

# How do exchange rate movements affect Chinese exports? — A firm-level investigation

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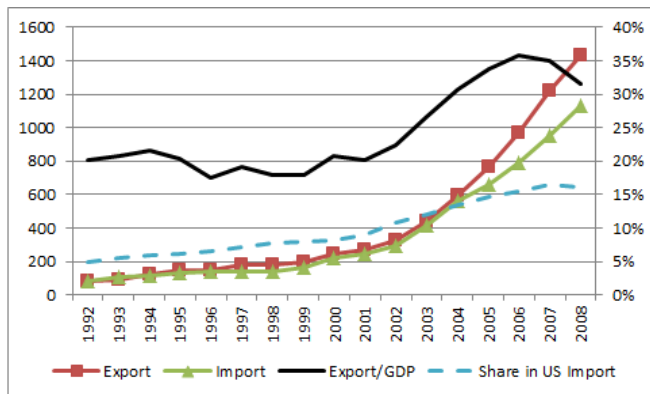
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- Lack of sensitivity of trade to exchange rate movements has been well documented
  - *Low exchange rate pass-through* onto *import/consumer* prices
    - sticky price & LCP (Gopinath and Rigobon, 2008)
    - pricing to market (PTM) (Atkeson and Burstein, 2008)
    - distribution costs (Goldberg and Campa, 2010)
  - *Low elasticities* of trade to exchange rate
    - typical macro elasticities around one.
    - Colacelli (2009) finds the estimated RER elasticities concentrate in the range of (0,1) with a mean of 0.22, out of 136 countries.
- But lack of evidence from the *firm level* on *export price*.
  - Exceptions: Berman, Martin and Mayer (BMM, 2012); Amiti, Itskhoki, and Konings (AIK, 2012).

# What does this paper do?

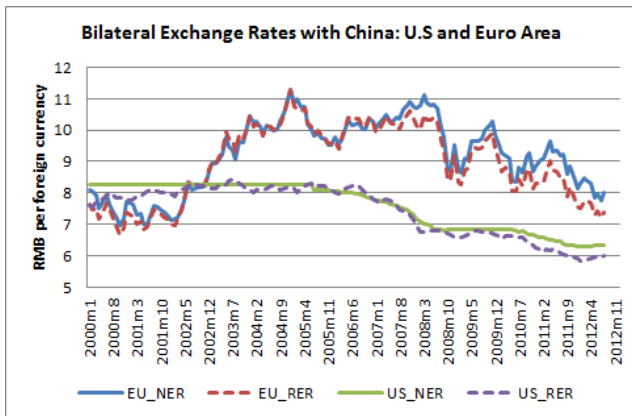
- How would Chinese exporters respond to *bilateral real* exchange rate movements?
  - empirically draw on a rich sample of Chinese exporters
  - reconcile the macro aggregates with micro firm behavior
- Closely related to very recent firm-level studies in Literature:
  - BMM (2012) on French exporters
  - AIK (2012) on Belgian exporters
- Focus on China

# Why China?



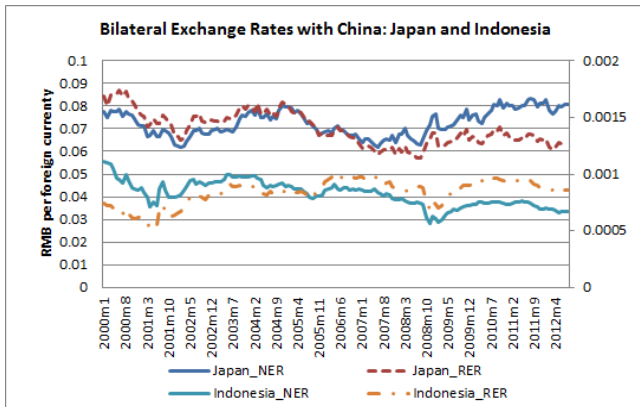
- Tremendous export growth and increasing influence in global economy
- China bashing and disputes on RMB undervaluation

# RMB Exchange Rate Movements



- Note: RMB actually depegged from \$ since 2005.06, and has risen by 21% by 2008.06.

