

Importers, Exporters and Exchange Rate Disconnect

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Motivation

- Large movements in exchange rates have small effects on the prices of internationally traded goods
 - this **exchange rate disconnect** constitutes one of the central puzzles in international macroeconomics
- The vast empirical pass-through literature has neglected one of the most salient features of international trade:
 - **the largest exporters are the largest importers**
- We show this pattern is key to understanding low aggregate pass-through and variation in pass-through across *heterogeneous* firms

Our Approach

1. develop theory to guide our empirical strategy, with two buliding blocks:
 - *Variable mark-ups* in each export destination
 - Firm's choice to *import intermediate inputs*
2. Use detailed firm-level Belgian data to test and quantify the mechanism:
 - merge firm data on *exports by destination, imports by source-country, and domestic cost data*
 - Construct *firm level import intensity* from outside the Euro Area (as a share of total variable cost)
 - Construct *firm-industry-export destination market shares* as a proxy for markup

We show two key mechanisms explaining low pass-through

- Import intensive exporters have lower exchange rate pass through into their export prices as they face **offsetting exchange rate effects on their marginal costs**.
- Import-intensive firms are among the largest exporters, hence have high export market shares and thus set **high markups, which they can actively move in response to changes in marginal costs**. This is a second channel that limits the effect of exchange rate shocks on export prices.

Main Findings

1. A firm in the 5-th percentile, with zero import intensity and market share, has **nearly complete pass through**.
2. A firm in the 95-th percentile of market share and import intensity distributions has **56% pass-through**.
3. **Marginal cost** and **markup channels** contribute roughly equally to this cross-sectional variation:
 - **Import intensity** and **market shares** are:
 - Positively correlated across firms
 - Prime determinants of pass-through
4. This leads to aggregate exchange rate pass through of 64%
 - Firm import intensity, as well as export market shares, are **heavily skewed** towards the largest exporters.

Related literature

- Exporters and Importers
 - Bernard, Redding and Schott (2009)
- Imports and productivity
 - Amiti and Konings (2007), Halpern, Koren and Szeidl (2011).
 - De Loecker, Goldberg, Khandelwal and Pavcnik (2012)

- incomplete pass through:
 - (i) Pricing to market (PTM) in models of **variable markups** in which firms optimally choose different prices depending on local conditions (Dornbusch, '87; Krugman '87; Atkeson and Burstein, 2008).
 - (ii) **Short-run nominal rigidities** with prices sticky in the local currency of the destination market (LCP). Under LCP firms that do not adjust prices have zero *short-run* pass through (Engel, 2006; Gopinath, Itskohki and Rigobon, 2010).
 - (iii) **Local distribution costs** margin (Campa and Goldberg, 2010).
- ➔ Our paper introduces the importance of imported inputs
- ➔ Related to Berman, Martin and Mayer (2012) who focus on firm size (TFP) and pass-through.

