

# Exchange rate movements, firm-level exports and heterogeneity

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# Motivation

Current account developments before and during the crisis have renewed the interest of academics and policy makers into the reaction of trade flows to relative price changes

Accurate estimations of trade elasticities are required in order to provide parameters for the simulation of macroeconomic models

There is however a debate among economists related to the value of these elasticities, with important discrepancies between (large) microeconomic and (small) macroeconomic trade elasticities

# Motivation : macro versus micro elasticities

**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)
- The elasticity of substitution between domestic and foreign goods used for calibration of macroeconomic models, such as in international business cycle theory, is often between 1 and 1.5 (Bodenstein, 2010 ; Drozd, 2014)

**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 with Constant Elasticities of Substitution.
- These elasticities have been used to quantify the effects of trade openness on aggregate welfare for different class of trade models (Arkolakis et al. 2012)

# Motivation : role of heterogeneity

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

- Strong heterogeneity in terms of firms' productivities within sectors and high concentration of aggregate exports among top players
- Aggregate trade fluctuations are driven by large incumbent exporter, at least in the short run.
- With CES preferences (e.g. Melitz, 2003), all firms face the same elasticity
- In the non-CES case (e.g. Melitz and Ottaviano, 2008, with linear demand system), more productive firms face lower price elasticity
- **High productive / large firms can absorb exchange rate variations through markups adjustment**
- Theoretical and Empirical evidence based on firm-level evidence for France (Berman et al. 2011 for France)

# What we do

**This paper provides cross-country evidence regarding the asymmetric response of firm-level exports consecutive to exchange rates movements**

Multi-country framework : 11 European economies, manufacturing industries, period 2001-2008  $\Rightarrow$  We use the heterogeneity within country-and-industry, and across countries

We investigate the role played by firms' productivity (and size) distributions within each sector and country

The reaction of the average firm to real effective exchange rate variations, a micro elasticity, hides a very substantial heterogeneity within a given sector and country.

- The benchmark average elasticity ranges from about -0.6 (CPI-based REER) to -1 (ULC-based REER)
- It is up to 3 times larger for least productive firms compared to high productive firms

Macro elasticities are weaker due to the very high concentration of aggregate exports into few highly productive firms

- Country-specific micro structure of exports can affect aggregate elasticities

## Related literature

- Very large concentration of aggregate exports into a small subset of firms : Mayer and Ottaviano (2008) “Happy Few” paper or CompNet’s trade module paper (Berthou et al. 2015)
- 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)
- Role of within-country productivity dispersion affecting the response of aggregate exports (di Mauro and Pappada, 2014 ; Demian and di Mauro, 2015 ; Barba-Navaretti et al, 2015 ; Bas, Mayer and Thoenig, 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
- Additional information by productivity / size class : levels and growth of productivity ; percentage of new/exiter/switcher/permanent exporters etc.

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

Note : Means reported, standard deviations in parentheses.

Correlation between delta log CPI-based and ULC-based REER : about 60%



# Methodology

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

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

- $V_{fikt}$  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
- $\lambda_f$  is firm-type fixed effects,  $\lambda_i$  is country fixed effects,  $\lambda_k$  is sector fixed effects
- Error term ( $\varepsilon_{fikt}$ ) 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)
	$\Delta \ln \text{export}_{fikt}$					
$\Delta \ln \text{reer}_{it}$	-0.362 (0.239)	-0.353 (0.229)	-0.319 (0.240)			
$\Delta \ln \text{reer}_{it/t-1}$				-0.659** (0.249)	-0.640** (0.252)	-0.661** (0.260)
$\Delta \ln \text{demand}_{ikt}$	0.597*** (0.093)	0.603*** (0.097)	0.593*** (0.103)	0.611*** (0.083)	0.615*** (0.082)	0.612*** (0.082)
Euro $it$		0.071*** (0.023)	0.069*** (0.024)	0.086*** (0.025)	0.088*** (0.023)	0.090*** (0.024)
$\ln \text{gdp per cap}_{it-1}$		-0.054 (0.088)	-0.041 (0.093)	-0.191* (0.096)	-0.211** (0.099)	-0.224** (0.099)
$\Delta \ln \text{tfp}_{fikt}$			0.119*** (0.031)			0.105*** (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 $\times$ 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.  $\Delta \ln \text{reer}_{it/t-1}$  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)
	$\Delta \ln \text{export}_{fikt}$					
$\Delta \ln \text{reer}_{it}$	-0.560*** (0.179)	-0.571*** (0.180)	-0.554*** (0.181)			
$\Delta \ln \text{reer}_{it/t-1}$				-1.007*** (0.315)	-0.981*** (0.325)	-0.979*** (0.320)
$\Delta \ln \text{demand}_{ikt}$	0.581*** (0.067)	0.573*** (0.075)	0.558*** (0.083)	0.631*** (0.078)	0.636*** (0.077)	0.638*** (0.077)
$\text{Euro}_{it}$		0.068*** (0.022)	0.065*** (0.023)	0.073*** (0.026)	0.075*** (0.024)	0.077*** (0.024)
$\ln \text{gdp per cap}_{it-1}$		-0.004 (0.094)	0.009 (0.100)	-0.116 (0.096)	-0.137 (0.100)	-0.150 (0.100)
$\Delta \ln \text{tfp}_{fikt}$			0.117*** (0.032)			0.102*** (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 $\times$ 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.  $\Delta \ln \text{reer}_{it/t-1}$  is the average of the delta logs of the real exchange rate in t and t-1. Significance levels : \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