# RMB Exchange Rate Movements



- RMB movements against US\$ were quite different from its movements against Yen or other East Asia currencies.

# What does this paper really do?

- Focus on Chinese exporters' response to real exchange rate movements in
  - volume
  - price
  - conditional entry probability
- Use rich micro information on Chinese exporters
  - connect to production and imported inputs
  - export values and volumes, and therefore unit values: the Chinese Import and Export Database, 2000-2007.
  - firm characteristics (productivity): Annual Surveys of Industrial Production
- how does it fit into the literature?
  - 1 ERPT onto *export* price instead of *import/consumer* price
  - 2 heterogeneity across firms in price and volume responsiveness
    - channels: TFP, marginal cost and/or market power

- 1 This paper discusses the movement of RER of RMB, so an appreciation means the RMB worth more relative to the currency of importing country, but not necessarily more dollars.
- 2 This paper talks about the impact of exchange rate movements on export unit prices, rather than import prices or consumer prices.
  - even if all exchange rate changes are passed-through to export prices, consumers may still feel price changes to a much less extent.
  - eg: Hale and Hobijn (2012) find that on average, 55 cents out of every dollar spent on an item imported from China go for services produced in the United States.



# Preliminary Findings

- ① Nearly *complete* ERPT: following a 10% appreciation of the RMB,
  - Chinese exporters' export price on average drops by around 0.5 – 1.0%.
  - on average export volume drops by 1.5 – 4%.
- ② Responses are heterogeneous
  - More *productive* exporters *price more to market*: a one s.d. increase in *TFP* increases the price drop by another 0.5%: a less complete pass-through.
  - As a result, they respond *less* in volume.
- ③ Heterogeneity in *marginal cost or markup* matters
  - Higher import intensity tends to reduce pass through
  - Larger market share tends to increase pass through
- ④ Exchange rate shocks also influence the *probability of entry*

# Main Specification

- Heterogeneous models:

$$\begin{aligned}\Delta \ln Y_{fpc,t} = & \alpha_0 + \alpha_1 \Delta \ln RER_{c,t} + \alpha_2 \Delta \ln RER_{c,t} \times \ln TFP_{f,t-1} \\ & + \alpha_3 \Delta \ln TFP_{f,t} + \delta \Delta Z_{c,t} + \mu_{fpc} + \lambda_t + \varepsilon_{fpc,t}\end{aligned}$$

- interpret  $\alpha_1$ 
  - Decrease in  $RER$  means appreciation of RMB
  - *positive*  $\alpha_1$  indicates incomplete pass-through
  - the price sensitiveness for an average-TFP exporter.
  - pass through =  $1 - \alpha_1$
- Interpret  $\alpha_2$ 
  - *positive*  $\alpha_2$  means increase in TFP will increase the price responsiveness – less pass-through
  - expect *positive*  $\alpha_2$  for price equation, *negative*  $\alpha_2$  for volume equation
- pass through =  $1 - (\alpha_1 + TFP \times \alpha_2)$

# Firm Heterogeneity in TFP

Table: Price&TFP

	full sample	single	major	
	(1)	(2)	(3)	(4)
	$\Delta \ln$ unit value			
$\Delta \ln$ RER	0.102*** (0.01)	0.091*** (0.01)	0.092*** (0.02)	0.105*** (0.02)
$\Delta \ln$ TFP	0.008*** (0.001)	0.008*** (0.001)	0.008*** (0.00)	0.009*** (0.001)
$\ln$ TFP * $\Delta \ln$ RER	0.045*** (0.01)	0.045*** (0.01)	0.039*** (0.01)	0.049*** (0.01)
rank		-0.005*** (0.001)		
rank * $\Delta \ln$ RER		-0.007*** (0.003)		
Observations	1444647	1444647	421021	547504