THEORY

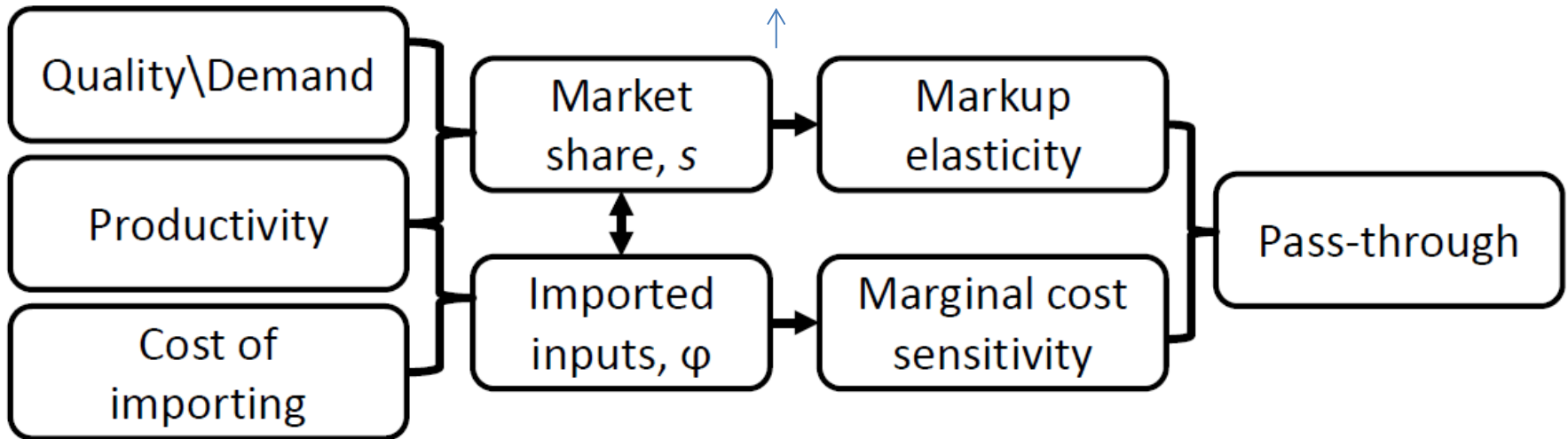
Model ingredients

Two building blocks:

- Consumers in each market have a nested CES demand, oligopoly and variable markups (Atkeson and Burstein, 2008)
- Access to imported inputs at a fixed cost (Halpern, Koren and Szeidl, 2011)

Mechanism

- Lower prices are associated with higher market share and hence makes it optimal to set a higher markup.
- High market share firms have a higher mark-up elasticity wrt price and hence adjust mark-up more to price shocks, making prices and quantities more stable



- Firms with larger total material costs or smaller fixed costs Of importing have larger import intensity
- Marginal cost elasticity wrt exchange rate is equal to the Import share

Demand (Atkeson and Burstein, 2008)

- Nested-CES demand:

$$Q_{k,i} = \xi_{k,i} P_{k,i}^{-\rho} P_k^{\rho-\eta} D_k, \quad \rho > \eta \geq 1,$$

where k –destination, s –industry (omitted), i –firm-product

- Price index:

$$P_k \equiv \left[\sum_i \xi_{k,i} P_{k,i}^{1-\rho} \right]^{\frac{1}{1-\rho}}$$

- Market share:

$$S_{k,i} \equiv \frac{P_{k,i} Q_{k,i}}{\sum_{i'} P_{k,i'} Q_{k,i'}} = \xi_{k,i} \left(\frac{P_{k,i}}{P_k} \right)^{1-\rho} \in [0, 1]$$

Demand & markup

- Demand elasticity and markup:

$$\sigma_{k,i} \equiv -\frac{d \log Q_{k,i}}{d \log P_{k,i}} = \rho(1 - S_{k,i}) + \eta S_{k,i},$$

$$\mathcal{M}_{k,i} \equiv \frac{\sigma_{k,i}}{\sigma_{k,i} - 1}$$

Higher S , lower demand elasticity, hence higher Markup

- Markup elasticity:

$$\Gamma_{k,i} \equiv -\frac{\partial \log \mathcal{M}_{k,i}}{\partial \log P_{k,i}} = \frac{S_{k,i}}{\left(\frac{\rho}{\rho-\eta} - S_{k,i}\right) \left(1 - \frac{\rho-\eta}{\rho-1} S_{k,i}\right)}$$

Proposition

- (i) Market share of the firm $S_{k,i}$ is a sufficient statistic for markup;
- (ii) both markup $\mathcal{M}_{k,i}$ and markup elasticity $\Gamma_{k,i}$ are increasing in the market share.

Production and imported inputs – Production

- Production function:

$$Y_i = \Omega_i X_i^\phi L_i^{1-\phi}, \quad \phi \in (0, 1),$$

$$X_i = \exp \left\{ \int_0^1 \gamma_j \log X_{i,j} dj \right\}, \quad \int_0^1 \gamma_j dj = 1,$$

$$X_{i,j} = \left[Z_{i,j}^{\frac{\zeta}{1+\zeta}} + a_j^{\frac{1}{1+\zeta}} M_{i,j}^{\frac{\zeta}{1+\zeta}} \right]^{\frac{1+\zeta}{\zeta}}, \quad \zeta > 0$$

Note:

- since home and foreign intermediate inputs are imperfect substitutes, production is possible without the use of imported inputs
- Imported inputs are useful both due to their potential productivity advantage, a , and the love of variety feature of the production technology.

