{\beta \chi} s_{i}(c) \theta_{i}(c)^{2-\beta}$$

• Same as in our benchmark model, we assume that entry cost for exporters is,

$$\chi \theta_i(c)^{\beta}(p_i - \varepsilon c) = f \Rightarrow \frac{\kappa}{\beta} \Lambda(c) = f$$

• It is straightforward to show that

$$\frac{d\log s_i}{d\log \varepsilon} = -\frac{\Phi_i}{\left(1 - \Phi_i\right)\frac{\beta}{2} + \frac{1}{\psi}\left(1 - \frac{\beta}{2}\right)} \quad \text{where} \quad \Phi_i = \frac{\varepsilon c/2}{p_i - \varepsilon c/2}$$

• The total import revenue of importer *i*:

$$TR_{i} = \int_{c} \left(A_{i}q_{i}\left(c\right)^{-\frac{1}{\psi}} + \frac{\varepsilon c}{2} \right) q_{i}\left(c\right) dF\left(c\right)$$

• The total quantity for importer *i*:

$$Q_{i} = \int_{c} q_{i}(c) dF(c)$$

• The unit price for importer *i*:

$$P_{i} \equiv \frac{TR_{i}}{Q_{i}} = \int_{c} \left(A_{i}q_{i}\left(c\right)^{-\frac{1}{\psi}} + \frac{\varepsilon c}{2} \right) \left(\frac{q_{i}\left(c\right)}{\int_{c} q_{i}\left(c\right) dF\left(c\right)} \right) dF\left(c\right)$$

• The exchange rate pass-through is:



Price Dispersion and Exchange Rate Pass-through

- The composition effect is connected with the term $p_i(c)/P_i$.
- Consider two extreme cases:
 - I. Homogeneous good, $p_i(c)/P_i$. $\rightarrow 1$. The composition effect is zero.
 - 2. Heterogeneous good. The composition effect is large and non-zero.

Data Source

- The import transaction data is drawn from the China's General Administration of Customs during 2000 2006.
- The real exchange rate data is calculated using the IFS dataset.
- We define a product at the HS 6-digit category, and collapse the data to quarterly frequency. The import price is denominated in RMB.
- To comply with the theory, in the baseline analysis we drop the exporters that are also exporters within the same quarter. In robustness, we also choose to drop all exporters.

Summary Statistics

Table 1. Inumber of Observations							
Full Sample				Reduced Sample			
	# of obs	# of firms	# of fpcs	# of obs	# of firms	# of fpcs	
2000	$2,\!363,\!725$	$57,\!619$	979,756	$998,\!059$	$50,\!641$	500,321	
2001	$2,\!515,\!421$	$61,\!893$	$1,\!036,\!550$	1,069,949	$54,\!068$	$532,\!250$	
2002	$2,\!532,\!655$	$69,\!699$	1,060,424	$1,\!131,\!836$	60,206	$567,\!251$	
2003	$2,\!849,\!582$	$79,\!621$	$1,\!172,\!126$	$1,\!314,\!403$	$68,\!325$	$634,\!259$	
2004	$3,\!234,\!642$	$92,\!598$	$1,\!303,\!201$	$1,\!532,\!309$	$79,\!114$	719,237	
2005	$3,\!636,\!828$	103,753	$1,\!451,\!004$	1,721,186	$88,\!304$	$791,\!667$	
2006	4,043,716	$113,\!274$	$1,\!545,\!235$	$1,\!892,\!936$	$95,\!416$	$841,\!073$	
Total	$21,\!176,\!569$	$204,\!200$	4,761,391	$9,\!660,\!678$	$187,\!327$	$2,\!825,\!690$	

Table 1. Number of Observations

The Construction of Market Share

- The key variables to capture importer size in the paper is import market share.
- The import market share of each firm-productsource country-time pair is calculated as:

$$S_{fpct}^{IM} = \frac{P_{fpct} \times Q_{fpct}}{\sum_{\Omega_{pct}} P_{fpct} \times Q_{fpct}}$$

Stylized Facts

 Table 2: Cumulative Market Share of Top Importing Transactions

	(1)	(2)	(3)	(4)	(5)
Transactions	Mean	Standard Deviation	10 percentile	50 percentile	90 percentile
Top 50%	0.91	0.11	0.75	0.96	0.99
Top 25%	0.80	0.15	0.57	0.84	0.97
Top 10%	0.69	0.19	0.43	0.69	0.96
Top 5%	0.64	0.22	0.35	0.63	0.95
Top 1%	0.60	0.25	0.27	0.59	0.95

Empirical Specification

• To test how exchange rate pass-through differ across importers, we use the following empirical specification:

 $\log p_{fpct} = \alpha + \beta \log RERct + \delta \left(S_{fpc}^{IM} \cdot \log RERct \right) + \gamma Z_{ct} + v_{fpc} + \lambda_t + \varepsilon_{fpct}$

- $-Z_{ct}$ is a set of control variables that affect importing prices.
- v_{fpc} , λ_t represents firm-product-country fixed dummies and time dummies.

