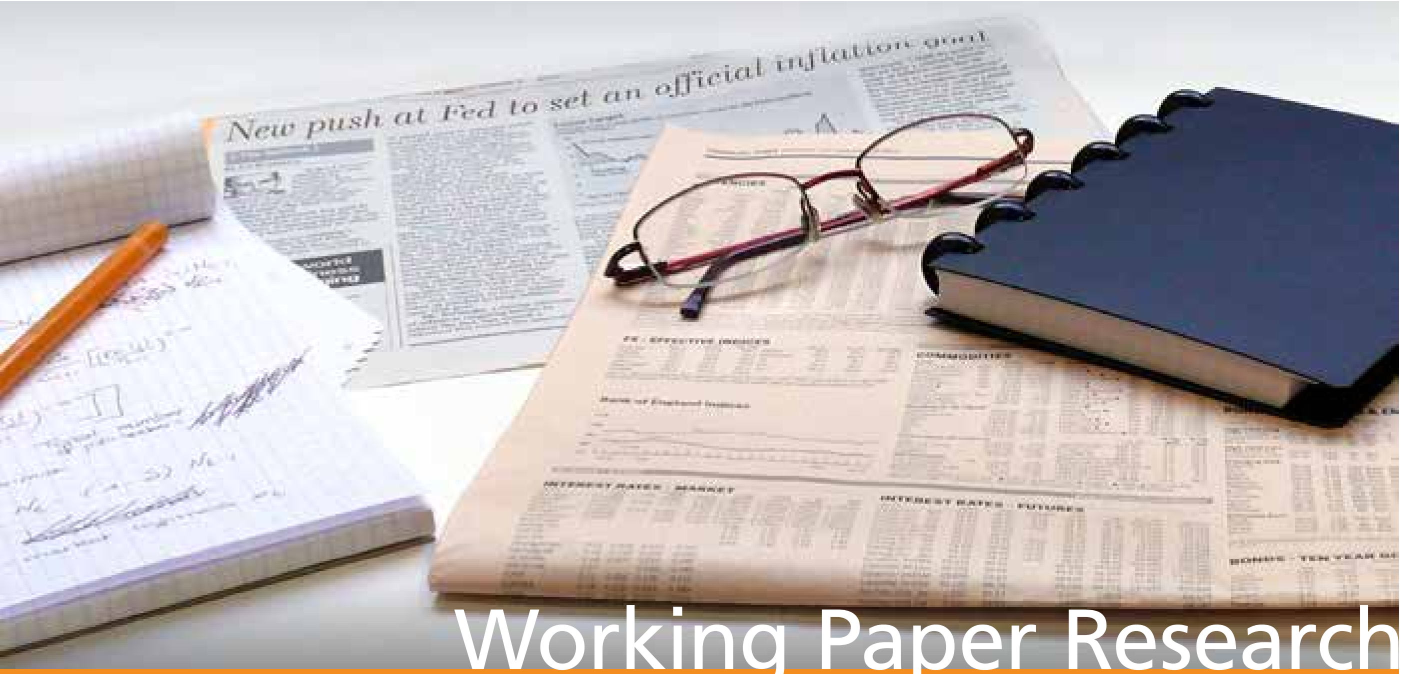
Exchange rate movements, firm-level exports and heterogeneity



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Abstract

This paper provides an estimation of the reaction of firm-level exports consecutive to real exchange rate movements – the exchange rate elasticity of exports. Following recent theoretical works emphasizing the role played by firm heterogeneity, we test in particular how the exchange rate elasticity may be affected by firm-level productivity, and how the heterogeneous reaction of different firms may contribute to shape the aggregate reaction of countries' exports. The analysis relies on a unique cross-country micro-based dataset of exporters available for 11 European countries (2001-2011), which details in particular information about firms' productivity and export performance. Our results show that while the average exchange rate elasticity across firms is quite weak, it is also highly heterogeneous. The least productive firms within each country and sector tend to react more to real exchange rate movements than the most productive firms. This weak reaction of highly productive and large exporters tends to reduce the macroeconomic exchange rate elasticity in all countries. Cross-country differences in the shape of the productivity distribution among exporters have a strong influence on the macroeconomic exchange rate elasticity: countries populated with a higher density of low productive firms tend to respond more to exchange rate movements in terms of aggregate exports than countries populated with highly productive exporters.

JEL classification: F12, F14, F31.

Key words: Firm-level exports, heterogeneity, exchange rates movements.

Authors:

Corresponding author:

Antoine Berthou, Banque de France, 31 rue Croix des Petits Champs, 75001 Paris.
e-mail: antoine.berthou@banque-france.fr

Emannuel Dhyne, Economics and Research Department, National Bank of Belgium, Brussels, Belgium – e-mail: emannuel.dhyne@nbb.be.

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TABLE OF CONTENTS

1 Introduction

The widening of current account imbalances before the Great Recession, and their persistence during the crisis, has been an important source of concern for policy makers (IMF, 2014, 2016). As the process of current account re-balancing requires relative price adjustments in deficit and in surplus economies, the debate regarding the value of the exchange rate elasticity – a key parameter for making any quantitative assessment in macroeconomic models – has also regained interest. Estimations based on macroeconomic time series data have found that aggregate trade volumes tend to respond only weakly to exchange rate movements (Goldstein and Khan, 1985; Hooper et al., 1998).[1] Country-level estimations also conclude that there is a substantial cross-country heterogeneity of this elasticity (Morin and Schwellnus, 2014; IMF, 2015).

Among different factors that may attenuate the reaction of aggregate exports volumes consecutive to exchange rates movements, recent contributions based on heterogenous firms' trade models have emphasized the role played by the incomplete exchange rate pass-through into export prices by large productive firms (Rodriguez-López, 2011; Berman et al., 2012).[2] The implications of this result for the aggregate exchange rate elasticity are twofold. Firstly, at the intensive margin, a greater *concentration* of aggregate exports into more productive firms is expected to attenuate the exchange rate elasticity. Secondly, at the extensive margin, different countries may be impacted differently by real exchange rate movements, due to differences in the shape of productivity *distribution* among the population of exporters. Testing for the relevance of these two channels for cross-country comparisons requires, however, detailed information on the population of exporters located in different countries, and such information is usually not available.