Production and imported inputs

Total costs

- A firm pays a firm-specific sunk cost in terms of labor to import each type of the intermediate input.
- The cost of labor, W^* , and domestic input prices, V^* , are denoted in units of producer currency, indicated with a star, the exchange rate is measured as a unit of producer currency for one unit of foreign currency.
- Cost minimization:

$$TC_i^* = W^* L_i + \int_0^1 V_j^* Z_{i,j} dj + \int_{J_{0,i}} (\mathcal{E}_m U_j M_{i,j} + W^* f_i) dj$$

$$TC_i^*(Y_i) = \frac{C^* Y_i}{B_i^\phi \Omega_i} + W^* f_i \cdot j_{0,i}$$

- Cost index:

$$C^* = \kappa W^{*1-\phi} V^{*\phi}$$

$$MC_i^* = \frac{C^*}{B_i^\phi \Omega_i}$$

Marginal cost:

$$MC_i^* = \frac{C^*}{\Omega_i} \cdot \left(\frac{\varepsilon_m U}{V^*} \right)^{\varphi_i}$$

- $C^* \equiv W^{*1-\phi} V^{*\phi}$ is local cost index
- φ_i is import intensity of the firm

Proposition

- (i) *Firms with larger total material cost or smaller fixed cost of importing have a larger import intensity, φ_i .*
- (ii) *Import intensity and market share are positively correlated in the cross-section.*
- (iii) *Partial elasticity of the marginal cost to the (import-weighted) exchange rate equals φ_i .*

Price setting and Pass-through

- Problem of the firm (given the choice of import intensity):

$$\max_{\substack{\{P_{k,i}, Q_{k,i}\}_k \\ Y_i = \sum_k Q_{k,i}}} \left\{ \sum_{k \in K_i} \varepsilon_k P_{k,i} Q_{k,i} - \frac{C^*}{B_i^\phi \Omega_i} Y_i \right\}$$

$$\Rightarrow P_{k,i}^* \equiv \varepsilon_k P_{k,i} = \frac{\sigma_{k,i}}{\sigma_{k,i} - 1} \frac{C^*}{B_i^\phi \Omega_i}$$

- The full differential of the export price:

$$d \log P_{k,i}^* = d \log \mathcal{M}_{k,i} + d \log MC_i^*$$

where

$$d \log \mathcal{M}_{k,i} = -\Gamma_{k,i} (d \log P_{k,i} - d \log P_k) + \frac{\Gamma_{k,i}}{\rho - 1} d \log \xi_{k,i}$$

$$d \log MC_i^* = \varphi_i d \log \frac{\mathcal{E}_m U}{V^*} + d \log \frac{C^*}{\Omega_i}$$

Pass-through

Proposition (theory)

Exchange rate pass-through elasticity into producer price:

$$\Psi_{k,i}^* \equiv \mathbb{E} \left\{ \frac{d \log P_{k,i}^*}{d \log \mathcal{E}_k} \right\} = \alpha_{s,k} + \beta_{s,k} \cdot \varphi_i + \gamma_{s,k} \cdot S_{k,i}.$$

- e.g., coefficient $\beta_{s,k} = \frac{1}{1+\bar{\Gamma}_{s,k}} \mathbb{E} \left\{ \frac{d \log \mathcal{E}_m}{d \log \mathcal{E}_k} \cdot \frac{d \log(\mathcal{E}_m U/V^*)}{d \log \mathcal{E}_m} \right\}$
- $(\varphi_i, S_{k,i})$ form a firm-level sufficient statistic for pass-through

Proposition (implementation)

OLS estimates of β and $\tilde{\gamma}$ in

$$\Delta \log P_{k,i,t}^* = \left[\alpha_{s,k} + \beta \varphi_{i,t-1} + \tilde{\gamma} \tilde{S}_{k,i,t-1} \right] \Delta \log \mathcal{E}_{k,t} + \dots + \tilde{u}_{k,i,t}$$

identify weighted averages of $\beta_{s,k}$ and $\gamma_{s,k} \cdot \mathbf{S}_{s,k,t-1}$ respectively.

Summary

Testable Implications

- ① Market share is a sufficient statistic for markup and markup variability
- ② Import intensity proxies for marginal cost sensitivity to exchange rate
- ③ Import intensity and market share are cross-sectionally positively correlated in equilibrium
- ④ Pass-through decreases in both import intensity and market share in the cross-section of firms
- ⑤ After controlling for *both* the change in marginal cost and market share (change in markup), pass-through no longer depends on import intensity

EMPIRICS

Data, Stylized Facts

- Belgian firm-level data (annual, 2000-2008):
 - ① NBB import and export data by firm-product-country at HS 8-digit (10K product codes): values and quantities
 - ② Belgian Business Registry firm panel with firm characteristics, including firm's inputs (wages and material costs)

- Export price (unit value):

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

- Focus on manufacturing exports to non-Euro OECD countries in major IO category

Key Variables

1 Import Intensity:

$$\varphi_{f,t} \equiv \frac{\text{Total non-Euro import value}_{f,t}}{\text{Total costs}_{f,t}}$$