# Robustness 1 : year dummies

TABLE: Real effective exchange rate elasticity : year dummies

Dep. var. REER var.	(1)	(2)	(3)	(4)	(5)	(6)
	CPI-based REER		$\Delta \ln export_{fikt}$	ULC-based REER		
$\Delta \ln reer_{it}/t-1$	-0.759** (0.330)	-0.727** (0.329)	-0.694** (0.332)			
$\Delta \ln reer_{it}/t-1$				-0.739** (0.292)	-0.672** (0.292)	-0.710** (0.297)
$\Delta \ln demand_{ikt}$	0.341*** (0.091)	0.334*** (0.094)	0.326*** (0.095)	0.335*** (0.091)	0.329*** (0.094)	0.320*** (0.095)
$Euro_{it}$	0.075*** (0.024)	0.076*** (0.025)	0.081*** (0.025)	0.070*** (0.025)	0.071*** (0.025)	0.076*** (0.025)
$\ln gdp\ per\ cap_{it}-1$	-0.098 (0.080)	-0.125 (0.080)	-0.154* (0.081)	-0.053 (0.088)	-0.089 (0.089)	-0.104 (0.091)
$\Delta \ln tfp_{fikt}$			0.098*** (0.023)			0.097*** (0.023)
Observations	7,364	7,364	6,999	7,364	7,364	6,999
R-squared	0.129	0.158	0.166	0.129	0.158	0.167
Country FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes
Year dummies	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 : \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Robustness 2 : product differentiation (Rauch classification)

TABLE: Real effective exchange rate elasticity : product differentiation

Dep. var.	(1)	(2)	(3)	(4)
REER var.	$\Delta \ln \text{export}_{fikt}$			
	CPI-based REER		ULC-based REER	
$\Delta \ln \text{reer}_{it}/t-1$	-0.853** (0.374)	-0.795** (0.371)	-1.723*** (0.404)	-1.649*** (0.422)
$\Delta \ln \text{reer}_{it}/t-1 * \text{Differentiation}_k$	0.564 (0.391)	0.495 (0.387)	1.087*** (0.323)	1.026*** (0.348)
$\Delta \ln \text{demand}_{ikt}$	0.808*** (0.072)	0.811*** (0.075)	0.797*** (0.071)	0.801*** (0.073)
euro	0.101*** (0.028)	0.102*** (0.029)	0.091*** (0.029)	0.092*** (0.030)
$\ln \text{gdp per cap}_{it-1}$	-0.187* (0.097)	-0.198** (0.097)	-0.123 (0.094)	-0.135 (0.095)
$\Delta \ln \text{tfp}_{fikt}$		0.126*** (0.031)		0.121*** (0.031)
Observations	6,591	6,291	6,591	6,291
R-squared	0.105	0.113	0.109	0.117
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes
Year dummies	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.  $\Delta \ln \text{reer}_{it}/t-1$  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  $Q_z$  :  
 $Cat\ 1 = \{1, 2\}$ ;  $Cat\ 2 = \{3, 4, 5\}$ ;  $Cat\ 3 = \{6, 7, 8\}$ ;  $Cat\ 4 = \{9, 10\}$
- Each variable is 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 ( $\lambda_{it}$ ) and concentrate on the heterogenous effects of REER variations, relative to the more productive firms' or largest firms' category

