

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

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Macro time-series estimations have found that real exchange rate movements have a weak impact on export volumes (e.g. Hooper et al., 2000, about -0.5 on average for G7 countries)

Great uncertainty for the calibration of macroeconomic models (e.g. Corsetti et al. 2008 use 0.85 or 8 for instance)

Motivation : role of firm heterogeneity

Heterogenous firms trade models emphasize the role played by firm productivity / size

- Low pass-through esp. among highly productive exporters : role of variable markups, distribution costs, and strategic complementarity (Rodriguez-Lopez, 2011 ; Berman et al., 2012 ; Amiti et al. 2017)
- Implies weak reaction of exports to XR movements for highly productive firms

Macro implication : weak effect of XR on trade volumes when...

- 1 Aggregate exports concentrated into highly productive firms
- 2 The productivity distribution of exporters biased towards highly productive firms

Our objective

- 1 Quantify the role of productivity heterogeneity in the reaction of firm-level exports to XR movements in a multi-country empirical setting (11 European countries), controlling for other factors (imports, export dynamics of small versus large firms etc.)
- 2 Identify the role of productivity when firms are ranked within country-sector or between countries in the same sector
- 3 Show the macro implications of (i) export concentration, and (ii) productivity distribution of exporters

Firm-level investigation

Multi-country framework : 11 European economies, manufacturing industries, period 2003-2011 (CompNet dataset)

Information about firms' export performance by productivity deciles, countries and sectors

- A 10% real appreciation reduces firm-level exports by 5% to 8% on average (CPI-REER elasticity : -0.8 ; ULC-REER elasticity : -0.5)
- Least productive firms react 3 times to 8 times more than the most productive firms within each country-sector
- Similar result when ranking firms based on a productivity scale for 11 countries

Aggregation exercise : (1) export concentration reduces the aggregate export elasticity in all countries ; (2) differences in the shape of productivity distributions generates different responses across countries

Related literature

- Structural estimations of the **price elasticity of demand** (Feenstra, 1994 ; Simonovska and Waugh, 2014 ; Imbs and Mejean, 2015, 2016), or reduced-form estimations (Fontagné et al., 2017)
- **Impact of tariffs** on trade (Buono and Lalanne, 2012 ; Fitzgerald and Haller, 2014 ; Caliendo and Parro, 2015 ; Bas et al., 2015 ; Berthou and Fontagné, 2016)
- **Impact of exchange rates** on trade using disaggregated trade data (Bussière et al., 2016), or firm-level data (Berman et al., 2012 ; Chatterjee et al., 2013 ; Fitzgerald and Haller, 2014 ; Li et al., 2015).
- **Aggregate implications of heterogeneous pricing to market or productivity dispersion** for the aggregate response of export volumes or current account to exchange rate movements (Berman et al., 2012 ; di Mauro and Pappada, 2014 ; Demian and di Mauro, 2015)
- Role of **financial frictions** (Berman and Berthou, 2009), **trade costs** (Berthou, 2008), firm-level **adjustment costs** (Alessandria et al., 2014), **imports** (Amiti et al., 2014), firm **selection** in export markets (Bas et al. 2015), **specialization** (Imbs and Mejean, 2015 and 2016), **nominal rigidities**, currency choice and the international role of the US dollar (Gopinath et al., 2010 ; Casas et al., 2016 ; or Boz et al., 2017)

Data

Firm-level exports data :

- CompNet trade module data : 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia), 22 manufacturing sectors, based on firm samples with more than 20 employees (+20E files in CompNet)
- Period 2003-2011
- Each cell reports the average of delta log of “firm”-level 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

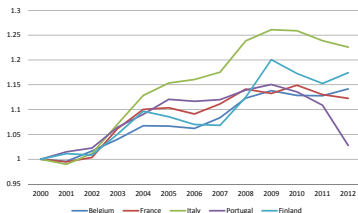
	REER CPI-based (delta log)	REER ULC-based (delta log)	Exports value (delta log)	Foreign demand (delta log)
Belgium	0.018 (0.015)	0.017 (0.010)	0.001 (0.220)	0.003 (0.05)
Estonia	0.025 (0.009)	0.052 (0.017)	0.089 (0.380)	0.033 (0.059)
Finland	0.007 (0.022)	0.019 (0.022)	0.043 (0.270)	0.033 (0.066)
France	0.011 (0.022)	0.017 (0.016)	0.019 (0.180)	0.020 (0.061)
Hungary	0.016 (0.037)	0.014 (0.037)	0.060 (0.260)	0.035 (0.058)
Italy	0.013 (0.024)	0.029 (0.016)	0.040 (0.160)	0.018 (0.062)
Lithuania	0.020 (0.026)	0.051 (0.037)	0.076 (0.440)	0.032 (0.069)
Poland	-0.000 (0.049)	0.003 (0.053)	0.053 (0.280)	0.028 (0.067)
Portugal	-0.003 (0.013)	0.007 (0.006)	0.057 (0.250)	0.007 (0.061)
Slovakia	0.066 (0.030)	0.056 (0.014)	0.083 (0.330)	0.024 (0.061)
Slovenia	0.009 (0.014)	0.018 (0.016)	0.066 (0.260)	0.044 (0.066)
Total	0.016 (0.032)	0.023 (0.029)	0.042 (0.250)	0.022 (0.062)

