Exchange rate movements, firm-level exports and heterogeneity

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Motivation

Large current account imbalances accumulated by European economies before 2008 have increased their vulnerability to external shocks during the crisis

The improvement of cost and price competitiveness is expected to facilitate current account re-balancing

Therefore, the question of the values of the trade elasticities has regained a clear interest among policy makers and academics

Motivation

On the macro side : apparent disconnection between exchange rates variations, and real variables such as exports (International Elasticity Puzzle ; see Ruhl, 2008)

- Estimated elasticities in aggregate exports equations often below one (see Hooper et al. 2000 among others)

On the micro side : Trade models (Melitz, 2003 ; Chaney, 2008) assume *micro* elasticities typically above one (and often much above)

- Imbs and Mejean (2014) find a median value of about 5 for elasticities of substitution ; which implies a price elasticity of demand of about -4

Motivation

Micro and macro elascitities can be reconciled in the presence of within-sector firm heterogeneity :

- High concentration of aggregate exports among top players

- Lower price elasticity of demand faced by large / more productive firms (e.g. Melitz and Ottaviano, 2008)

- **High productive / large firms can absorb exchange rate variations through lower markups adjustment** (incomplete Exchange rates pass-through))

- Empirical evidence based on firm-level exports response to exchange rates variations across destinations for <u>one single country</u> (Berman et al. 2011 for France)

What we do

We investigate the linkages between firm-level export revenues and real effective exchange rates variations in a multi-country framework :

- Panel of 11 countries reporting information about firm-level exports by size or productivity class and sector during the period 2001-2008

- We estimate a micro elasticity of exports growth to REER variations

- Investigate different response of exporters in relation to size or productivity, controlling for other factors

- The benchmark elasticity ranges from about -0.6 (CPI-based REER) to -1 (ULC-based REER) controlling for other factors

- The elasticity obtained is between 2 and 3 times larger for least productive / smallest firms (bottom 25%) compared to most productive / largest firms (top 25%)

- Results contribute to explain the "International Elasticity Puzzle" : weak aggregate elasticities driven by large firms who represent a very large share of aggregate exports

Related literature

- Very large concentration of aggregate exports into a small subset of firms : Mayer and Ottaviano "Happy Few" paper ; CompNet trade module paper

- Aggregate implications of "granularity" (Gabaix, 2011)

- Incomplete exchange rates pass-through in models with Cournot competition (Atkeson and Burstein, 2008) or local distribution costs (Corsetti and Dedola, 2005)

- Estimation of the micro elasticities of firm-level exports w.r.t. variable trade costs variations (Berthou and Fontagné, 2015 ; Bas, Mayer and Thoenig 2015 ; Fitzgerald and Haller, 2015)

- Firm-level exchange rates elasticities (Fitzgerald and Haller, 2015) and the role of firm-level productivity heterogeneity (Berman et al., 2011)

- Productivity dispersion and the response of sector-level aggregate exports to exchange rates movements (Demian and di Mauro, 2015)

Data

Firm-level exports data :

- CompNet trade module data : 11 European countries with 20E files (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia
- Period 2001-2008
- Each cell reports the average of delta log of firm-level exports exports by country, sector, year, and productivity / size class

Exchange rates data : Bruegel REER database (Darvas, 2012), CPI or ULC based

BACI dataset : Aggregated in NACE 2-digits sectors and used to construct the demand shifters