2 Marginal Cost:

$$\Delta mc_{f,t}^* \equiv \sum_{j \in J_{f,t}, m \in M_{f,t}} \omega_{f,j,m,t} \Delta \log U_{f,j,m,t}^*$$

3 Market Share:

$$\underbrace{\frac{\text{Export Value}_{f,s,k,t}}{\text{Total Sales}_{s,k,t}}}_{\equiv S_{f,s,k,t}} = \underbrace{\frac{\text{Export Value}_{f,s,k,t}}{\text{Total Belgium Exports}_{s,k,t}}}_{\equiv \tilde{S}_{f,s,k,t}} \cdot \underbrace{\frac{\text{Total Belgium exports}_{s,k,t}}{\text{Total Sales}_{s,k,t}}}_{\equiv S_{s,k,t}}$$

Importers and exporters

	Exporters and/or importers	All exporters
Fraction of all firms of them:	32.6%	23.7%
— exporters and importers	57.0%	78.4%
— only exporters	15.8%	21.6%
— only importers	27.2%	—

Heterogeneity within exporters: Exporters by import intensity

	Exporters		Non-exporters
	Import intensive	Not import intensive	
Import intensity	0.37	0.17	0.02
Non-Euro import intensity (φ_f)	0.17	0.01	0.00
Employment (# workers)	270.9	112.1	20.7
Average wage bill (KK Euros)	48.8	42.3	34.9
Material cost (MM Euros)	103.5	28.1	3.0
Total Factor Productivity	0.36	0.07	
Total manuf. exports (MM Euros)	66.5	14.1	
— to non-Euro OECD	14.4	2.4	
Total imports (MM Euros)	49.3	6.8	
— outside Euro Zone	20.8	0.5	
# of import source countries	14.4	6.6	
# of HS 8-digit products imported	79.8	53.4	

Import intensity

Cross-section correlations

	Import intensity	TFP	Revenues	Empl't	Material cost
Market share	0.16	0.20	0.28	0.25	0.27
Material cost	0.23	0.70	0.99	0.83	
Employment	0.10	0.60	0.86		
Revenues	0.21	0.72			
TFP	0.15				

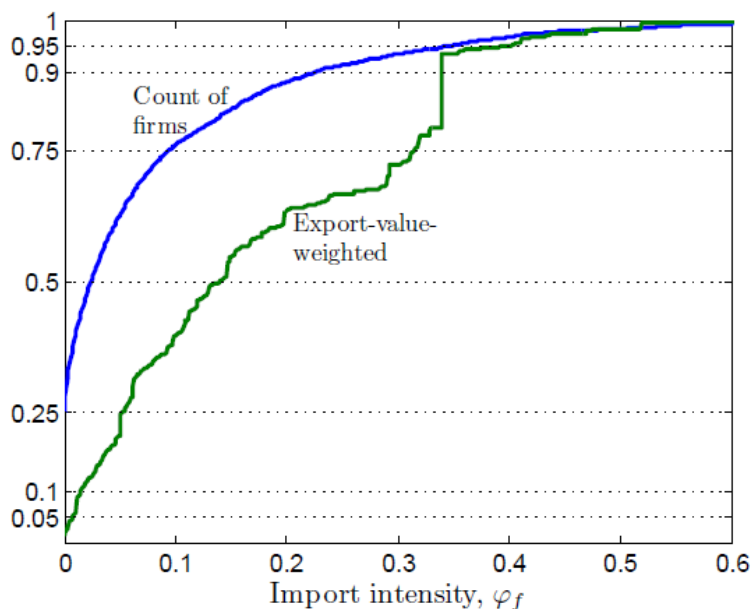
Distribution Import intensity

	# firms	frac firms	frac exp. value
$\varphi_f = 0$	716	24.9%	1.2%
$0 < \varphi_f \leq 0.1$	1,478	51.3%	38.5%
$0.1 < \varphi_f \leq 0.2$	348	12.1%	23.8%
$0.2 < \varphi_f \leq 0.3$	154	5.4%	8.9%
$0.3 < \varphi_f \leq 0.4$	95	3.3%	22.7%
$0.4 < \varphi_f \leq 0.5$	44	1.5%	3.3%
$\varphi_f > 0.5$	45	1.6%	1.6%