In this paper, we use a unique cross-country micro-based dataset of exporters available for 11 European countries (2001-2011) to investigate how the reaction of firm-level exports to real exchange rate movements may be affected by their productivity level. We then combine the estimated firm-level exchange rate elasticities with information about the microeconomic structure of each country's exports to predict the macroeconomic exchange rate elasticity for each of these countries.[3] While we do not have *direct* access to firm level data, this dataset reports detailed information about firms' activity related to exports by productivity classes (deciles) defined within each country, sector and year. This information allows us to identify in particular, for each country and sector, the distributions of exporters' productivity as well as their export performance (level or growth). To the best of our knowledge, our paper is the first that investigates the role played by productivity heterogeneity, within and between countries, for the determination of the exchange rates elasticity, in a disaggregated multi-country setting.

An important feature of the dataset used in our empirical investigation is that we can observe, for each country, sector, productivity-decile and year, the *average* growth of exports (in log difference)

[1] Estimations relying on firm-level data have confirmed the weakness of the exchange rate elasticity (Fitzgerald and Haller, 2014).

[2] Berman et al. (2012) provide theoretical predictions and empirical evidence of this mechanism in the case of France, as well as a quantification of the aggregate exchange rate elasticity in the case of a single country.

[3] See Berthou et al. (2015) for more details on the dataset.

by firms classified in a specific cell between two consecutive years. Throughout the paper, we will refer to "firms", being a representative business identified by detailed cells in the dataset (country-sector-year and productivity-decile). In our empirical investigations, the exports growth of each firm is explained by real effective exchange rate movements in the exporting country, an indicator of foreign demand, a control for the euro membership, and a set of fixed effects controlling for unobserved country, sector, productivity-class and year characteristics. We consider both real effective exchange rate (REER) variations based on relative unit labor costs (ULC) and consumer price index (CPI) changes, as they reveal different but complementary information regarding changes in production costs and prices. Our sample of 11 countries from "Western" Europe (Belgium, France, Italy, Portugal and Finland) and "Eastern" Europe (Estonia, Hungary, Lithuania, Poland, Slovenia, and Slovakia) with information reported before and during the Great recession up to 2011 offers us a wide variety of shocks and a sufficient variance for identification.

Our estimation results can be summarized as follows. Firstly, the benchmark average microeconomic elasticity obtained from our estimations ranges from about -0.5 (ULC-based REER) to -0.8 (CPI-based-REER): a 10% appreciation of the real effective exchange rate tends to reduce the exports value in euros of the average firm by 5% to 8%. This microeconomic elasticity is in line with different estimations provided in the literature based on firm-level data for different countries such as France (Berman et al., 2012; Fontagné et al., 2017) or Ireland (Fitzgerald and Haller, 2014). Secondly, we find that the reaction of the average firm to REER variations hides substantial heterogeneity within a given sector and country. The elasticity obtained for least productive firms (the bottom 20% of the productivity distribution in each country sector and year) is three times higher than for the most productive firms (the top 20% productive firms) when we consider the CPI-based REER, and eight times higher when we consider the ULC-based REER. These results are robust to alternative estimation techniques and robustness tests: alternative sets of fixed effects, alternative definition of productivity thresholds for exporters, control for the effect of twoway exporters or non-permanent exporters (switchers) or for the effect of the degree of upstreamness of a given country x sector in the global value chains (GVCs). These results are consistent with the empirical findings for France presented in Berman et al. (2012). Thirdly, we confirm the role played by productivity heterogeneity when firms are ranked based on a European distribution of productivity within each sector rather than on a country-specific productivity distribution: the least productive European exporting firms are on average more responsive to exchange rate movements compared with the most productive ones.

These results imply that firm-heterogeneity in terms of productivity matters for the determination of the macroeconomic exchange rate elasticity in each country. Firstly, differences in the *concentration* of aggregate exports into more productive firms across countries matter, as a greater concentration of exports into more productive firms tends to attenuate the reaction of aggregate exports consecutive to REER movements. Secondly, differences in terms of the *distribution* of firms' productivity levels across countries can also have a strong influence, as less productive European firms tend to be more sensitive to REER movements.

To illustrate these two mechanisms, we proceed with an aggregation exercise where we compute two alternative macroeconomic exchange rate elasticities for each country. This quantification exercise, which is based on the firm-level reaction to exchange rate movements allows us to assess which type of heterogeneity matters for cross-country comparisons.

In a first step, we consider only the role played by cross-country differences in terms of the concentration of aggregate exports among top productive firms. The macroeconomic elasticity is defined as a weighted average of the microeconomic elasticities obtained when firms are ranked in terms of productivity within each country and sector. In each country, the very high concentration of aggregate exports into the most productive firms tends to attenuate the reaction of aggregate exports consecutive to REER movements: we obtain an elasticity of about -0.7 when we consider the CPI-based REER, and about -0.3 when we consider the ULC-based REER. However, accounting for the role of within-country heterogeneity in terms of productivity generates only little cross-country differences in terms of macroeconomic exchange rate elasticities, as similar concentration of aggregate exports into top productive firms is observed in all countries of our sample.

In a second step, we account for the cross-country differences in terms of productivity distributions. As more heterogeneity is observed across countries, our quantification exercise generates large differences in terms of the macroeconomic exchange rate elasticity. In this exercise, the CPI-based REER elasticity ranges from -0.7 to -0.9, whereas the ULC-based REER elasticity ranges from -0.1 to -0.7, with Western European countries being less responsive to REER movements, and Eastern European countries more responsive. In estimations based on aggregate trade data for our sample of countries, we confirm that real exchange rate movements have a weaker impact on exports in countries populated with more productive exporters.

Overall, these results imply that while cross-country differences in the aggregate exports concentration among most productive firms are too weak to generate significant heterogeneity in macroeconomic exchange rate elasticities, differences in terms of productivity distributions at the extensive margin play a major role. Real effective exchange rate variations have a large impact on aggregate exports in countries populated with a high density of low productive firms, and a weak impact in countries populated with a small density of low productive firms. This result suggests that relative price changes may have only a weak effect on exports in mature European economies.

Related literature. This paper contributes to the empirical research in international economics that has focused on the estimation of the "trade elasticities", using both macroeconomic or microeconomic data and different empirical strategies. Of particular interest is a key parameter used to calibrate international macroeconomic models, the "Armington elasticity", that determines the substitutability between domestic and foreign goods.