Note : Means reported, standard deviations in parentheses.

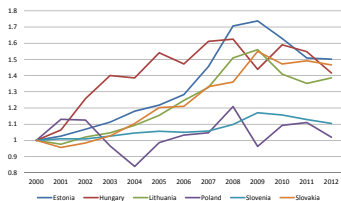
Correlation between delta log CPI-based and ULC-based REER : 78%

FIGURE : ULC-based real effective exchange rate variations

1. "Western" EU member states



2. "Eastern" EU member states



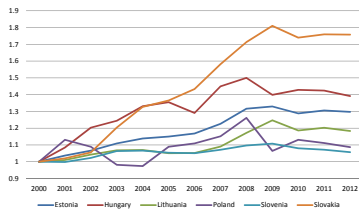
Note : Authors calculations based on Bruegel real effective exchange rates dataset (Darvas, 2012).

FIGURE : CPI-based real effective exchange rate variations

1. "Western" EU member states



2. "Eastern" EU member states



Note : Authors calculations based on Bruegel real effective exchange rates dataset (Darvas, 2012).

Trade elasticities at firm-level

Methodology

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

$$\Delta \ln V_{fikt} = \beta \Delta \ln \overline{REER}_{it-1} + \gamma_1 \Delta \ln \overline{D}_{ikt} + \gamma_2 Euro_{it} + \lambda_f + \lambda_i + \lambda_k + \lambda_t + \varepsilon_{fikt} \quad (1)$$

- 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 rate (ULC or CPI-based)
- D_{ikt} is average of foreign demand in t and $t-1$, with

$$D_{ikt} = \sum_{j \neq i} \frac{V_{ijkt0}}{V_{ikt0}} (Y_{jkt} + M_{jkt} - X_{jkt})$$
- $\Delta \ln Z_t = \ln Z_t - \ln Z_{t-1}$ and $\Delta \ln \overline{Z}_t = \frac{1}{2}(\Delta \ln Z_t + \Delta \ln Z_{t-1})$
- 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, λ_t correspond to year dummies.
- Alternative specification with country-and-sector fixed effects : λ_{ik}
- Error term (ε_{fikt}) clustered by country and year

TABLE : Real effective exchange rate elasticity

Dep. var. REER var.	(1)	(2)	(3)	(4)	(5)	(6)
	CPI-based REER		$\Delta \ln V_{fikt}$	ULC-based REER		
$\Delta \ln \overline{REER}_{it-1}$	-0.825*** (0.259)	-0.843*** (0.256)	-0.833*** (0.253)	-0.498*** (0.166)	-0.502*** (0.164)	-0.546*** (0.181)
$\Delta \ln \overline{REER}_{it-1} \times Euro_{it}$			-0.626 (0.378)			0.297 (0.441)
$\Delta \ln \overline{D}_{ikt}$	1.205*** (0.186)	1.327*** (0.198)	1.313*** (0.203)	1.240*** (0.192)	1.366*** (0.202)	1.362*** (0.199)
$Euro_{it}$	-0.060* (0.031)	-0.058** (0.029)	-0.021 (0.029)	-0.052 (0.037)	-0.050 (0.033)	-0.065 (0.042)
Observations	8,626	8,626	8,626	8,626	8,626	8,626
R-squared	0.317	0.329	0.329	0.316	0.328	0.328
Country FE	yes	no	no	yes	no	no
Sector FE	yes	no	no	yes	no	no
Country X sector FE	no	yes	yes	no	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. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs of the real exchange rate in t-1 and t-2. Significance levels : *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE : Real effective exchange rate elasticity : current and past REER variations