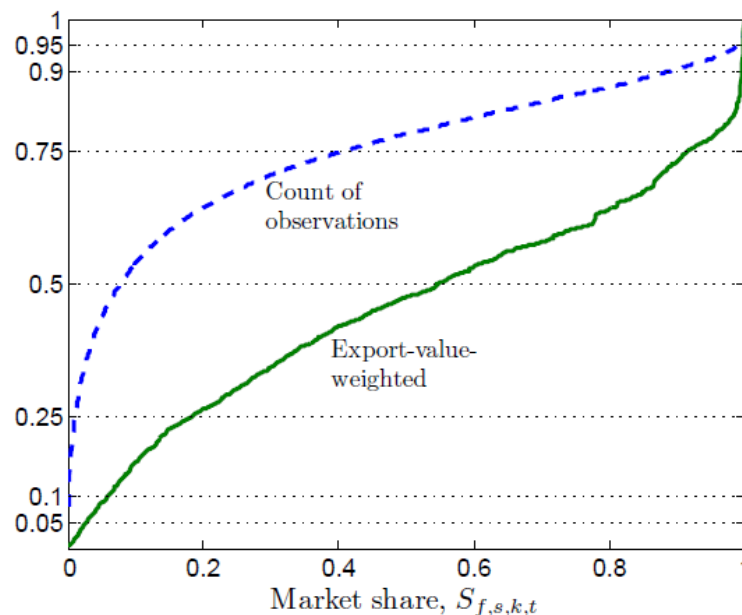
- Time-averaged firm import intensity φ_f , contributes over 85% to the variation in $\varphi_{f,t}$
- For a given firm, $\Delta\varphi_{f,t}$ responds little to $\Delta e_{f,t}^M$

Import intensity and market share, cumulative distributions

Import intensity



Market share



Results

Main specification

$$\psi_{k,i}^* = \frac{\partial \log P_{f,i,k,t}^*}{\partial \log \mathcal{E}_{k,t}} = \alpha_{s,k} + \beta \varphi_i + \gamma S_{f,s,k,t} + \epsilon_{f,i,k,t}$$

Note that pass through in destination currency import prices is
 $1 - \psi_{k,i}^*$

$$\Delta \log P_{f,i,k,t}^* = [\alpha_{s,k} + \beta \varphi_i + \gamma S_{f,s,k,t}] \cdot \Delta \log \mathcal{E}_{k,t} + \dots + \epsilon_{f,i,k,t}$$