Different empirical strategies have been used in the literature to estimate the price elasticity of domestic relative to foreign goods. These estimations, based on variations of trade prices, tariffs applied on foreign imports, or exchange rates, have produced both small and large elasticities. This generates a great uncertainty for the calibration of macroeconomic models, which is referred to as the "international elasticity puzzle" (Ruhl, 2008).[4] On the one hand, structural estimations of the price

[4]How the estimated parameters map the Armington elasticity, however, critically depends on the model's assump-

elasticity of demand (Feenstra, 1994; Simonovska and Waugh, 2014; Imbs and Mejean, 2015, 2016), as well as firm-level reduced-form estimation of the price elasticity of exports (Fontagné et al., 2017) or reduced-form estimations based on differences in tariffs applied on foreign imports (Buono and Lalanne, 2012; Fitzgerald and Haller, 2014; Caliendo and Parro, 2015; Bas et al., 2015; Berthou and Fontagné, 2016) have obtained quite large numbers (often -5 on average or even larger).[5] On the other hand, and as discussed above, estimations relying on exchange rate fluctuations typically provide small values for the exchange rate elasticity in aggregate or disaggregated trade data (Bussière et al., 2016), or when micro firm-level data are used (Berman et al., 2012; Chatterjee et al., 2013; Fitzgerald and Haller, 2014; Li et al., 2015).[6] Berman et al. (2012) and Li et al. (2015) show in the cases of France and China respectively that exports by highly productive firms tend to respond less to exchange rate fluctuations than exports by low productive firms.

Previous empirical work has shown that the supply conditions in the exporting country may modify the reaction of aggregate exports consecutive to exchange rate movements. There is for instance an important role played by frictions in labor or capital markets (Berman and Berthou, 2009). Other works have emphasized different reasons why aggregate exports and exchange rates might be disconnected. They highlight the role of trade costs (Berthou, 2008), firm-level adjustment costs that tend to generate a weak elasticity in the short run (Alessandria et al., 2014), firm-level imports which provide a natural hedging to exporters against exchange rate fluctuations (Amiti et al., 2014), firm selection into different export markets (Bas et al., 2015), specialization due to cross-industry heterogeneity in terms of the price elasticity of demand (Imbs and Mejean, 2016), or the aggregation bias which generates a wedge between estimations of the price elasticity based on aggregated or disaggregated trade data (Imbs and Mejean, 2015). Our paper instead measures the role played by the underlying microeconomic structure of exports, and in particular the role played by exports concentration and differences across countries in terms of the shape of the firm-level productivity distribution. To the best of our knowledge, only our dataset allows to identify the role of these factors, as this requires measuring the productivity of exporters for several countries, and this information is usually not available.

Standard heterogeneous firms trade models such as Melitz (2003) or Chaney (2008) with monopolistic competition, CES preferences and ad-valorem trade costs do not allow for an heterogeneous response of exporters consecutive to changes in exchange rates. Different reactions by firms requires different pricing strategies, which is possible when exchange rates also modify firm-level markups, as in the frameworks developed by Rodriguez-López (2011) with a translog demand system, or by

tions. Most of the papers in this literature on trade elasticities rely on theoretical frameworks assuming a constant elasticity of substitution (C.E.S.) between varieties. For instance, Feenstra et al. (2014) rely on a nested C.E.S. preference structure, allowing a combination of a *micro* elasticity between different varieties of a foreign good, and a *macro* elasticity between home and foreign goods. The uncertainty regarding the calibration of the Armington elasticity has been acknowledged by the international business cycles literature, which shows that the choice of the parameter can have dramatic consequences on the outcome of a simulation (Corsetti et al., 2008; Bodenstein, 2010; Drozd et al., 2014).

[5] Such parameters have been used f.i. to simulate the gains from trade liberalization in general equilibrium models (Arkolakis et al., 2012).

[6] Different papers have investigated the role of nominal exchange rate volatility and shown that it tends to reduce firm-level exports (Héricourt and Poncet, 2015)

Berman et al. (2012) using market specific distribution cost combined with a CES demand system, or a linear demand system as in Melitz and Ottaviano (2008). In their model, highly productive exporters absorb part of the exchange rate variation by changing the export price expressed in the exporter's currency (leaving the export price in the importer's currency unchanged), which limits the reaction of export volumes.[7] Our results confirm that productivity plays an important role in determining the microeconomic response of exporters consecutive to exchange rate movements, and that this result has important implications for assessing the effect of exchange rate movements on aggregate exports in different countries.

While the focus of our paper is mostly on the variation of firm-level exports (the intensive margin), different works have emphasized the role played by firms' entry and exit in aggregate exports and shown that this channel only represent a small fraction of aggregate exports growth in the short run (Eaton et al., 2007). In an aggregation exercise, Berman et al. (2012) show that the extensive margin contributes to about 10% of the reaction of aggregate exports consecutive to exchange rate movement in the long run. Pappadà (2011) or di Mauro and Pappadà (2014) show that the contribution of the extensive margin depends on the shape of the distribution of firm-level productivity within each country.[8] In the last part of the paper, we show that the number of exporters in each country is also affected by exchange rate movements, especially in European countries where exporters tend to be less productive.

Outline. The paper is organised as follows. Section 2 presents the data used in the analysis as well as descriptive statistics. Section 3 reports the estimation results for the average exchange rate elasticity of exports among European exporters. Section 4 presents estimation results highlighting the role played by productivity heterogeneity within each country. Section 5 presents results when different productivity distributions are allowed in different countries, and exporters are ranked on a European productivity scale. Section 6 details our aggregation exercise. Finally, section 7 concludes.

2 Data and descriptive statistics.

Three data sources are used in our empirical investigations: a firm-level exports and productivity dataset (CompNet), a country-level real effective exchange rate (REER) dataset, and bilateral trade dataset reported for each country pair and sector.[9]

The CompNet dataset. Firm-level information is based on the CompNet dataset, which was produced by the Competitiveness Research Network. We used mainly the "trade module" of the

[7] Empirical evidence of the lack of exchange rate pass-through into import prices and theoretical explanations are provided in the Handbook chapter by Burstein and Gopinath (2014). Incomplete exchange rates pass-through can be obtained in models with Bertrand competition (Atkeson and Burstein, 2008) or local distribution costs (Corsetti and Dedola, 2005). Gopinath et al. (2010), Casas et al. (2016) or Boz et al. (2017) explore the role played by nominal rigidities related to the choice of currency pricing and in particular US dollar pricing of import contracts.