# Firm Heterogeneity in TFP

Table: Volume&TFP

	$\Delta \ln \text{ volume}$			
$\Delta \ln \text{ RER}$	0.245*** (0.04)	0.391*** (0.05)	0.411*** (0.06)	0.403*** (0.06)
$\Delta \ln \text{ TFP}$	0.032*** (0.002)	0.033*** (0.002)	0.029*** (0.00)	0.039*** (0.003)
$\ln \text{ TFP} * \Delta \ln \text{ RER}$	-0.067*** (0.03)	-0.042 (0.03)	-0.037 (0.04)	-0.078** (0.04)
rank		-0.149*** (0.01)		
rank * $\Delta \ln \text{ RER}$		0.140*** (0.02)		
Observations	1444647	1444647	421021	547504

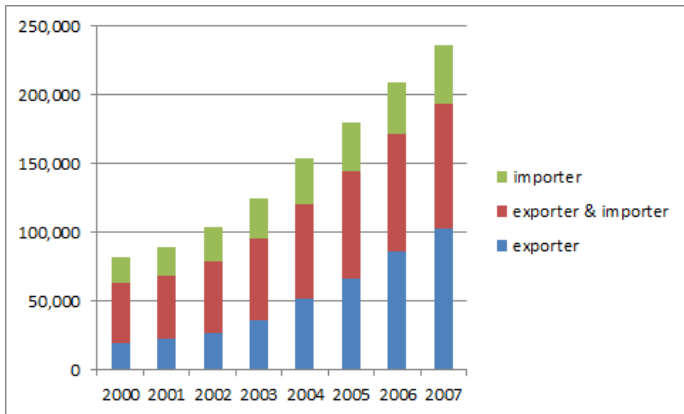
# What does TFP measure?

$$\frac{\partial \ln P_{fcp,t}^*}{\partial \ln RER_{c,t}} = \alpha_2 \ln TFP_{f,t} + \text{control}$$

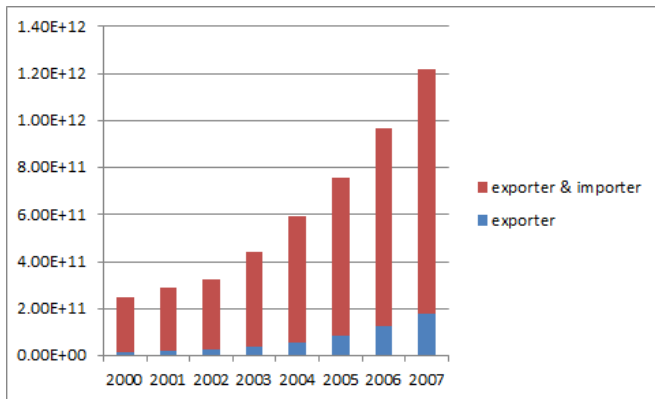
- TFP is revenue based, *no firm level* price index available
  - so it incorporates *marginal cost* effect and *markup* effect:

$$P^* = \text{Markup} \times MC$$

- destination market share could proxy for markup;
- imported intermed. inputs could proxy for marginal costs.



- A lot of firms are simultaneously exporting and importing...



- Exporters that also import account for the lion's share of export value.

# The marginal cost linkages

- out of our matched sample, on average 64% exporters are also importing.

$$\text{Corr}(IMP, EXP) = 0.8$$

- large exporters are often large importers.
- Evidence: *US* (Bernard, Jensen, and Schott, 2009); *Belgium* (AIK, 2012); *China* (Manova and Zhang, 2011)
- Import intensity

$$\omega_{f,t} = \frac{\text{total import of inputs}_{f,t}}{\text{total input costs}_{f,t}}$$

- using BEC to identify inputs + processing inputs



# The marginal cost linkages

- Ekholm, et al. (2012) document that RER shocks lead to manufacturing restructuring for Norwegian exporters
- Second proxy for marginal cost changes:
- Import effective exchange rate

$$\ln \theta_{f,t} = \sum_c (IMPS_{fc,0} \times \Delta \ln RER_{c,t})$$

- an increase in  $\ln \theta_{f,t}$  implies costs of imported inputs are increasing...
- $IMPS_{fc,0}$  is the import share, which takes the value of *starting* period (robust to using current period share)