Dep. var. REER var.	(1)	(2)	(3)	(4)	(5)	(6)
	CPI-based REER		$\Delta \ln V_{fikt}$	ULC-based REER		
$\Delta \ln \overline{REER}_{it}$	-0.167 (0.239)	-0.190 (0.233)	-0.020 (0.266)	-0.126 (0.160)	-0.129 (0.160)	-0.196 (0.175)
$\Delta \ln \overline{REER}_{it-1}$	-0.819*** (0.262)	-0.837*** (0.259)	-0.833*** (0.254)	-0.495*** (0.167)	-0.500*** (0.163)	-0.579*** (0.176)
$\Delta \ln \overline{REER}_{it-1} \times Euro_{it}$			-0.610 (0.442)			0.551 (0.485)
$\Delta \ln \overline{D}_{ikt}$	1.218*** (0.187)	1.345*** (0.200)	1.315*** (0.209)	1.252*** (0.190)	1.380*** (0.201)	1.380*** (0.200)
$Euro_{it}$	-0.063* (0.032)	-0.061** (0.029)	-0.022 (0.036)	-0.051 (0.035)	-0.049 (0.032)	-0.078* (0.044)
Observations	8,626	8,626	8,626	8,626	8,626	8,626
R-squared	0.317	0.329	0.329	0.316	0.328	0.328
Country FE	yes	no	no	yes	no	no
Sector FE	yes	no	no	yes	no	no
Country \times sector FE	no	yes	yes	no	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. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs of the real exchange rate in t-1 and t-2. Significance levels : *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Firm heterogeneity within-country

Methodology : productivity interactions

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

- Define 3 categories of productivity within country and sector identified by a dummy variable P_{kt}^z : $Cat\ 1 = \{1, 2\}$; $Cat\ 2 = \{3, 4, 5, 6, 7, 8\}$; $Cat\ 3 = \{9, 10\}$
- Each variable is interacted with the REER variable
- We obtain 3 coefficients of the impact of REER variations on export revenues, 1 for each category

$$\Delta \ln V_{fikt} = \sum_{z=1}^3 \beta_z \Delta \ln \overline{REER}_{it-1} \times P_{kt}^z + \gamma_1 \Delta \ln \overline{D}_{ikt} + \gamma_1 Euro_{it} \Omega' + \lambda_f + \lambda_i + \lambda_k + \lambda_t + \varepsilon_{fikt} \quad (2)$$

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

Baseline estimation

TABLE : REER elasticity and within-country heterogeneity

Dep. var.	(1)	(2)	(3)	(4)	(5)	(6)
REER var.	CPI-based REER			ULC-based REER		
	$\Delta \ln V_{fikt}$					
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$	-1.321*** (0.287)	-1.345*** (0.284)	-0.930*** (0.269)	-0.907*** (0.318)	-0.877*** (0.319)	-0.833** (0.334)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$	-0.828*** (0.191)	-0.844*** (0.190)	-0.412** (0.181)	-0.524*** (0.145)	-0.524*** (0.145)	-0.418** (0.185)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$	-0.423* (0.216)	-0.440** (0.217)		-0.105 (0.176)	-0.116 (0.175)	
$\Delta \ln \overline{D}_{ikt}$	1.205*** (0.108)	1.326*** (0.115)	1.062*** (0.116)	1.365*** (0.115)	1.239*** (0.108)	1.064*** (0.116)
$Euro_{it}$	-0.060*** (0.018)	-0.058*** (0.018)		-0.050*** (0.019)	-0.052*** (0.019)	
Observations	8,626	8,626	8,626	8,626	8,626	8,626
R-squared	0.318	0.330	0.337	0.329	0.317	0.337
Country FE	yes	no	no	yes	no	no
Sector FE	yes	no	yes	yes	no	yes
Country-sector FE	no	yes	no	no	yes	no
Prod.-class FE	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	no	yes	yes	no
Country-year FE	no	no	yes	no	no	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). Robust standard errors. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs of the real exchange rate in t-1 and t-2. Significance levels : *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Robustness : alternative productivity thresholds

3 categories of productivity P_{kt}^z :

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

TABLE : REER elasticity and within-country heterogeneity : alternative thresholds