[8] In these two papers the productivity distribution is based on the full sample of firms in each country, whereas we focus on the population of exporters

[9] By firm level, we refer to various moments of the distribution of a set of variables observed at firm level data in eleven European countries aggregated at the country - sector - productivity decile as mentioned in the introduction.

dataset, which provides information about the export performance of firms located in different European countries, sectors and productivity or size classes.[10] The Compnet dataset does not report micro-data at firm-level per se, but the statistical moments (average, variance, deciles etc.) calculated for a large set of variables of interest for firms located in different countries and operating within different sectors. This strategy allows to bypass the confidentiality rules that apply in each country. In our analysis, we will rely on "representative firms" within each country and sector: 10 representative firms based on 10 productivity deciles for which we have information on export performance. To ensure the greatest possible comparability of the computed indicators across countries, a common STATA do-file was circulated to each participating team to compute the set of variables of interest. Up to 17 countries are represented in the CompNet dataset, depending on the type of indicator considered.

As discussed above, most of the analysis presented in this paper relies on the "trade module" of the CompNet dataset, which is available for 11 countries and 22 manufacturing sectors (NACE 2-digits, revision 2) over the period 2001-2011. In this module, information about the representative firms' activity is reported within cells characterized by a country, a sector, and a productivity decile (based on the apparent productivity of labor of firms). Each cell contains different moments of firm-level export variables. Our main variable of interest is the average of the log variation of firm-level exports between to consecutive years (t and t-1), which is defined by country of origin, sector and productivity class. In the analysis, variable V_{fikt} represents the total value of the firm's exports expressed in euros, f is the firm type corresponding to a productivity decile, i is the country of origin, k is the sector, t is the year. In each country×sector, we therefore have information about 10 representative firms every year. Importantly, the log variation of firm-level exports $\Delta \ln V_{fikt}$ was computed from the raw data at the firm-level, and then averaged within each country-sector-productivity triplet, which ensures that the average growth rate of exports of the representative firm is not affected by composition effects due to entry into or exit from the export market. In the rest of the analysis, a "firm" will refer to one of the representative businesses that is observed in our dataset.

Some restrictions in this data need to be highlighted. Firstly, we based our analysis on the CompNet data files relying on firms with 20 employees or more. This ensures more comparability across countries, as different reporting thresholds may apply. Secondly, while we observe the country of origin (location) and sector of the firm, we do not observe in this dataset the destination of the exportation or the product exported. The information about the countries of origin of the representative firms, however, will offer us enough variance for the identification of the impact of real effective exchange rate variations on exports. We will be able in particular to assess with this information whether the microeconomic structure of exports matters for the determination of the aggregate exchange rate elasticity.

Real effective exchange rates. Real effective exchange rates are obtained from the Bruegel

[10] More information on the dataset can be found on the research network's webpage, http://www.comp-net.org/. The network has prepared several descriptive and methodological papers on the creation and structure of the database. See Lopez-Garcia et al. (2015) for a general description and Berthou et al. (2015) for a description of the trade variables within the dataset

REER database (Darvas, 2012). Two different REER variables are used: one based on Consumer Price Indices (CPI) and one based on Unit Labor Costs (ULC). CPI based REER are annual and computed using a broad index of 172 trading partners. ULC based REER is calculated against 30 trading partners for manufacturing sectors only. As ULC REER data is reported at a quarterly frequency in the Bruegel database, we use only the first quarter data of each year to compute the yearly REER growth rate. We will use both REERs, in turn, in order to check the sensitivity of our results to measurement issues. Different results for the ULC-based REER and the CPI-based REER elasticities will also be informative, as the ULC-based REER refers to costs which may be imperfectly passed through prices.

Foreign demand. Finally, controls for foreign demand in the export equation are computed based on the foreign absorption in trade partners, i.e. foreign imports and production minus exports. The foreign demand variable D_{ikt} is computed based on information reported at the 2-digits sector level (NACE revision 2) in the World Input Output Database (WIOD, see Timmer et al. (2015)). We construct the demand shifters as $D_{ikt} = \sum_{j \neq i} \frac{V_{ijkt0}}{V_{ikt0}} (Y_{jkt} + M_{jkt} - X_{jkt})$, where V_{ijkt} are bilateral exports from country i to country j in sector k at time t, V_{ikt} are total export of country i in sector k, Y_{jkt} is the production by country j in sector k, M_{jkt} are total imports of country j in sector k, and X_{jkt} are the total exports of country j in sector k. The weights are computed over the years 1998-2000, i.e. before the period of the analysis, to avoid endogeneity problems.

The main explanatory variables (the firm-level exports, the real effective exchange rate, and the foreign demand addressed to domestic producers) are expressed in log variation between two consecutive years (t/t-1): $\Delta \ln Z_t = \ln Z_t - \ln Z_{t-1}$, with Z being one of the variables of interest. To reduce the noise associated with the measurement of the yearly variations of the real effective exchange rate and foreign demand between two consecutive years, we will use the average of the variations in years t and t-1 : $\Delta \ln \overline{Z}_t = \frac{1}{2}(\Delta \ln Z_t + \Delta \ln Z_{t-1})$.

Descriptive statistics. Table 1 reports the mean and standard deviations of the main variables of interest that are used in the analysis. Over the period of the analysis (2001-2011), a strong heterogeneity can be observed among the set of Eastern European countries and Western European countries in terms of real effective exchange rates variations. Countries such as Slovakia suffered indeed from a stronger real effective appreciation over the whole period on average (about 6% per year) compared with countries such as Finland, Poland or Portugal, which had no real appreciation *on average*. Eastern European countries experienced a more rapid exports growth, presumably due to a more rapid productivity growth, compared with Western European countries during the period of the analysis (2001-2011).

The four charts reported in Figures 1 and 2 also highlight that different shocks to the real effective exchange rate can be exploited in the analysis for identification: most European countries appreciated in real terms before the crisis that started in 2008/2009, although at different speeds. Conversely, the crisis period was characterized by a real depreciation among the economies in our sample, though with some heterogeneity again: for example, the real effective exchange rate of Slovakia stabilized after the start of the crisis, whereas Poland was able to depreciate thanks to the flexibility of the exchange rate vis-à-vis eurozone countries.