# Import Intensity & ERPT

Table: Import Intensity

sample:	full	major	full	major
	(1)	(2)	(3)	(4)
<i>Observations</i>	1045157	355386	1045157	355386
	$\Delta \ln$ unit value		$\Delta \ln$ volume	
$\Delta \ln$ RER	0.031	0.210***	0.639***	0.857***
	(0.05)	(0.07)	(0.18)	(0.21)
$\ln$ TFP * $\Delta \ln$ RER	0.052***	0.069***	-0.061*	-0.074*
	(0.01)	(0.01)	(0.03)	(0.04)
$\omega_{f,t}$ * $\Delta \ln$ RER	0.008*	0.009*	-0.023	-0.044**
	(0.01)	(0.01)	(0.02)	(0.02)

- Import intensity reduces pass-through

Table: Import-weighted RER

sample:	full	major	full	major
	(1)	(2)	(3)	(4)
<i>Observations</i>	1045157	355386	1045157	355386
	$\Delta \ln$ unit value		$\Delta \ln$ volume	
$\Delta \ln$ RER	0.098*** (0.02)	0.128*** (0.02)	0.420*** (0.05)	0.447*** (0.07)
$\ln$ TFP * $\Delta \ln$ RER	0.049*** (0.01)	0.070*** (0.01)	-0.065* (0.03)	-0.086** (0.04)
$\ln \theta_{f,t}$ * $\Delta \ln$ RER	-0.768*** (0.22)	-0.483* (0.28)	1.537** (0.67)	0.013 (0.10)

- Appreciation in import effective exchange rate (i.e., an drop in  $\ln \theta_{f,t}$ ) reduces pass-through and elasticity

- Endogenous markup affects ERPT:
  - Weaker effect of exchange rates in industries with high markups. (Campa and Goldberg, 1995)
  - Feenstra, Gagnon, and Knetter (1996) show that the ERPT depends on the firm's market share.
- proxy for markup
  - destination market share

$$S_{fpc,t} = \frac{EXP_{fpc,t}}{\sum_{f'} EXP_{f'pc,t}}$$

Table: Market Share

sample:	full	major	full	major
	(1)	(2)	(3)	(4)
	$\Delta \ln$ unit value		$\Delta \ln$ volume	
$\Delta \ln$ RER	0.109***	0.122***	0.408***	0.542***
	(0.02)	(0.02)	(0.05)	(0.07)
$\ln$ TFP * $\Delta \ln$ RER	0.046***	0.051***	-0.028	-0.085**
	(0.01)	(0.01)	(0.03)	(0.04)
exp_share * $\Delta \ln$ RER	-0.068***	-0.053*	-0.348***	-0.324***
	(0.02)	(0.03)	(0.08)	(0.11)

- Higher market share increases pass-through and elasticity simultaneously

# Brief Summary

- Following a 10% appreciation, an average exporter pass through 9% of that change onto f.o.b. *export* price
- Good exporters pass-thru to a less extent
- Reverse effect on volume: *good* exporters do NOT adjust volume as much
- *High ERPT to export prices* is consistent with recent firm-level studies such as BMM (2012) and AIK (2012), and aggregate estimation on China by Bussiere and Peltonen (2008).
- *Elasticity estimates* in general lower than the time series estimates on China
  - product churning, entry & exit of firms

Table: churning

	<i># of HS8</i>			<i>LOG CV</i>		
	All (1)	High (2)	Low (3)	All (4)	High (5)	Low (6)
TFP	0.029***	0.037***	0.024***	0.028***	0.027***	0.029***
<b>RER</b>	<b>0.028*</b>	<b>0.01</b>	<b>0.049**</b>	<b>0.070*</b>	<b>0.097*</b>	<b>0.079</b>

- Note: CV=std. deviation/mean

$$\Pr(x_{fc,t=1}) = \Phi(\alpha_0 + \alpha_1 \ln(TFP_{f,t-1}) + \Delta \ln(RER_{c,t}) + \varepsilon_{fc,t})$$