Dep. var. REER var.	(1)	(2)	(3)	(4)	(5)	(6)
	CPI-based REER			ULC-based REER		
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$	-1.189*** (0.243)	-1.212*** (0.241)	-0.700*** (0.209)	-0.770*** (0.251)	-0.743*** (0.251)	-0.619** (0.259)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$	-0.833*** (0.207)	-0.852*** (0.205)	-0.319* (0.178)	-0.593*** (0.162)	-0.592*** (0.162)	-0.421** (0.182)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$	-0.516*** (0.199)	-0.528*** (0.199)		-0.164 (0.157)	-0.178 (0.156)	
$\Delta \ln \overline{D}_{ikt}$	1.204*** (0.108)	1.325*** (0.115)	1.061*** (0.116)	1.365*** (0.115)	1.239*** (0.108)	1.064*** (0.116)
$Euro_{it}$	-0.060*** (0.018)	-0.058*** (0.018)		-0.050*** (0.019)	-0.052*** (0.019)	
Observations	8,626	8,626	8,626	8,626	8,626	8,626
R-squared	0.318	0.330	0.337	0.329	0.317	0.337
Country FE	yes	no	no	yes	no	no
Sector FE	yes	no	yes	yes	no	yes
Country-sector FE	no	yes	no	no	yes	no
Prod.-class FE	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	no	yes	yes	no
Country-year FE	no	no	yes	no	no	yes

Robustness : Two-way traders

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

Dep. var. REER var.	(1) CPI-based REER	(2) $\Delta \ln V_{fikt}$	(3) ULC-based REER	(4)
$\Delta \ln \overline{REER}_{it-1}$	-1.395*** (0.376)		-1.436*** (0.386)	
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$		-1.888*** (0.421)		-1.759*** (0.511)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$		-1.080*** (0.388)		-1.144*** (0.388)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$		-0.682 (0.420)		-0.936** (0.457)
$\Delta \ln \overline{REER}_{it-1} \times Sharetwofway_{fikt-1}$	0.623 (0.461)	0.038 (0.481)	1.781*** (0.560)	1.279** (0.600)
$\Delta \ln D_{ikt}$	1.152*** (0.116)	1.123*** (0.116)	1.229*** (0.116)	1.216*** (0.117)
$Euro_{it}$	-0.064*** (0.018)	-0.064*** (0.018)	-0.057*** (0.019)	-0.055*** (0.019)
$twofway_{fikt-1}$	-0.011 (0.023)	0.006 (0.023)	-0.045* (0.024)	-0.031 (0.025)
Observations	7,757	7,757	7,757	7,757
R-squared	0.305	0.307	0.305	0.305
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). Robust standard errors. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs

Robustness : Switchers

TABLE : Real effective exchange rate elasticity : switchers

Dep. var.	(1)	(2)	(3)	(4)
REER var.	CPI-based REER	$\Delta \ln V_{fikt}$	ULC-based REER	
$\Delta \ln \overline{REER}_{t-1}$	-0.800*** (0.192)		-0.402*** (0.146)	
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$		-1.296*** (0.298)		-0.776** (0.330)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$		-0.807*** (0.201)		-0.433*** (0.155)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$		-0.400* (0.223)		-0.027 (0.182)
$\Delta \ln \overline{REER}_{it-1} \times Shareswitch_{fikt-1}$	-2.434 (5.540)	-2.137 (5.515)	-9.319* (5.656)	-8.985 (5.635)
$\Delta \ln \overline{D}_{ikt}$	1.207*** (0.108)	1.206*** (0.107)	1.242*** (0.108)	1.241*** (0.108)
$Euro_{it}$	-0.060*** (0.018)	-0.060*** (0.018)	-0.052*** (0.019)	-0.052*** (0.019)
$Switch_{fikt-1}$	0.053 (0.191)	0.045 (0.190)	0.254 (0.213)	0.249 (0.212)
Observations	8,625	8,625	8,625	8,625
R-squared	0.317	0.318	0.316	0.317
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). Robust standard errors. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs of the real exchange rate in t-1 and t-2. Significance levels : *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Firm heterogeneity within and between countries

Methodology

We now investigate the role of productivity by considering a cross-country distribution of firms' productivity : firms are now ranked according to a productivity distribution based on the 11 countries in sample.