Empirical challenges. The empirical strategy that will be presented in details in the next section will account for mainly two empirical challenges associated with the identification of the impact of real effective exchange rate variations on exports. Firstly, country and sector, or country times sector fixed effects will be controlled for in our estimated export equation in order to control for the role played by different productivity trends across the set of countries in our sample (i.e. Eastern versus Western European countries). The higher productivity growth observed in the East during the period of the analysis could indeed be correlated with the real effective exchange rate (due for instance to a Balassa-Samuelson effect), which would generate a biased estimation of the impact of the real effective exchange rate on exports. Secondly, time dummies will control for the general trend on the real effective exchange rate before and after the crisis. All the identification will therefore be obtained thanks to the divergence across countries in terms of the real effective exchange rate variation at each date.

3 The average response of firm-level exports.

3.1 Empirical methodology.

We start by providing an estimation of the average response of European exporters, consecutive to real effective exchange rates movements. To do so, we estimate Equation 1 below. This type of firm-level export equation is now standard in empirical trade studies using firm-level data (see for instance Fitzgerald and Haller (2014)). For these estimations, we will use both measures of the real effective exchange rate based on relative Unit Labor Costs (ULC) across countries or Consumer Price Indexes (CPI). The main variable of interest is the variation of the REER variable in t-1 (we will consider in a robustness check both the REER variations in the current year and with one lag). As we control for country, sector, firm-type fixed effects as well as year dummies, all the remaining information used for the estimation comes from the variance across all these dimensions (i.e. across countries-and-sectors-and-firms).

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

In this equation, and as discussed in the data section, $\Delta \ln V_{fikt}$ is the yearly variation of the firm's total exports (firm productivity type f, country i, sector k, year t). $\Delta \ln \overline{REER}_{it-1}$ is the variation of the real exchange rate lagged one year. $\Delta \ln \overline{D}_{ikt}$ is the variation of foreign demand. $Euro_{it}$ is a dummy variable controlling for the Euro membership. λ_f, λ_i, λ_k and λ_t are firm-type, country, sector and year fixed effects, respectively and ε_{fikt} is an error term clustered by country and year. Alternatively, we also consider a country×sector fixed effect instead of country and sector fixed effects taken separately. Finally, we will introduce an interaction term with the euro membership in one of our specifications, to test whether being a member of the eurozone can modify the exchange rate elasticity.

3.2 Estimation results.

The baseline estimation results are reported in Table 2. In the first three columns (1 to 3), the real effective exchange rates variation is based on relative CPI variations, whereas in columns 4 to 6, the real effective exchange rate variations are based on relative ULC changes. The estimation also controls for changes in the foreign demand addressed to home exporters, for a euro dummy variable, as well as for an interaction term between the REER variable and the euro dummy in specifications 3 and 6.

Estimation results confirm that REER movements affect firm-level exports performance in the expected direction: the exchange rate elasticity for the average firm in our sample ranges from about -0.5 (ULC-based REER) to -0.8 (CPI-based REER), which implies that a 10% appreciation of the REER tends to reduce firm-level exports by 5% to 8%. This result is robust to the different specifications presented in Table 2 where we test our main specification with different sets of fixed effects and controls.

We also find that an increase in foreign demand boosts export revenues as expected, with an elasticity slightly above unity and very stable across the various specifications. Being a euro country does not affect significantly firm-level exports growth when we control for all the fixed effects included in our specification, and non-euro countries do not react differently to REER movements compared with euro countries.

As the exchange rate elasticity may be different in the short or medium run, we proceed to a robustness estimation where we consider now both REER variations in the current year (t) and with one lag (t-1). Estimation results presented in Table 3 show that while REER variations tend to have no significant effect on the average firm-level exports in the short run (t), more sizeable effect is identified in the medium-run (t-1). These results confirm that the impact of exchange rate variations on export volumes may amplify over time (Ruhl, 2008; Alessandria et al., 2014).

4 Firm heterogeneity within-country.

4.1 Empirical methodology.

We now exploit the information contained in our dataset related to the productivity level of firms within each country, sector and year. Starting from the information stratified by productivity deciles, we created three productivity groups within each country and sector, which are identified by three productivity-class dummy variables. These three productivity groups of firms are identified as follows : P^z_{kt} : $Cat\ 1 = \{1, 2\}$; $Cat\ 2 = \{3, 4, 5, 6, 7, 8\}$; $Cat\ 3 = \{9, 10\}$. Category 1 corresponds to the bottom 20% of firms in terms of productivity in a given country, sector and year; category 3 corresponds to the top 20%; category 2 corresponds to the rest of firms with an intermediate productivity level (identifying 60% of the firms).

Each of these dummies is interacted with the REER variable. We obtain three coefficients that allow us to identify the impact of REER variations on export revenues. Our main specification is detailed in Equation 2:

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

Alternative sets of fixed effects are used to test the robustness of our estimations. In one specification, we use country-year dummies (λ_{it}), so that the effect of REER variations on exports is identified in this case *relative to* the reference group of firms, which will be the category of the most productive firms (the REER variable will be absorbed by the country-year fixed effects).

4.2 Estimation results.

Table 4 reports the results of the estimation of Equation 2, when the CPI-REER (columns 1 to 3) or the ULC-based REER (columns 4 to 6) is used. In each column, we obtain 3 elasticities, each corresponding to a specific productivity group (2 elasticities in columns 3 and 6 when country-year dummies are included). The results indicate that less productive firms tend to react more to REER changes compared with highly productive firms. For instance, the bottom 20% of firms in terms of productivity have an elasticity of about -1.3 when we consider the CPI-based REER (column 2) or -0.8 with the ULC-based REER (column 5), whereas the elasticity obtained for the 20% most productive firms in each country and sector is respectively -0.4 and -0.1, and the effect is insignificant in both cases. These results are not driven by our specific sample of countries or sectors, and they are robust to the exclusion of any given country or sector from our sample.[11]

Including country-year dummies in the estimation allows controlling for unobserved country-specific effects. In this case, all the identification is based on the heterogeneous response of exporters to REER movements, and the category of the most productive firms is omitted and serves as the reference category. Results reported in columns 3 and 6 confirm our previous results: the least productive firms in each country and sector are much more responsive to REER movements than most productive and average productive firms.