Descriptive statistics

TABLE: Descriptive statistics : real effective exchange rate, exports and demand

	REER CPI-based (delta log)	REER ULC-based (delta log)	Exports value (delta log)	Foreign demand (delta log)
BEL	0.019	0.017	0.028	0.043
	(0.019)	(0.013)	(0.231)	(0.050)
EST	0.034	0.073	0.090	0.045
	(0.020)	(0.046)	(0.391)	(0.057)
FIN	0.011	0.015	0.050	0.042
	(0.026)	(0.026)	(0.265)	(0.052)
FRA	0.018	0.020	0.033	0.042
	(0.023)	(0.021)	(0.162)	(0.051)
HUN	0.037	0.030	0.084	0.053
	(0.054)	(0.059)	(0.220)	(0.044)
ITA	0.021	0.032	0.050	0.042
	(0.025)	(0.020)	(0.129)	(0.050)
LTU	0.022	0.063	0.100	0.039
	(0.028)	(0.031)	(0.433)	(0.054)
POL	0.049	0.068	0.115	0.058
	(0.031)	(0.055)	(0.230)	(0.049)
PRT	0.011	0.010	0.075	0.048
	(0.002)	(0.007)	(0.226)	(0.051)
SVK	0.074	0.050	0.125	0.040
	(0.035)	(0.032)	(0.325)	(0.053)
SVN	0.013	0.012	0.082	0.041
	(0.017)	(0.013)	(0.271)	(0.054)
Total	0.027	0.031	0.065	0.044
	(0.034)	(0.037)	(0.252)	(0.051)

Note : Means reported, standard deviations in parentheses.

Methodology

In a first step, we estimate the impact of REER variations on firm-level export revenues from the following specification :

$$\Delta \ln V_{fikt} = \beta \Delta \ln REER_{it} + \gamma \Delta \ln D_{ikt} + \mathbf{C}_{fikt}\Omega' + \lambda_f + \lambda_i + \lambda_k + \varepsilon_{fikt} \qquad (1)$$

- V_{fikt} is the exports revenue of firm f operating in country i, sector k in year t

- $REER_{it}$ is the real effective exchange rates

- D_{ikt} is the foreign demand, with $D_{ikt} = \sum_j \frac{V_{ijkt}}{V_{ikt}} M_{jkt}$

- $\mathbf{C}_{fikt}$ is a vector of controls

- λ_f is firm-type fixed effects, λ_i is country fixed effects, λ_k is sector fixed effects

- Error term (ε_{fikt}) clustered by country and year

In a second step, we augment this specification with interactions between the real exchange rates and the firm-level productivity class

TABLE: Real effective exchange rate elasticity : CPI-based

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
			$\Delta \ln export_{fikt}$			
$\Delta \ln reer_{it}$	-0.362	-0.353	-0.319			
	(0.239)	(0.229)	(0.240)			
$\Delta \ln reer_{it/t-1}$				-0.659**	-0.640**	-0.661**
				(0.249)	(0.252)	(0.260)
$\Delta \ln demand_{ikt}$	0.597***	0.603***	0.593***	0.611***	0.615***	0.612***
	(0.093)	(0.097)	(0.103)	(0.083)	(0.082)	(0.082)
Euro $_{it}$		0.071***	0.069***	0.086***	0.088***	0.090***
		(0.023)	(0.024)	(0.025)	(0.023)	(0.024)
$\ln gdp\ per\ cap_{it-1}$		-0.054	-0.041	-0.191*	-0.211**	-0.224**
		(0.088)	(0.093)	(0.096)	(0.099)	(0.099)
$\Delta \ln tfp_{fikt}$			0.119***			0.105***
			(0.031)			(0.030)
Observations	8,800	8,800	7,767	7,364	7,364	6,999
R-squared	0.117	0.118	0.122	0.123	0.152	0.161
Country FE	yes	yes	yes	yes	no	no
Sector FE	yes	yes	yes	yes	no	no
Country × sector FE	no	no	no	no	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes

Note : Source : estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). Standard errors clustered by country and year. $\Delta \ln reer_{it/t-1}$ is the average of the delta logs of the real exchange rate in t and t-1. Significance levels : *** p<0.01, ** p<0.05, * p<0.1.

TABLE: Real effective exchange rate elasticity : ULC-based

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
			$\Delta \ln export_{fikt}$			
$\Delta \ln reer_{it}$	-0.560***	-0.571***	-0.554***			
	(0.179)	(0.180)	(0.181)			
$\Delta \ln reer_{it/t-1}$				-1.007***	-0.981***	-0.979***
				(0.315)	(0.325)	(0.320)
$\Delta \ln demand_{ikt}$	0.581***	0.573***	0.558***	0.631***	0.636***	0.638***
	(0.067)	(0.075)	(0.083)	(0.078)	(0.077)	(0.077)
$Euro_{it}$		0.068***	0.065***	0.073***	0.075***	0.077***
		(0.022)	(0.023)	(0.026)	(0.024)	(0.024)
$\ln gdp\ per\ cap_{it-1}$		-0.004	0.009	-0.116	-0.137	-0.150
		(0.094)	(0.100)	(0.096)	(0.100)	(0.100)
$\Delta \ln tfp_{fikt}$			0.117***			0.102***
			(0.032)			(0.030)
Observations	8,800	8,800	7,767	7,364	7,364	6,999
R-squared	0.120	0.121	0.125	0.125	0.153	0.163
Country FE	yes	yes	yes	yes	no	no
Sector FE	yes	yes	yes	yes	no	no
Country × sector FE	no	no	no	no	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes

Note : Source : estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). Standard errors clustered by country and year. $\Delta \ln reer_{it/t-1}$ is the average of the delta logs of the real exchange rate in t and t-1. Significance levels : *** p<0.01, ** p<0.05, * p<0.1.

Methodology : productivity and size interactions

In a second step, we exploit the information about the heterogenous productivity and size of firms, contained in the CompNet dataset.

- Define 4 categories of productivity and size by dummy variable Q_z, interacted with the REER variable

- We obtain 4 coefficients of the impact of REER variations on export revenues, 1 for each category

$$\Delta \ln V_{fikt} = \sum_{z=1}^{4} \beta_z \Delta \ln REER_{it} \times Q_z + \gamma \Delta \ln D_{ikt} + \mathbf{C}_{fikt}\Omega' + \lambda_f + \lambda_i + \lambda_k + \varepsilon_{fikt} \quad (2)$$

- Alternatively, we use exporter-year fixed effect (λ_{it}) and concentrate on the heterogenous effects of REER variations, relative to the more productive firms' or largest firms' category

$$\Delta \ln V_{fikt} = \sum_{z=1}^{3} \beta_z \Delta \ln REER_{it} \times Q_z + \gamma \Delta \ln D_{ikt} + \mathbf{C}_{fikt}\Omega' + \lambda_f + \lambda_{it} + \lambda_k + \varepsilon_{fikt} \quad (3)$$

TABLE: Real effective exchange rate elasticity : productivity interactions

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
				$\Delta \ln export_{fikt}$		
REER var.		CPI-based REER			ULC-based REER	
$\Delta \ln reer_{it/t-1}$	-0.659***			-1.007***		
	(0.147)			(0.175)		
$\Delta \ln reer_{it/t-1} \times Q1\ prod_{fikt}$		-1.074***	-0.534*		-1.678***	-1.143***
		(0.244)	(0.287)		(0.284)	(0.337)
$\Delta \ln reer_{it/t-1} \times Q2\ prod_{fikt}$		-0.707***	-0.173		-1.229***	-0.634**
		(0.204)	(0.256)		(0.242)	(0.303)
$\Delta \ln reer_{it/t-1} \times Q3\ prod_{fikt}$		-0.467**	0.101		-0.670***	-0.034
		(0.199)	(0.253)		(0.237)	(0.298)
$\Delta \ln reer_{it/t-1} \times Q4\ prod_{fikt}$		-0.553**			-0.599**	
		(0.228)			(0.270)	
$\Delta \ln demand_{ikt}$	0.611***	0.609***	0.360***	0.631***	0.630***	0.361***
	(0.073)	(0.073)	(0.091)	(0.067)	(0.067)	(0.091)
Euro $_{it}$	0.086***	0.086***		0.073***	0.073***	
	(0.024)	(0.024)		(0.024)	(0.024)	
ln $gdp\ per\ cap_{it-1}$	-0.191***	-0.192***		-0.116***	-0.117***	
	(0.042)	(0.042)		(0.044)	(0.044)	
Observations	7,364	7,364	7,364	7,364	7,364	7,364
R-squared	0.123	0.124	0.148	0.125	0.126	0.149
Country FE	yes	yes	no	yes	yes	no
Country-year FE	no	no	yes	no	no	yes
Sector FE	yes	yes	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes

Note : Source : estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). $\Delta \ln reer_{it/t-1}$ is the average of the delta logs of the real exchange rate in t and t-1. Significance levels : *** p<0.01, ** p<0.05, * p<0.1.