- conditional on the firm already self-selected to export to somewhere
- Entry:  $\Pr(x_{fc,t=1} | x_{fc,t} = 0)$
- Continue:  $\Pr(x_{fc,t=1} | x_{fc,t} = 1)$



# RER and Entry Decision

Table 9: Extensive Margin (Firm Entry)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Logit			LPM			LPM		
	exist	enter	continue	exist	enter	continue	exist	enter	continue
lnRER	0.868*** (0.013)	0.788*** (0.017)	0.633*** (0.023)	0.176*** (0.003)	0.135*** (0.003)	0.141*** (0.005)	0.179*** (0.003)	0.121*** (0.004)	0.077*** (0.007)
lnTFPt-1	0.020*** (0.001)	0.001 (0.001)	0.031*** (0.002)	0.004*** (0.000)	0.000 (0.000)	0.007*** (0.000)	0.008*** (0.000)	0.015*** (0.001)	-0.001 (0.001)
lnRGDPPC	0.168** (0.071)	0.484*** (0.088)	-0.14 (0.136)	0.086*** (0.014)	0.125*** (0.016)	-0.023 (0.029)	0.087*** (0.018)	0.338*** (0.023)	0.184*** (0.049)
lnRGDP	0.621*** (0.066)	0.261*** (0.083)	1.149*** (0.123)	0.031** (0.013)	-0.021 (0.016)	0.250*** (0.027)	0.030* (0.017)	-0.304*** (0.022)	-0.174*** (0.044)
Observations	3978513	2509446	1468996	3978513	2509446	1469067	3978513	1469067	1469067
Fixed Effects	Destination			Destination			Firm-Destination		
Marginal Effects									
lnRER	0.21*** (0.003)	0.163*** (0.004)	0.149*** (0.005)						
lnTFPt-1	0.005*** (0.000)	0.0003 (0.000)	0.007*** (0.000)						

# Concluding Remarks

- An empirical investigation on the response of Chinese exporters to exchange rate movements
- Mainly focus on the *intensive margin*
  - relatively complete pass-through and low volume elasticity for an average exporter,
  - but the response depends on TFP / Market share / Import Cost changes
- *extensive margin*: exchange rate changes are also found to affect entry decisions
  - consistent with BMM
  - in contrast to Greenaway, Kneller and Zhang (2007)

# Inertia of price and quantity responses

possible explanations and research agenda

- Quality differentiation
  - Larger exporters usually export at higher unit values (Manova and Zhang, 2011).
- Transportation and local distribution costs.
  - Hale and Hobijn (2012): on average, 55 cents out of every dollar spent on an item imported from China go for services produced in the United States.
- The fragmentation of global supply chain
  - consistent with the declining ERPT onto *import price* over time
  - A substantial part of the remaining 45 cents are actually attributed to material and components that Chinese producer import from foreign countries.
  - The foreign content may account for over 50% of Chinese exports (Wang and Wei, 2009).
- product churning and firm entry and exit seem very important.

Thank you very much!

# Sampling & Data Issues (I)

Table: Representativeness

	all exporters		sample - exporters		matched sample	
	Bn\$	#	out of all exporters Bn\$	out of all exporters #	out of sample exporters Bn\$	out of sample exporters #
2001	266.3	68487	67.6%	63.1%	30.7%	36.0%
2002	325.6	78612	60.2%	60.6%	31.6%	39.0%
2003	438.4	95688	64.2%	60.8%	30.6%	38.6%
2004	593.4	120590	66.4%	58.6%	30.5%	44.6%
2005	762.0	144030	65.7%	61.5%	32.0%	42.7%
2006	969.1	171310	67.5%	62.5%	30.7%	37.2%
2007	1217.9	193567	53.7%	62.9%	28.9%	31.1%

- Sampling of the data, 2000-2007
  - export price and volume, TFP from ASIP data
  - drop very volatile price or volume changes (eg: top and bottom 1 percentile; and if  $p_t/p_{t-1} > 10$  or  $< 0.1$ )