Overall, our results show that there exists a considerable heterogeneity in REER elasticity across firms. The least productive firms react up to eight times more than the most productive firms in a country and sector (i.e. comparing to very similar firms except productivity), consecutive to REER variations. The results also show that this heterogeneity is far from being a linear function of productivity. Rather, there is a considerable difference between the least productive firms and the rest of the firms within each sector.

[11] These robustness checks are not included in the paper but are avaiable on request.

4.3 Robustness analysis.

Alternative thresholds. As the results presented above may be subject to different biases related to the definition of the firm productivity categories, we report in this section the results from robustness tests where we consider three categories of firms' productivity within each country and sector, but with different thresholds as compared with the baseline exercise: the category of low productive firms is now defined as the bottom 30% of firms in terms of productivity, whereas the category of high productive firms is now defined as the top 30% of the distribution. We therefore have three new dummy variables P^z_{kt} defined as follows: $Cat\ 1 = \{1, 2, 3\}$; $Cat\ 2 = \{4, 5, 6, 7\}$; $Cat\ 3 = \{8, 9, 10\}$.

The estimation results are reported in Table 5. They confirm that the effect of real exchange rate movements is closely linked to the level of the firm's productivity within a country and sector, as less productive firms tend to react more compared with highly productive firms. In these estimations, the top 30% of firms in terms of productivity is now sensitive to CPI-based REER movements, whereas the elasticity for the top 20% was not significant.

The role of imports. In a second robustness test, we control for the role played by imports. As emphasized by Amiti et al. (2014), importing allows exporters to hedge against exchange rate fluctuations, as the cost of their inputs declines when the exchange rate appreciates. This implies that the effect of REER movements may be partly attenuated due to the fact that some of the firms in our sample, and in particular the most productive ones, operate in international markets both as an exporter and as an importer.

To control for this particular channel, we construct a proxy for the import behavior within each country sector and year. Our micro-based cross-country dataset reports information regarding the percentage of the population of exporters in each cell which also imports. We control for this variable in our main specification, and interact it with the REER variable.

Estimation results are reported in Table 6. A first important finding is that the baseline elasticity for the average firm is reinforced by this control (columns 1 and 3): the CPI-based and ULC-based REER elasticities are now similar and close to -1.4, against about -0.8 and -0.5 respectively in our baseline estimation. This result emphasizes the important role played by the firm-level import status, which provides exporters with an implicit hedging against exchange rate fluctuations, and attenuates the exchange rate elasticity on the export side.

To test for the robustness of our main estimation results based on the role of heterogeneity, we introduce in the estimated equation three interaction terms between productivity dummies and the REER. The estimation is therefore similar to Equation 2, but we now have in addition an interaction term between REER movements and the share of exporters. We obtain for each productivity category much larger elasticities compared with our baseline estimations: they are close to -1.9 (CPI-based REER) or -1.7 (ULC-based REER) for the last productive firms. These estimates are indeed closer to those provided based on import tariff variations. The main result however remains valid: the least productive firms are much more sensitive to REER movements than the most productive ones (about 3 times more with the CPI-based REER, and about 2 times more with the ULC-based REER).

Volatility of the export status. An other source of heterogeneity of the firms' response consecutive to REER movements could also be that the least productive firms are in general more volatile in terms of exports growth compared with other firms. The literature in international trade has indeed provided evidence that less productive, smaller, younger exporters tend to grow more rapidly in export markets, but they have as well a smaller probability of survival (Berthou and Vicard, 2015). Therefore, the greater REER elasticity among the least productive firms could be related to the fact that these firms have in general higher growth rates in absolute value.

To control for the role played by this potential channel, we use the information contained in the trade module of the CompNet dataset, which reports in particular the percentage of "switchers" within each cell, i.e. the percentage of firms not being listed as "permanent" exporters over three consecutive years. This control is then interacted with the REER variable, as in the previous exercise.

Estimation results are reported in Table 7. These estimations indicate that, as expected, a higher proportion of switchers tends to reinforce the effect of exchange rates on firm-level exports growth. But, overall, the main results remain qualitatively and quantitatively unchanged.

The position in the Global Value Chains. The firms' reponse to REER movements may also be related to their position in global value chains. Firms specialized in more upstream activities may react differently from more downstream firms (see f.i. Riad et al. (2012)). If the position occupied in the GVC may be related to productivity, with countries x sectors with a large fraction of less productive firms specializing for instance in more upstream activities, this dimension may also affect our results. To control for the position of each sector x country pair in the global value chains, we computed the upstreamness measure proposed in (Fally, 2011) and in (Antras et al., 2012).

We compute this indicator using the annual World Input-Output provided by WIOD. Based on this data, the most upstream sector in 2011 was the Finish manufacture of "computer, electronics and optical products", while the most downstream was the French manufacture of "Leather and Related Products". We introduced this variable in our Equation 2 interacting the demeaned upstreamness with the REER variation variable. The upstreamness is also introduced directly in our Equation 2.

Estimation results are reported in Table 8. The results obtained point to a negative impact of sectoral upstreamness on the REER export elasticity but this impact is not significant. Overall, the main results are unaffected by this additional control.

5 Firm heterogeneity within and between countries.

5.1 Empirical methodology.

How does cross-country heterogeneity in terms of productivity distribution matters for the reaction of home firms' exports consecutive to REER movements? So far, we have considered productivity heterogeneity *within* countries only, without considering productivity differences across firms operating in the same sector, but located in different countries. In reality, firms operate and compete in integrated markets, so that the high productive firms in one country may be compared with firms being highly productive in their country, but less so when compared with foreign competitors. Rather than comparing firms based on a country-specific distribution of productivity, it is therefore possible to consider a cross-country productivity distribution for firms operating in a given sector, e.g. the productivity distribution of European car makers, where firms can be ranked without referring to their country of origin.

In order to test for the role played by firm heterogeneity in a cross-country setting, we now define three categories of firms' productivity within sector and year, corresponding to the bottom 33% (low productive firms), the top 33% (high productive firms) and the intermediate productivity category (average productivity firms). The productivity dummies associated with these categories are then interacted with the REER variables.