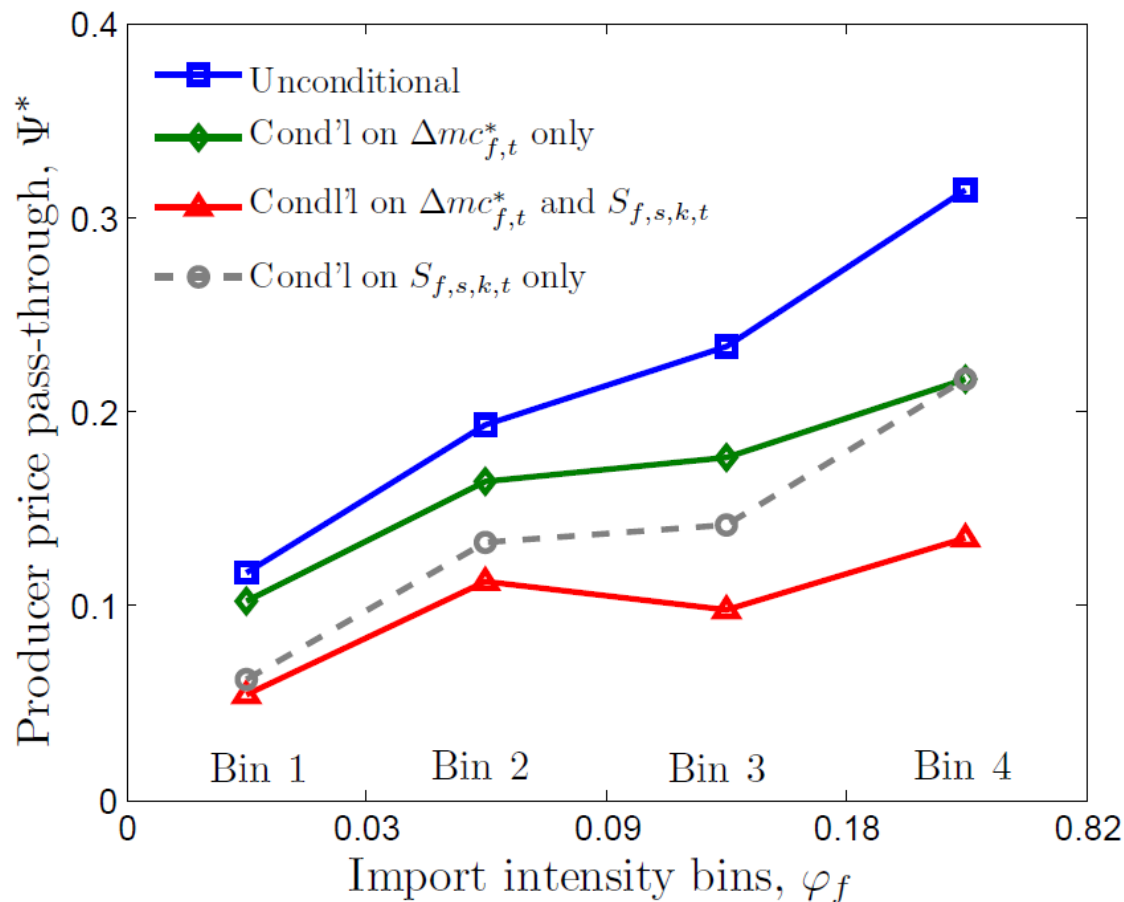
Main results

$$\Delta p_{f,i,k,t}^* = [\alpha + \beta \varphi_f + \tilde{\gamma} \tilde{S}_{f,s,k,t}] \cdot \Delta \log e_{k,t} + \dots + \epsilon_{f,i,k,t}$$

Dep. var.:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta p_{f,i,k,t}^*$							
$\Delta e_{k,t}$	0.203*** (0.026)	0.127*** (0.027)	0.157*** (0.028)	0.149*** (0.037)	0.098*** (0.030)	0.057*** (0.031)	—
$\Delta e_{k,t} \cdot \varphi_f$		0.604*** (0.112)	0.370*** (0.117)	0.341* (0.201)	0.263** (0.115)	0.473*** (0.104)	0.470** (0.236)
$\Delta e_{k,t} \cdot \tilde{S}_{f,s,k,t}$					0.238*** (0.060)	0.284*** (0.063)	0.299*** (0.100)
$\Delta mc_{f,t}^*$			0.512*** (0.030)		0.506*** (0.031)		
SD + Y FE	yes	yes	yes	no	yes	yes	no
SDY FE	no	no	no	no	no	no	yes
FPY FE	no	no	no	yes	no	no	no

$$\text{Pass-through} = 1 - \underbrace{0.06}_{=0.94} - \underbrace{0.47 \cdot 0.38}_{=0.18} - \underbrace{0.28 \cdot 0.75}_{=0.21} = \mathbf{0.55}$$

Non-parametric results, by quartiles of import intensity



Pass-through matrix

(median import intensity, 75 percentile market share)

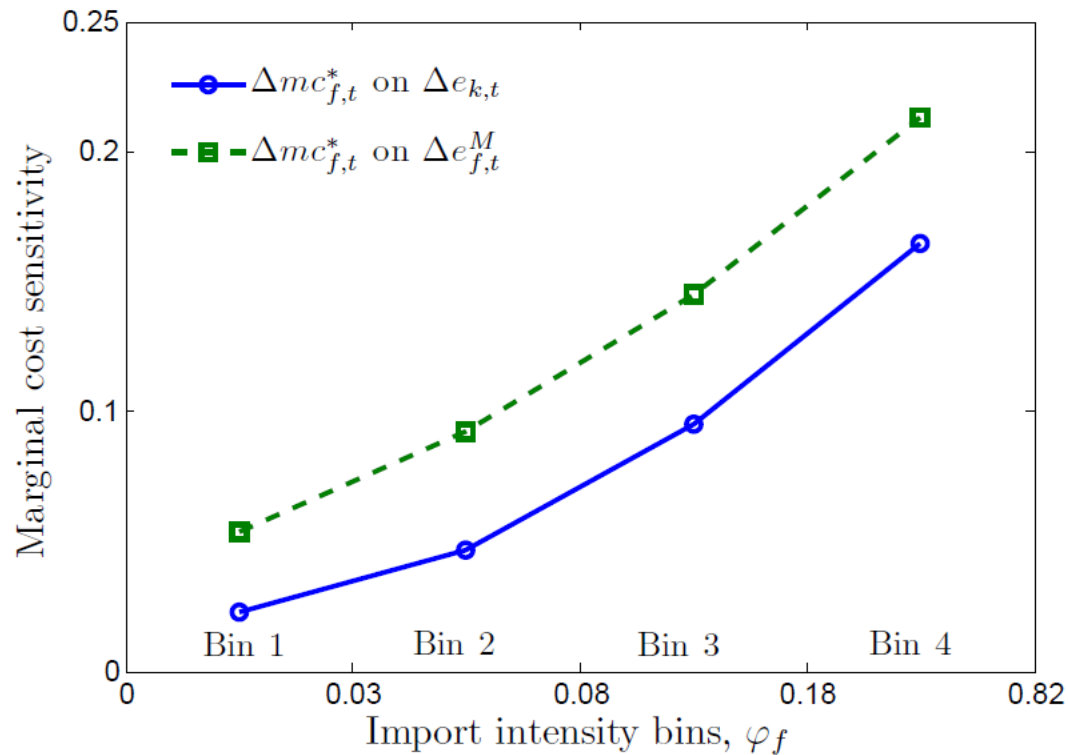
	Low import intensity	High import intensity
Low market share	0.131***	0.194***
<i>Fraction of observations</i>	30.0%	21.0%
<i>Share in export value</i>	8.1%	9.6%
High market share	0.214***	0.339***
<i>Fraction of observations</i>	20.0%	29.2%
<i>Share in export value</i>	21.3%	61.1%