TABLE: Real effective exchange rate elasticity : Size interactions

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.				$\Delta \ln export_{fikt}$		
REER var.		CPI-based REER			ULC-based REER	
$\Delta \ln reer_{it/t-1}$	-0.518***			-0.974***		
	(0.157)			(0.185)		
$\Delta \ln reer_{it/t-1} \times Q1\ size_{fikt}$		-0.873***	-0.646**		-1.760***	-1.343***
		(0.268)	(0.310)		(0.329)	(0.379)
$\Delta \ln reer_{it/t-1} \times Q2\ size_{fikt}$		-0.439**	-0.180		-1.165***	-0.736**
		(0.218)	(0.268)		(0.254)	(0.314)
$\Delta \ln reer_{it/t-1} \times Q3\ size_{fikt}$		-0.592***	-0.313		-0.766***	-0.290
		(0.208)	(0.261)		(0.248)	(0.307)
$\Delta \ln reer_{it/t-1} \times Q4\ size_{fikt}$		-0.274			-0.477*	
		(0.236)			(0.280)	
Observations	7,197	7,197	7,197	7,197	7,197	7,197
R-squared	0.097	0.097	0.117	0.099	0.100	0.118
Country FE	yes	yes	no	yes	yes	no
Country-year FE	no	no	yes	no	no	yes
Sector FE	yes	yes	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes

Note : Source : estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). $\Delta \ln reer_{it/t-1}$ is the average of the delta logs of the real exchange rate in t and t-1. Significance levels : *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

TABLE: Robustness : different elasticity for euro countries

Dep. var.	(1)	(2)	(3)	(4)
		$\Delta \ln export_{fikt}$		
REER var.	CPI-based REER		ULC-based REER	
$\Delta \ln reer_{it/t-1}$	-0.931***		-1.272***	
	(0.202)		(0.216)	
$\Delta \ln reer_{it/t-1} \times Q1 - prod_{fikt}$		-1.380***		-1.952***
		(0.285)		(0.311)
$\Delta \ln reer_{it/t-1} \times Q2 - prod_{fikt}$		-0.994***		-1.499***
		(0.247)		(0.273)
$\Delta \ln reer_{it/t-1} \times Q3 - prod_{fikt}$		-0.749***		-0.939***
		(0.241)		(0.268)
$\Delta \ln reer_{it/t-1} \times Q4 - prod_{fikt}$		-0.832***		-0.864***
		(0.265)		(0.297)
$\Delta \ln reer_{it/t-1} \times Euro_{it}$	0.499*	0.529**	0.480**	0.489**
	(0.255)	(0.256)	(0.229)	(0.229)
$\Delta \ln demand_{ikt}$	0.621***	0.620***	0.671***	0.671***
	(0.074)	(0.074)	(0.070)	(0.070)
$Euro_{it}$	0.077***	0.077***	0.060***	0.060***
	(0.025)	(0.025)	(0.025)	(0.025)
$\ln gdp\ per\ cap_{it-1}$	-0.174***	-0.174***	-0.082*	-0.082*
	(0.043)	(0.043)	(0.047)	(0.047)
Observations	7,364	7,364	7,364	7,364
R-squared	0.124	0.124	0.125	0.127
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes

Note : Source : estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). $\Delta \ln reer_{it/t-1}$ is the average of the delta logs of the real exchange rate in t and t-1. Significance levels : *** p<0.01, ** p<0.05, * p<0.1.

Conclusion

Results confirm that firm-size or productivity heterogeneity is an important factor explaining the discrepancy between micro and macro elasticities

- Micro elasticities of the impact of REER variations on firm-level revenues range from -0.6 to about -1
- Much weaker reaction of large / highly productive firms w.r.t. small / unproductive firms
- Contributes to the explanation of the "International Elasticity Puzzle"

Way forward :

- Robustness using alternative samples, dropping one country at a time etc.
- Test for the different mechanisms
  - Firm-level profit margins or markus ⇒ firms absorb external shocks through *internal* finance
  - Firm-financial position or financial market frictions ⇒ firms absorb external shocks through *external* finance
  - Explore other types of distortions (e.g.labor market, misallocation) and cross-sector elasticities of substitution