We firstly estimate the following equation where the REER variable is simply interacted with the labor productivity of each firm:

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

Where $ln\ lprod_{fikt-1}$ is the firm-level labor productivity lagged one year, calculated as the real value-added over labor employed. Alternatively, we define within each sector, three productivity categories P^m_{kt} supported by the entire distribution of firms within the EU sample:

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

5.2 Estimation results.

Table 9 reports the estimation results when the REER variable is interacted with the productivity level of the firm. The interaction term between the real effective exchange rate and the lagged productivity is positive, meaning that less productive European firms tend to react more to REER changes compared with more productive European businesses. We obtain a similar finding with both the CPI-based REER and the ULC-based REER.

We complete this estimation with an alternative specification where productivity dummies identifying productivity groups among European firms are interacted with the REER variable. Estimation results reported in Table 10 confirm the previous findings: the most productive European firms are almost unresponsive to REER movements in all specifications, whereas the 33% least productive European exporters in a given sector are conversely quite sensitive to REER movements.

6 Aggregation.

The estimation results obtained so far have several implications for the elasticity of country-level exports vis-à-vis real exchange rate fluctuations in the short and medium term. Firstly, a greater *concentration* of aggregate exports into the most productive firms is expected to reduce the macroeconomic exchange rate elasticity. Secondly, cross-country differences in terms of the shape of the productivity *distribution* among exporters are expected to modify the macroeconomic exchange rate elasticity as well.

In order to assess quantitatively the importance of these two channels, we present in this section a back-of-the-envelope aggregation exercise where the macroeconomic exchange rate elasticity is computed for each country as a weighted average of the microeconomic elasticities obtained for each productivity category. We will firstly consider the effect of differences in terms of export concentration across countries (i.e. the role of allocation at the intensive margin), and then allow for differences in terms of the productivity distributions across countries (an extensive margin channel).

6.1 Cross-country differences in terms of export concentration.

We start by considering only the productivity differences within each country, which allows us to explore specifically the effect of export concentration. We compute the macroeconomic exchange rate elasticity as a weighted average of the microeconomic elasticities reported in Table 4, where each microeconomic elasticity is a coefficient, and the weights correspond to the share of each firm-type z of sector k in country i's total exports θ_{zik}. The macroeconomic exchange rate elasticity is calculated as follows:

$$\Phi_i = \sum_{k,z=1}^{3} \theta_{zik} \times \varepsilon_z \tag{5}$$

Figure 3 reports the distribution of the export shares for each country in our sample. The key finding here is that, while some heterogeneity exists between countries, a great majority of total exports in each country is made by the top 20% firms in terms of productivity. This implies that these firms will account disproportionately for the aggregate reaction of exports following REER movements, at least in the short or medium term.

The aggregate elasticities computed for each individual country are provided in Figure 4. A first striking result is that CPI-based REER elasticities are about twice as large as ULC-based REER elasticities after aggregation, which reflects differences based on microeconomic estimates. This result can be explained by an incomplete pass-through of cost changes into prices. A second finding is that while some heterogeneity exists between countries due to differences in the concentration rate of exports among highly productive firms, this heterogeneity does not generate quantitatively important cross-country differences. ULC-based REER elasticities are estimated between -0.3 and -0.4 in each country, whereas CPI-based REER elasticities range between -0.6 and -0.7. Hence, while the concentration of aggregate exports into highly productive firms tends to attenuate the macroeconomic REER elasticity in each country, we end-up with only weak cross-country differences.

6.2 Cross-country differences in terms of productivity distributions.

We now consider cross-country heterogeneity in terms of the distribution of exporters' productivity. The macroeconomic exchange rate elasticity is now determined using the weight of firm-type m of sector k in country i's total exports (θ_{mik}). The allocation of firms into productivity categories $m = \{1, 2, 3\}$ is determined by the ranking of each firm vis-à-vis all firms that operate in the same sector, irrespective of their country of origin (i.e. considering all European firms in-sample operating in the same sector). The macroeconomic exchange rate elasticity accounting for cross-country differences in terms of the productivity distribution is calculated as follow:

$$\Psi_i = \sum_{k,m=1}^{3} \theta_{mik} \times \varepsilon_m \tag{6}$$

The weights reported in Figure 5 suggest that there exists a great heterogeneity in terms of the microeconomic structure of countries' exports. In countries such as Finland, Belgium and France, a large majority of exports is made by firms being ranked as highly productive at the European level, whereas the reverse is true for Hungary, Slovenia or Estonia where firms are rather ranked into low or average productive European exporters.

The aggregation exercise presented in Figure 6 confirms the importance of accounting for the cross-country heterogeneity related to productivity distribution. There is now more heterogeneity between countries, with the aggregate exchange rate elasticity ranging from -0.7 to -0.9 (CPI-based REER) or -0.1 to -0.7 (ULC-based REER). In Finland, Belgium and France, as aggregate exports are concentrated among highly productive European firms, the sensitivity of aggregate exports to REER changes is reduced. On the other hand, Lithuania, Slovenia and Hungary appear as much more sensitive to REER movements, as the export sector is concentrated among weakly productive European firms.

6.3 Aggregate trade margins decomposition.

So far the analysis focused on the response of aggregate exports to exchange rate movements through the intensive margin of exports (i.e. the exports growth of incumbent exporters). We have, however, ignored the response at the extensive margin through the net entry of exporters.

To explore the relative contributions of these two margins, we make use of a different file of the CompNet trade data reporting, for each country and sector, the total value of exports as well as the number of exporters (being restricted to firms with more than 20 employees). Using this information, we decompose the total value of exports of country i in sector k (X_{ikt}) into a number of exporters (N_{ikt}) and the average value of exports per firm ($\overline{x}_{ikt}$). Taking logs and first-differentiating, the yearly aggregate exports growth in a country and sector can be decomposed as the sum of the growth of the number of exporters and the average value of exports per firm : $\Delta \ln X_{ikt} = \Delta \ln N_{ikt} + \Delta \ln \overline{x}_{ikt}$.