We estimate the following equation :

$$\Delta \ln V_{fikt} = \beta_1 \Delta \ln \overline{REER}_{it-1} + \beta_2 \Delta \ln \overline{REER}_{it-1} \times \ln lprod_{fikt-1} + \beta_3 \ln lprod_{fikt-1} + \gamma_1 \Delta \ln \overline{D}_{ikt} + \gamma_2 Euro_{it} + \lambda_f + \lambda_i + \lambda_k + \lambda_t + \varepsilon_{fikt} \quad (3)$$

Where $\ln lprod_{fikt-1}$ is the firm-level labor productivity. Alternatively, we define , within each sector, 3 productivity categories P_{kt}^m supported by the entire distribution of firms within the EU sample :

$$\Delta \ln V_{fikt} = \sum_{m=1}^3 \beta_m \Delta \ln \overline{REER}_{it-1} \times P_{kt}^m + \beta_5 \ln lprod_{fikt-1} + \gamma_1 \Delta \ln \overline{D}_{ikt} + \gamma_2 Euro_{it} + \lambda_f + \lambda_i + \lambda_k + \lambda_t + \varepsilon_{fikt} \quad (4)$$

Linear productivity interactions

TABLE : REER elasticity : interaction with firm-level productivity

Dep. var. REER var.	(1)	(2)	(3)	(4)	(5)	(6)
	CPI-based REER		$\Delta \ln V_{fikt}$	ULC-based REER		
$\Delta \ln \overline{REER}_{it-1}$	-1.148*** (0.259)	-1.067*** (0.266)		-1.155*** (0.290)	-1.007*** (0.295)	
$\Delta \ln \overline{REER}_{it-1} \times \ln prod_{fikt-1}$	0.154* (0.088)	0.103 (0.092)	0.231** (0.104)	0.282*** (0.101)	0.216** (0.103)	0.235** (0.117)
$\Delta \ln \overline{D}_{ikt}$	1.199*** (0.108)	1.319*** (0.115)	1.060*** (0.117)	1.225*** (0.108)	1.346*** (0.115)	1.059*** (0.117)
$\ln prod_{fikt-1}$	0.005 (0.006)	0.033* (0.018)	0.007 (0.006)	0.002 (0.006)	0.029 (0.018)	0.006 (0.006)
$Euro_{it}$	-0.068*** (0.019)	-0.070*** (0.019)		-0.057*** (0.019)	-0.060*** (0.019)	
Observations	8,625	8,625	8,625	8,625	8,625	8,625
R-squared	0.317	0.330	0.337	0.317	0.329	0.337
Country FE	yes	no	no	yes	no	no
Sector FE	yes	no	yes	yes	no	yes
Country-sector FE	no	yes	no	no	yes	no
Country-year FE	no	no	yes	no	no	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). Robust standard errors. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs of the real exchange rate in t-1 and t-2. Significance levels : *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Productivity groups over the entire population of EU firms

TABLE : REER elasticity : interaction with productivity groups (cross-country distribution)

Dep. var. REER var.	(1)	(2)	(3)	(4)
	CPI-based REER		$\Delta \ln V_{fikt}$	ULC-based REER
$\Delta \ln \overline{REER}_{it-1} \times P1 - lprod_{kt}$	-0.945*** (0.195)	-0.942*** (0.195)	-0.770*** (0.162)	-0.751*** (0.165)
$\Delta \ln \overline{REER}_{it-1} \times P2 - lprod_{kt}$	-0.577*** (0.203)	-0.646*** (0.199)	-0.322** (0.156)	-0.348** (0.155)
$\Delta \ln \overline{REER}_{it-1} \times P3 - lprod_{kt}$	-0.591** (0.268)	-0.676** (0.271)	-0.053 (0.210)	-0.112 (0.216)
$\Delta \ln \overline{D}_{ikt}$	1.246*** (0.107)	1.382*** (0.113)	1.264*** (0.107)	1.398*** (0.113)
$lprod_{fikt-1}$	0.003 (0.006)	0.021 (0.019)	0.002 (0.006)	0.021 (0.019)
Observations	8,625	8,625	8,625	8,625
R-squared	0.316	0.328	0.316	0.328
Country FE	yes	no	yes	no
Sector FE	yes	no	yes	no
Country-sector FE	no	yes	no	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). Robust standard errors. $\Delta \ln \overline{REER}_{it-1}$ is the average of the delta logs of the real exchange rate in t-1 and t-2. Significance levels : *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Aggregation : the role of within-country heterogeneity

Methodology

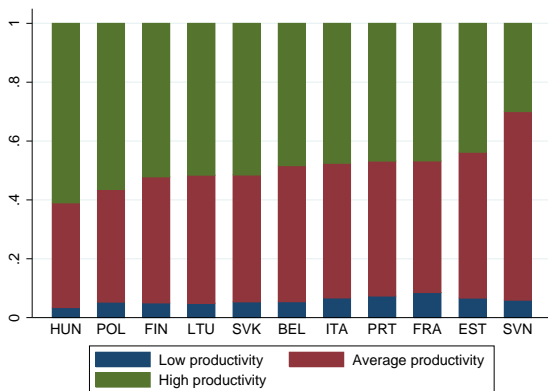
Country-specific microeconomic trade structure has an impact on aggregate elasticities : concentration of exports within sectors