# Baseline 1 : linear productivity interactions

TABLE: Real effective exchange rate elasticity : product differentiation

Dep. var.	(1)	(2)	(3)	(4)
REER var.	CPI-based REER	$\Delta \ln export_{fikt}$	ULC-based REER	
$\Delta \ln reer_{it/t-1}$	-0.930*** (0.289)	-0.678*** (0.152)	-2.033*** (0.400)	-0.965*** (0.182)
$\Delta \ln reer_{it/t-1} \times \ln prod_{fikt-1}$	0.098 (0.088)		0.336*** (0.121)	
$\Delta \ln reer_{it/t-1} \times Intfp_{fikt-1}$		0.090 (0.055)		0.151** (0.068)
Controls : foreign demand, initial productivity, euro, initial gdp per capita				
Observations	7,543	7,176	7,543	7,176
R-squared	0.122	0.124	0.124	0.126
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes

# Baseline 1 : linear productivity interactions

TABLE: Real effective exchange rate elasticity : product differentiation

Dep. var.	(1)	(2)	(3)	(4)
REER var.	CPI-based REER	$\Delta \ln export_{fikt}$	ULC-based REER	
$\Delta \ln reer_{it/t-1}$	-0.930*** (0.289)	-0.678*** (0.152)	-2.033*** (0.400)	-0.965*** (0.182)
$\Delta \ln reer_{it/t-1} \times \ln prod_{fikt-1}$	0.098 (0.088)		0.336*** (0.121)	
$\Delta \ln reer_{it/t-1} \times Intfp_{fikt-1}$		0.090 (0.055)		0.151** (0.068)
Controls : foreign demand, initial productivity, euro, initial gdp per capita				
Observations	7,543	7,176	7,543	7,176
R-squared	0.122	0.124	0.124	0.126
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes



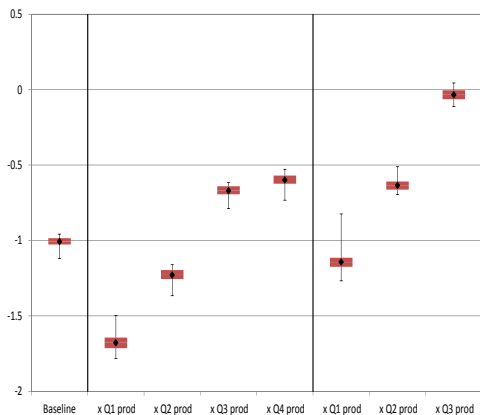
## Baseline 2 : 4 productivity categories

TABLE: Real effective exchange rate elasticity : productivity interactions

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
REER var.	CPI-based REER			$\Delta \ln \text{export}_{fikt}$	ULC-based REER	
$\Delta \ln \text{reer}_{it}/t-1$	-0.664*** (0.147)			-1.039*** (0.174)		
$\Delta \ln \text{reer}_{it}/t-1 \times Q1 - \text{prod}_{fikt}$		-1.023*** (0.241)	-0.471* (0.283)		-1.743*** (0.282)	-1.270*** (0.333)
$\Delta \ln \text{reer}_{it}/t-1 \times Q2 - \text{prod}_{fikt}$		-0.676*** (0.201)	-0.126 (0.253)		-1.192*** (0.241)	-0.662** (0.299)
$\Delta \ln \text{reer}_{it}/t-1 \times Q3 - \text{prod}_{fikt}$		-0.521*** (0.197)	0.051 (0.250)		-0.806*** (0.236)	-0.255 (0.295)
$\Delta \ln \text{reer}_{it}/t-1 \times Q4 - \text{prod}_{fikt}$		-0.575** (0.226)			-0.546** (0.266)	
	Controls : foreign demand, euro, initial gdp per capita					
Observations	7,607	7,607	7,607	7,607	7,607	7,607
R-squared	0.119	0.120	0.141	0.121	0.123	0.142
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

# Robustness : distribution of elasticities

FIGURE: Distribution of elasticities (dropping one country-sector at a time)