- Weighted pass-through is 62% versus unweighted pass-through of 80%

EMPIRICS

3. EXTENSIONS/ROBUSTNESS

Marginal Cost Mechanism



- The projection of $\Delta e_{f,t}^M$ on $\Delta e_{k,t}$ has a coefficient of 0.45, stable around φ_f -quartiles
- Share of OECD imports decreases from 75% to 55% across the quartiles of φ_f -distribution

Which imports matter?

- Recall: β increases in correlation and pass-through

Dep. var.: $\Delta p_{f,i,k,t}^*$	Exchange rate	Import	OECD and
	▶ correlation	▶ pass-through	Euro Area
	(1)	(2)	(3)
$\Delta e_{k,t} \cdot \varphi_{f,k}^{High}$	0.864*** (0.277)	0.763*** (0.239)	0.472*** (0.154)
$\Delta e_{k,t} \cdot \varphi_{f,k}^{Low}$	0.376*** (0.131)	0.348 (0.241)	0.505** (0.210)
$\Delta e_{k,t} \cdot \varphi_f^{Other}$	—	0.058 (0.314)	0.057 (0.126)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	0.284*** (0.063)	0.285*** (0.063)	0.282*** (0.064)

High and low pass-through

source countries

High pass-through (≥ 0.50)			Low pass-through (< 0.50)		
Country	Pass-through	Import share	Country	Pass-through	Import share
Peru	1.20***	0.5%	Israel [†]	0.45***	0.2%
Bangladesh	0.93***	0.2%	India	0.42***	1.0%
Chile	0.75***	0.2%	Brazil	0.41***	3.1%
Taiwan	0.74***	0.5%	Thailand	0.41***	1.0%
Canada [†]	0.71***	1.8%	Sri Lanka	0.40**	0.2%
Australia [†]	0.69**	1.5%	Malaysia	0.40***	0.3%
Saudi Arabia	0.67**	1.3%	Egypt	0.39***	0.4%
China	0.67***	3.8%	Philippines	0.39*	0.5%
United States [†]	0.63***	16.6%	Venezuela	0.36**	0.4%
Russia	0.62***	3.8%	Singapore	0.31	0.2%
Hong Kong	0.61***	0.2%	Sweden [†]	0.31***	14.3%
Japan [†]	0.55***	5.4%	South Korea [†]	0.24***	0.9%
Colombia	0.55***	0.3%	United Kingdom [†]	0.19***	15.7%
Switzerland [†]	0.53***	1.5%	Indonesia	0.18**	0.6%
Mexico	0.50***	0.4%	Ukraine	0.15	0.2%
			Argentina	0.08**	0.3%
			Turkey	0.02	1.5%
			Pakistan	-0.02	0.2%
			Vietnam	-0.03	0.3%
			South Africa	-0.09	1.0%

Robustness

- Additional controls
- Alternative samples
- Definitions of import intensity
- Measurement error and selection bias