# Sampling & Data Issues (II)

- An exporter may simultaneously export multiple products to the same destination
  - observations are at firm-product-destination level
  - productivity can only be estimated at firm level

Table: Sample Choice

	Full Sample	Single Sample	Major Sample
<b># of firms</b>	61,389	50,991	61,389
<b># of obs</b>	1,569,417	421,021	547,504
ave. growth of volume	0.086	0.134	0.256
ave. growth of price	0.044	0.038	0.04
ave. # of employees	552	374	361
ave. VA per worker	82.44	91.37	88.4

# Initial Regressions

- sample: all chinese exporters' export activity
  - drop very volatile price or volume changes (eg: top and bottom 1 percentile; and if  $p_t/p_{t-1} > 10$  or  $< 0.1$ )
  - focus on intensive margin
- specification:

$$\Delta \ln Y_{fpc,t} = \alpha_0 + \alpha_1 \Delta \ln RER_{c,t} + \delta \Delta Z_{c,t} + \mu_{fpc} + \lambda_t + \varepsilon_{fpc,t}$$

- within variation: all with firm-product-country fixed effects  $\mu_{fpc}$  and year dummies  $\lambda_t$
- robust std. error clustered at country level or firm level.
- *Interpreting  $\alpha_1$* 
  - Decrease in *RER* means appreciation of RMB
  - *positive*  $\alpha_1$  indicates incomplete pass-through
  - pass through =  $1 - \alpha_1$
- Samples: full versus single; by sectors

# Benchmark Price: full sample of exporters

Table: Price Response

	(1)	(2)	(3)	(4)
	$\Delta \ln$ unit value			
	full	single	trading	producing
$\Delta \ln$ RER	0.056*** (0.01)	0.048*** (0.01)	0.031*** (0.01)	0.077*** (0.01)
$\Delta \ln$ RGDP	-0.414** (0.17)	-0.071 (0.28)	-0.403* (0.23)	-0.472*** (0.18)
$\Delta \ln$ RGDPPC	0.374** (0.17)	0.022 (0.27)	0.391* (0.22)	0.413** (0.17)
Constant	0.086*** (0.002)	-0.010*** (0.004)	-0.012*** (0.002)	-0.007*** (0.002)

- 10% RMB appreciation leads to 0.5% price drop: nearly complete pass-through;
- Trading intermediary pass through more than producer



# Benchmark Volume: full sample of exporters

Table: Volume Response

	(5)	(6)	(7)	(8)
	$\Delta \ln \text{ volume}$			
	full sample	single product	trading company	producing comp
$\Delta \ln \text{ RER}$	0.192*** (0.02)	0.380*** (0.08)	0.243*** (0.02)	0.153*** (0.02)
$\Delta \ln \text{ RGDP}$	1.496*** (0.58)	3.063*** (0.92)	3.163*** (0.70)	0.242 (0.61)
$\Delta \ln \text{ RGDPPC}$	-0.741 (0.57)	-1.837** (0.91)	-2.528*** (0.69)	0.616 (0.60)
Constant	-0.460*** (0.009)	0.718*** (0.013)	0.656*** (0.008)	0.702*** (0.006)

- those who pass through more have larger elasticity...

- full specification with all controls
- take into account processing share of trade
- exclude US and dollar peggers

Table: processing volume

	major sample		processing sample	
	(5)	(6)	(7)	(8)
<i>Observations</i>	355386	355386	234154	234154
	$\Delta \ln$ volume			
$\Delta \ln$ RER	0.447*** (0.07)	0.857*** (0.21)	0.469*** (0.08)	0.466*** (0.10)
$\ln$ TFP * $\Delta \ln$ RER	-0.086** (0.04)	-0.074* (0.04)	-0.118** (0.05)	-0.119** (0.05)
$\ln(\theta)$ * $\Delta \ln$ RER	0.013 (0.10)		0.708 (1.08)	
$\omega^*$ $\Delta \ln$ RER		-0.044** (0.02)		-0.004 (0.04)