# Robustness : alternative fixed effects

**TABLE:** Real effective exchange rate elasticity : country-sector fixed effects

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
REER var.	CPI-based REER		$\Delta \ln \text{export}_{fikt}$	ULC-based REER		
$\Delta \ln \text{reer}_{it/t-1} \times Q1 - \text{prod}_{fikt}$	-1.004*** (0.241)	-1.379*** (0.387)	-1.414*** (0.387)	-1.721*** (0.282)	-1.484*** (0.361)	-1.404*** (0.363)
$\Delta \ln \text{reer}_{it/t-1} \times Q2 - \text{prod}_{fikt}$	-0.664*** (0.201)	-1.027*** (0.358)	-1.133*** (0.358)	-1.184*** (0.240)	-0.941*** (0.330)	-0.998*** (0.330)
$\Delta \ln \text{reer}_{it/t-1} \times Q3 - \text{prod}_{fikt}$	-0.528*** (0.198)	-0.880** (0.354)	-0.999*** (0.355)	-0.799*** (0.236)	-0.551* (0.326)	-0.640* (0.328)
$\Delta \ln \text{reer}_{it/t-1} \times Q4 - \text{prod}_{fikt}$	-0.580** (0.226)	-0.931** (0.369)	-1.068*** (0.370)	-0.540** (0.266)	-0.292 (0.348)	-0.445 (0.351)
$\Delta \ln \text{lprod}_{fikt}$			0.093*** (0.023)			0.081*** (0.023)
	Controls : foreign demand, euro, initial gdp per capita					
Observations	7,607	7,607	7,601	7,607	7,607	7,601
R-squared	0.145	0.151	0.153	0.148	0.152	0.153
Country-sector FE	yes	yes	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes
Year dummies	no	yes	yes	no	yes	yes

# Robustness : alternative productivity thresholds

Productivity categories :

$Cat\ 1 = \{1, 2, 3\}$ ;  $Cat\ 2 = \{4, 5\}$ ;  $Cat\ 3 = \{6, 7\}$ ;  $Cat\ 4 = \{8, 9, 10\}$

**TABLE:** Real effective exchange rate elasticity : alternative productivity thresholds

Dep. var. REER var.	(1)	(2)	(3)	(4)	(5)	(6)
		CPI-based REER		$\Delta \ln export_{fikt}$	ULC-based REER	
$\Delta \ln reer_{it}/t-1$	-0.664*** (0.147)			-1.039*** (0.174)		
$\Delta \ln reer_{it}/t-1 \times Q1 - prod_{fikt}$		-0.932*** (0.207)	-0.387* (0.229)		-1.582*** (0.244)	-1.043*** (0.272)
$\Delta \ln reer_{it}/t-1 \times Q2 - prod_{fikt}$		-0.631*** (0.232)	-0.092 (0.254)		-1.165*** (0.275)	-0.623** (0.299)
$\Delta \ln reer_{it}/t-1 \times Q3 - prod_{fikt}$		-0.510** (0.229)	0.059 (0.251)		-0.904*** (0.275)	-0.313 (0.299)
$\Delta \ln reer_{it}/t-1 \times Q4 - prod_{fikt}$		-0.562*** (0.196)			-0.576** (0.231)	
	Controls : foreign demand, euro, initial gdp per capita					
Observations	7,607	7,607	7,607	7,607	7,607	7,607
R-squared	0.119	0.120	0.141	0.121	0.123	0.142
Country-sector FE	yes	yes	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes	yes	yes
Year dummies	no	no	yes	no	no	yes

# Robustness : different elasticity for euro countries

TABLE: Real effective exchange rate elasticity : euro interactions

Dep. var.	(1)	(2)	(3)	(4)
REER var.	CPI-based REER	$\Delta \ln export_{fikt}$	ULC-based REER	
$\Delta \ln reer_{it/t-1}$	-0.911*** (0.200)		-1.338*** (0.260)	
$\Delta \ln reer_{it/t-1} \times Euro_{it}$	0.464* (0.255)	0.486* (0.255)	0.546 (0.350)	0.560 (0.350)
$\Delta \ln reer_{it/t-1} \times Q1 - prod_{fikt}$		-1.298*** (0.281)		-2.053*** (0.342)
$\Delta \ln reer_{it/t-1} \times Q2 - prod_{fikt}$		-0.935*** (0.243)		-1.501*** (0.308)
$\Delta \ln reer_{it/t-1} \times Q3 - prod_{fikt}$		-0.777*** (0.239)		-1.115*** (0.305)
$\Delta \ln reer_{it/t-1} \times Q4 - prod_{fikt}$		-0.829*** (0.262)		-0.849*** (0.327)
Controls : foreign demand, euro, initial gdp per capita				
Observations	7,607	7,607	7,607	7,607
R-squared	0.120	0.120	0.121	0.123
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes

# Robustness : Two-way traders

- Cf. Amiti-Koenings-Itskhoki AER paper

TABLE: Real effective exchange rate elasticity : Two-way traders

Dep. var. REER var.	(1)	(2)	(3)	(4)
		$\Delta \ln \text{export}_{fikt}$		
	CPI-based REER		ULC-based REER	
$\Delta \ln \text{reer}_{it/t-1}$	-0.672*** (0.252)		-2.018*** (0.347)	
$\Delta \ln \text{reer}_{it/t-1} \times \text{Share two-way}_{fikt-1}$	0.170 (0.372)	0.006 (0.392)	1.870*** (0.518)	1.283** (0.570)
$\Delta \ln \text{reer}_{it/t-1} \times Q1 - \text{prod}_{fikt}$		-0.939*** (0.298)		-2.313*** (0.386)
$\Delta \ln \text{reer}_{it/t-1} \times Q2 - \text{prod}_{fikt}$		-0.541* (0.284)		-1.676*** (0.393)
$\Delta \ln \text{reer}_{it/t-1} \times Q3 - \text{prod}_{fikt}$		-0.480 (0.304)		-1.562*** (0.429)
$\Delta \ln \text{reer}_{it/t-1} \times Q4 - \text{prod}_{fikt}$		-0.508 (0.345)		-1.316*** (0.485)
Controls : Share two-way traders, foreign demand, euro, initial gdp per capita				
Observations	7,107	7,107	7,107	7,107
R-squared	0.116	0.117	0.119	0.120
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes

# Robustness : Switchers

TABLE: Real effective exchange rate elasticity : switchers

Dep. var.	(1)	(2)	(3)	(4)
REER var.	CPI-based REER	$\Delta \ln \text{export}_{fikt}$	ULC-based REER	
$\Delta \ln \text{reer}_{it/t-1}$	-0.541*** (0.154)		-0.880*** (0.181)	
$\Delta \ln \text{reer}_{it/t-1} \times \text{Shareswitch}_{fikt-1}$	-11.810** (4.711)	-11.404** (4.726)	-16.308*** (5.146)	-15.643*** (5.154)
$\Delta \ln \text{reer}_{it/t-1} \times Q1 - \text{prod}_{fikt}$		-0.865*** (0.246)		-1.594*** (0.286)
$\Delta \ln \text{reer}_{it/t-1} \times Q2 - \text{prod}_{fikt}$		-0.551*** (0.208)		-1.015*** (0.247)
$\Delta \ln \text{reer}_{it/t-1} \times Q3 - \text{prod}_{fikt}$		-0.426** (0.200)		-0.649*** (0.240)
$\Delta \ln \text{reer}_{it/t-1} \times Q4 - \text{prod}_{fikt}$		-0.463** (0.231)		-0.427 (0.269)
Controls : Share two-way traders, foreign demand, euro, initial gdp per capita				
Observations	7,543	7,543	7,543	7,543
R-squared	0.122	0.122	0.124	0.126
Country FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Prod.-class FE	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes

# From micro to macro elasticities

Country-specific trade structure has an impact on aggregate elasticities :

- Sector specialization : different patterns of concentration of activities across sectors
- Country-specific concentration of activities within sectors

Aggregate elasticity is determined by the weight of firm-type  $f$  of sector  $k$  in country  $i$ 's exports  $\theta_{fik}$  :

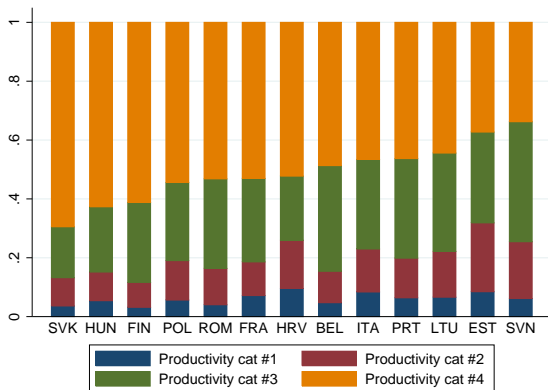
$$\varepsilon_i = \sum_{fk} \theta_{fik} \times \varepsilon_f = \sum_{fk} \omega_{fik} \times \alpha_{ik} \times \varepsilon_f$$