The aggregate elasticity is determined by the weight of firm-type z of sector k in country i 's exports θ_{fik} :

$$\Phi_i = \sum_{k,z=1}^3 \theta_{zik} \times \varepsilon_z$$

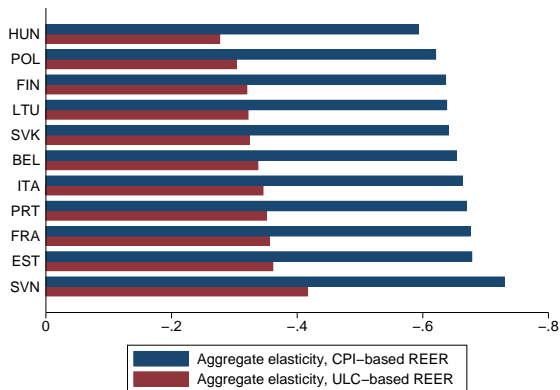
Export concentration

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. CPI-based REER elasticities : $\varepsilon_1 = -1.32$; $\varepsilon_2 = -0.82$; $\varepsilon_3 = -0.42$.
 ULC-based REER elasticities : $\varepsilon_1 = -0.90$; $\varepsilon_2 = -0.52$; $\varepsilon_3 = -0.10$.

Aggregation : the role of within-and-between country heterogeneity

Methodology

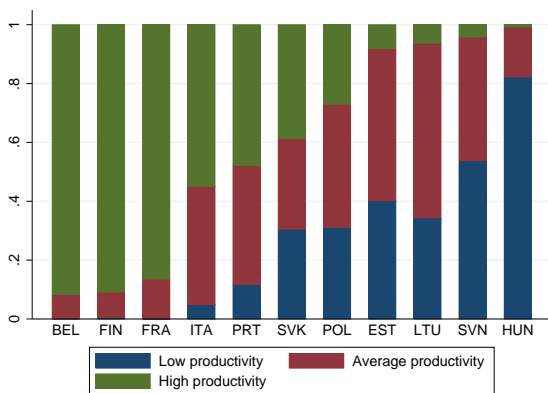
Aggregate elasticity is determined by the weight of firm-type m of sector k in country i 's exports θ_{mik} , where m categories of productivity 1 to 3 are determined by considering the productivity distribution of sector for the whole sample of countries (Within and Across countries micro trade structure).

$$\Psi_i = \sum_{k,m=1}^3 \theta_{mik} \times \varepsilon_m$$

Heterogeneity across countries will be determined by the heterogeneity in the allocation of aggregate exports across firms within countries (like with the previous aggregation), and by differences in the shape of the productivity distribution across countries.

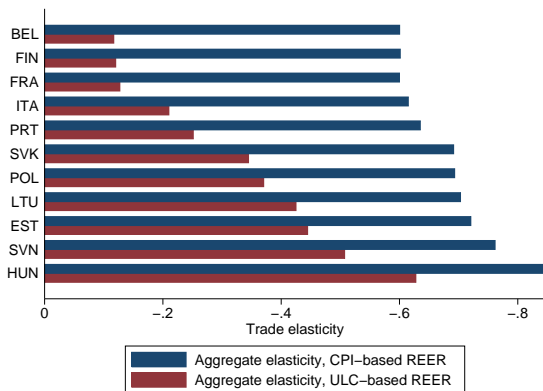
Share of aggregate exports within each productivity category

FIGURE : Distribution of export shares across productivity categories (EU distribution)



Aggregate elasticities : Within and between-country heterogeneity

FIGURE : Aggregate elasticities : Within and across-country heterogeneity



Note : Elasticities taken from the baseline estimation. CPI-based REER : $\varepsilon_1 = -0.9$; $\varepsilon_2 = -0.6$; $\varepsilon_3 = -0.6$. ULC-based REER : $\varepsilon_1 = -0.7$; $\varepsilon_2 = -0.3$; $\varepsilon_3 = -0.1$.

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 -0.5 to about -0.8
- 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
- Cross-country heterogeneity comes from differences in the shape of productivity distributions across firms, rather than from differences in the concentration of aggregate exports among most productive exporters

Real effective exchange rate variations have a larger impact on aggregate exports in countries populated with a higher density of less productive firms, and less impact in countries with high productivity.