Robustness

Additional controls

Dep. var.: $\Delta p_{f,i,k,t}^*$	(1)	(2)	(3)
$\Delta e_{k,t} \cdot \varphi_f$	0.413*** (0.106)	0.433*** (0.109)	0.418*** (0.119)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	0.219*** (0.065)	0.249*** (0.064)	0.245*** (0.065)
$\Delta e_{k,t} \cdot \log L_{f,t}$	0.044*** (0.012)		
$\Delta e_{k,t} \cdot \log TFP_{f,t}$		0.070*** (0.023)	0.080*** (0.024)
$\Delta \log W_{f,t}^*$			0.004* (0.002)
$\Delta \log TFP_{f,t}$			0.035*** (0.007)
FE: $\delta_{s,k} + \delta_t$	yes	yes	yes
# obs.	92,576	92,106	87,608
R^2	0.058	0.058	0.061

Robustness

Alternative samples

Dep. var.: $\Delta p_{f,i,k,t}^*$	Destinations			All firms including wholesalers	Dropping intra-firm trade	Products		
	all countries	w/out US	only US			all products	HS 4-digit	
	(1)	(2)	(3)			(4)	(5)	(6)
$\Delta e_{k,t}$	-0.011 (0.016)	0.034 (0.035)	0.184** (0.062)	0.094*** (0.028)	0.070** (0.033)	0.062** (0.027)	0.102** (0.042)	0.090** (0.045)
$\Delta e_{k,t} \cdot \varphi_f$	0.263*** (0.064)	0.438*** (0.122)	0.652* (0.385)	0.335*** (0.079)	0.479*** (0.120)	0.587*** (0.107)	0.400** (0.175)	0.505*** (0.165)
$\Delta e_{k,t} \cdot S_{f,s,k,t}$	0.097*** (0.029)	0.292*** (0.062)	0.312*** (0.110)	0.162*** (0.057)	0.211*** (0.071)	0.224*** (0.051)	0.195*** (0.070)	0.198** (0.087)
Fixed Effects:								
$\delta_{s,k} + \delta_t$	yes	yes	no	yes	yes	yes	yes	yes
δ_s	no	no	yes	no	no	no	no	no
# countries	55	11	1	12	12	12	12	12
# obs.	218,879	82,438	10,957	158,804	79,461	143,912	62,679	53,037
R^2	0.077	0.058	0.055	0.041	0.062	0.043	0.057	0.060

Robustness

Definition of import intensity

Dep. var.: $\Delta p_{f,i,k,t}^*$	Lagged time-varying ($\varphi_{f,t-1}, S_{\cdot,t-1}$) (1)	Only manuf. imports (2)	Drop consumer goods (3)	Drop capital goods (4)	Only IO-table inputs (5)	Only IO-table inputs* (6)	Drop inputs in export CN8 (7)
$\Delta e_{k,t}$	0.054* (0.032)	0.062** (0.030)	0.068** (0.030)	0.065** (0.032)	0.057* (0.031)	0.056* (0.031)	0.077** (0.033)
$\Delta e_{k,t} \cdot \varphi_{f,\cdot}$	0.452*** (0.154)	0.459*** (0.114)	0.429*** (0.135)	0.450*** (0.153)	0.471*** (0.106)	0.486*** (0.106)	1.062*** (0.376)
$\Delta e_{k,t} \cdot S_{f,s,k,\cdot}$	0.278*** (0.058)	0.294*** (0.064)	0.292*** (0.063)	0.286*** (0.062)	0.287*** (0.063)	0.286*** (0.063)	0.288*** (0.060)
FE: $\delta_{s,k} + \delta_t$	yes	yes	yes	yes	yes	yes	yes
# obs.	87,799	93,395	93,395	93,395	93,395	93,395	93,395
R^2	0.059	0.058	0.057	0.057	0.057	0.057	0.057

Conclusion

- Import intensity is a prime predictor of low pass-through
 - operates both directly through marginal cost and indirectly through mark-up (selection)
- Large cross-sectional variation:
 - Small non-importing firms: nearly complete pass-through
 - Large import-intensive exporters: pass-through of 55%
 - Variation roughly equally due to marginal cost and markup
- Import intensity heavily skewed towards largest exporters:
 - ⇒ aggregate pass-through is 62%

appendix

① Price stickiness and currency choice

- Low flexible-price pass-through (PTM) versus LCP?
- GIR (2010): work in the same direction

② Financial and real hedging:

- Without liquidity frictions, financial hedging has no effect on marginal cost and pricing
- Our mechanism can be viewed as 'real hedging': offsetting movements in marginal costs
- We find little effects of switching source countries in response to exchange rate