- $\omega_{fik}$  is the export share of firm type  $f$  in sector  $k$ 's exports of country  $i$
- $\alpha_{ik}$  is the export share of sector  $k$  in country  $i$ 's aggregate exports
- These two weights can be set to EU sample average to determine the respective influence of within-sector concentration of exports, and the sector composition within each country



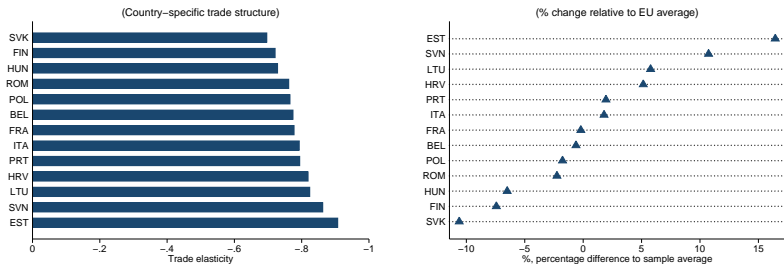
# Export concentration

**FIGURE:** Distribution of export shares across firm productivity categories (weighted average)



# Baseline

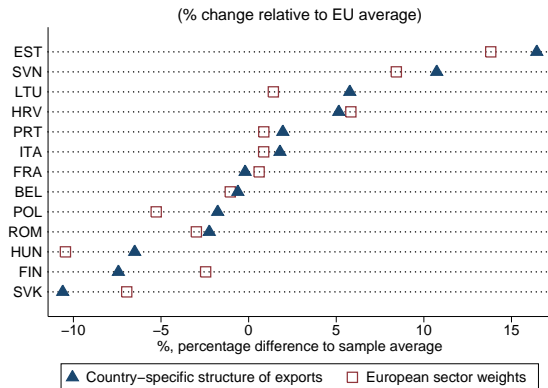
**FIGURE:** Aggregate elasticities : influence of within-sector export concentration



Note : Elasticities taken from the baseline estimation with ULC-based REER.  $\varepsilon_1 = -1.74$ ;  $\varepsilon_2 = -1.19$ ;  $\varepsilon_3 = -0.806$ ;  $\varepsilon_4 = -0.54$ .

# EU sector weights

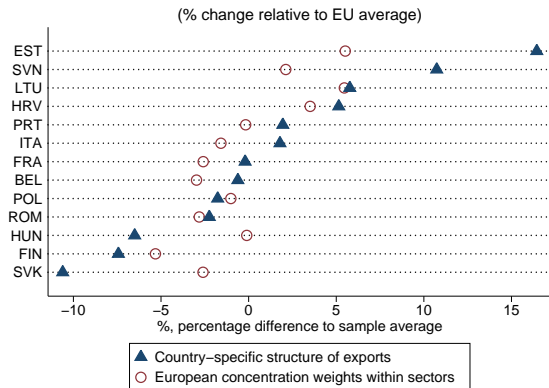
FIGURE: Aggregate elasticities : influence of within-sector export concentration



Note : Elasticities taken from the baseline estimation with ULC-based REER.  $\varepsilon_1 = -1.74$ ;  $\varepsilon_2 = -1.19$ ;  $\varepsilon_3 = -0.806$ ;  $\varepsilon_4 = -0.54$ .

# EU concentration weights within sectors

FIGURE: Aggregate elasticities : influence of within-sector export concentration



Note : Elasticities taken from the baseline estimation with ULC-based REER.  $\varepsilon_1 = -1.74$ ;  $\varepsilon_2 = -1.19$ ;  $\varepsilon_3 = -0.806$ ;  
 $\varepsilon_4 = -0.54$ .

# Conclusion

Results confirm that firm 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”
- High concentration of export activities on top productive firms explains weak macro elasticities

Way forward :

- Test for the different mechanisms using additional firm-level information (markups, firms financial position...)
- Role of countries / sectors characteristics affecting the distribution of firm productivity (distortions in labor and capital markets etc.)