Empirical Specification

• The estimated exchange rate pass-through is,

$$\Delta_{fpct} = \beta + \delta \cdot S_{fpct}^{IM}$$

• Our theory predicts:

if
$$\Delta_{fpct} > 0$$
, then $\delta < 0$

Baseline Regression

Table 3: Import Share and Pass-through

Dep.Var.:log p_{fpct}	(1)	(2)	(3)
$\log RERct$	0.233^{***}	0.273^{***}	0.149^{***}
	(31.48)	(31.15)	(9.27)
$S_{fpc}^{IM} imes \log RERct$		-0.372***	-0.155***
51		(-10.33)	(-2.77)
$\log(wage_{ct})$			0.213^{***}
			(11.70)
Constant	4.864^{***}	4.883^{***}	4.425^{***}
	(1, 144.93)	(1,017.10)	(52.02)
Fixed Effects			
FPC FE	Y	Y	Y
Time FE	Y	Y	Y
Observations	$9,\!413,\!242$	$9,\!413,\!242$	$3,\!123,\!605$
R-squared	0.948	0.948	0.940

Regression Results with Bins

Dep.Var.:log p_{fpct}	(1)	(2)	(3)
logRERct	0.295***	0.272***	0.296***
0	(22.05)	(29.24)	(29.70)
Top 50% $S_{fpc}^{IM*} \log RERct$	-0.084***		× /
J F	(-5.61)		
Top 75% $S_{fnc}^{IM*} \log RERct$		-0.096***	
JFS		(-7.42)	
$(50\%,75\%) S_{fpc}^{IM} * \log RERct$			-0.073***
			(-3.93)
$(75\%,90\%) S_{fpc}^{IM*} \log RERct$			-0.126^{***}
JE DO JE DO			(-6.23)
$(90\%,100\%)$ $S_{fpc}^{IM}*\log RERct$			-0.206***
JPO			(-12.07)
Fixed Effects			
FPC FE	Y	Y	Y
Time FE	Y	Y	Y
Constant	4.879^{***}	4.870^{***}	4.880^{***}
	(913.30)	(1, 120.65)	(1,099.35)
Observations	$9,\!419,\!743$	$9,\!419,\!743$	$9,\!370,\!683$
R-squared	0.948	0.948	0.970

Table 4. Regression Results with Bins

Robustness Check

- 1. Alternative Samples
 - Delete import and export to the same country simultaneously.
 - Delete processing trade firms
 - Delete all firms that export
- 2. Alternative Specifications
 - Alternative measure of market share
 - First-difference specification

Homogeneous good v.s. Heterogeneous good

Individual bargaining effect is stronger for homogeneous goods. Thus, we • can indirectly test the theory by adding a heterogeneity good dummy.

Table 7 Disentanging The Two Effects					
	(1)	(2)	(3)	(4)	
Dep.Var.: $\log p_{fpct}$	\cos	con	lib	lib	
$\log RERct$	0.244^{***}	0.298^{***}	0.245^{***}	0.296***	
	(27.55)	(27.42)	(27.92)	(27.65)	
$S_{fpc}^{IM} imes \log RERct imes diff$		0.153^{**}		0.140^{*}	
<i>J</i> I ⁻		(2.15)		(1.95)	
$diff \times \log RERct$	-0.020*	-0.042^{***}	-0.022*	-0.042***	
	(-1.67)	(-2.94)	(-1.86)	(-2.91)	
$S_{fpc}^{IM} imes \log RERct$		-0.458^{***}		-0.447***	
JF		(-10.31)		(-10.22)	
Constant	4.864^{***}	4.884***	4.865^{***}	4.885^{***}	
	(1, 152.41)	(1,031.11)	(1, 159.04)	(1,034.60)	
Fixed Effects					
FPC FE	Y	Y	Y	Y	
Time FE	Υ	Υ	Y	Υ	
Observations	$9,\!413,\!242$	$9,\!413,\!242$	$9,\!413,\!242$	$9,\!413,\!242$	
R-squared	0.948	0.948	0.948	0.948	

Table 7 Disortangling The Two Effects

Single-Product Firm

 Table 8 Separate Estimation for Single Product Importers

	(1)	(2)	(3)	(4)
Dep.Var.: $\log p_{fpct}$	\mathbf{SPF}	MPF	tfp_{f}^{op}	tfp_{f}^{lp}
$\log RERct$	0.088^{***}	0.347^{***}	0.142^{***}	0.116***
	(6.71)	(30.78)	(4.61)	(3.16)
$S_{fpc}^{IM} imes \log RERct$	-0.254^{***}	-0.531^{***}		
JPO	(-3.38)	(-7.57)		
$tfp_f imes \log RERct$			-0.027***	-0.012*
J and			(-3.24)	(-1.96)
Constant	4.571^{***}	4.982***	4.249^{***}	4.241***
	(662.32)	(787.52)	(496.04)	(505.37)
Fixed Effects				10.40 (* 10
FPC FE	Y	Y	Y	Υ
Time FE	Y	Y	Y	Υ
Observations	$1,\!622,\!430$	$7,\!680,\!635$	$658,\!209$	$658,\!975$
R-squared	0.985	0.939	0.986	0.986

Conclusions

- This paper analyzes how importer heterogeneity affects exchange rate pass-through.
- We find both theoretically and empirically that larger importers are associated with lower exchange rate pass-through.