We use this decomposition to assess the effect of exchange rate movements on the margins of aggregate exports. We proceed in a similar fashion as with the firm-level estimations, and estimate Equation 7 using the growth of aggregate exports as the dependent variable, and then the number of exporters or the average value of exports per firm.

$$\Delta \ln X_{ikt} = \beta \Delta \ln REER_{it} + \gamma_1 \Delta \ln D_{ikt} + \gamma_2 Euro_{it} + \lambda_i + \lambda_k + \lambda_t + \varepsilon_{fikt} \quad (7)$$

Estimation results are reported in Table 11. The results show that the variation of the CPI-based REER and the ULC-based REER have slightly similar effects on aggregate exports: a 10% depreciation of the REER increases aggregate exports by about 5%. According to our estimations, about half of the effect is explained by the net entry of exporters, while the remaining effect comes from the contribution of the average value of exports per firm. Note, however, that the contribution of the average value of exports per firm is attenuated due to the presumably small size of new entrants.

We complete our investigation by testing for the role of the productivity of exporters for aggregate exports. To do so, we use information contained in the CompNet data about the productivity of exporters and their ranking on a cross-country scale. We define a new variable, Top exporters$_{it}$, to identify countries having firms ranked in the top 10% of the cross-country productivity distribution of exporters. More precisely, Top exporters$_{it}$ is a dummy variable which takes the value 1 when country i has exporters ranked among the top 10% of exporters in terms of productivity in at least one sector among the sample of 11 countries, and 0 otherwise. This variable is then interacted with the REER variable.

Estimation results are reported in Table 12. The estimation results confirm the results from previous estimations performed at the firm-level. We obtain a negative coefficient on the REER variable in all estimations, but a positive coefficient on the interaction term, meaning that aggregate exports tend to respond less to real exchange rate movements in countries populated with highly productive exporters. For instance, the estimation results from the first column with the CPI-based REER indicate that a 10% real exchange rate depreciation would increase aggregate exports by about 12% in countries populated with weakly productive exporters (this is the coefficient on the REER variable in column 1), against about 2% in European countries populated with highly productive exporters (this quantification is obtained by summing the coefficients on the REER variable and the interaction term in column 1). Similar result is obtained with the ULC-based REER.

Interestingly, the results reported in columns (2) and (5) show that the productivity distribution of exporters matters also at the extensive margin: real exchange rate movements have a weaker impact on the number of exporters in countries having highly productive exporters. This result can be explained by the fact that, controlling for other factors such as countries' geographical size, many firms already export in highly productive countries, so that there is less opportunities for new entries.

Finally, the estimation results at the intensive margin (columns 3 and 6) confirm our previous results as the interaction term is estimated with a positive coefficient: the effect of exchange rate movements on the average value of exports per firm is weaker in highly productive countries. This coefficient, however, is not statistically significant, which can be explained by the composition effect discussed above: new exporters' entry tend to reduce the average value of exports per firm, which attenuates the effect of the real exchange rate at the intensive margin in our decomposition.

Overall, these estimation results confirm that cross-country differences in the productivity distribution of exporters can have a large impact on the aggregate response of exports consecutive to exchange rate movements.

7 Conclusion.

In this paper, we questioned the role played by firm heterogeneity for the determination of the exchange rate elasticity of exports at the firm and macroeconomic level. We provided an estimation of the elasticity of firm-level exports with respect to real effective exchange rate variations, for a panel of 11 European countries. While we confirm the weakness of the microeconomic exchange rate elasticity *on average*, substantial heterogeneity is recorded between firms operating in a given country and sector. The least productive firms tend to be much more reactive to real exchange rate movements, while the most productive firms are quite unreactive.

Allowing for differences in the shape of the productivity distribution across countries allows us to enrich the analysis, as within a given sector, firms can be ranked in productivity terms irrespective of their country of origin. We find in particular that the ranking of exporters on the cross-country productivity scale is an important determinant of their reaction consecutive to exchange rate movements. In our dataset of European firms, the least productive European exporters react more to real exchange rate movements compared to the most productive European ones.

In an aggregation exercise, we assess the role played by the *concentration* of exports within each country, and differences in terms of the productivity *distribution* of exporters across countries. We show that the concentration of aggregate exports into more productive firms tends to dampen the macroeconomic exchange rate elasticity. It generates, however, only little cross-country differences, as highly productive firms concentrate a large share of aggregate exports in each country of our sample. Conversely, cross-country differences in terms of the shape of their productivity distribution among exporters have strong implications for the macroeconomic exchange rate elasticity. In particular, countries concentrating more productive firms among the set of European exporters in our sample tend to be less responsive to real exchange rate movements, compared with countries where the least productive European exporters are located.

In other words, our findings imply that 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 where highly productive firms are located.

References

Alessandria, G., Choi, H., and Ruhl, K. (2014). Trade Adjustment Dynamics and the Welfare Gains from Trade. NBER Working Papers 20663, National Bureau of Economic Research, Inc.

Amiti, M., Itskhoki, O., and Konings, J. (2014). Importers, Exporters, and Exchange Rate Disconnect. *American Economic Review*, 104(7):1942–1978.

Antras, P., Chor, D., Fally, T., and Hillberry, R. (2012). Measuring the Upstreamness of Production and Trade Flows. *American Economic Review*, 102(3):412–16.

Arkolakis, C., Costinot, A., and Rodriguez-Clare, A. (2012). New Trade Models, Same Old Gains? *American Economic Review*, 102(1):94–130.

Atkeson, A. and Burstein, A. (2008). Pricing-to-Market, Trade Costs, and International Relative Prices. *American Economic Review*, 98(5):1998–2031.

Bas, M., Mayer, T., and Thoenig, M. (2015). From Micro to Macro: Demand, Supply, and Heterogeneity in the Trade Elasticity. CEPR Discussion Papers 10637, C.E.P.R. Discussion Papers.

Berman, N. and Berthou, A. (2009). Financial Market Imperfections and the Impact of Exchange Rate Movements on Exports. *Review of International Economics*, 17(1):103–120.

Berman, N., Martin, P., and Mayer, T. (2012). How do Different Exporters React to Exchange Rate Changes? *The Quarterly Journal of Economics*, 127(1):437–492.

Berthou, A. (2008). An investigation on the effect of real exchange rate movements on OECD bilateral exports. Working Paper Series 0920, European Central Bank.

Berthou, A., Dhyne, E., Soares, A. C., Bugamelli, M., Cazacu, A.-M., Lalinsky, T., Meriküll, J., Harasztosi, P., Demian, C.-V., and Oropallo, F. (2015). Assessing European firms' exports and productivity distributions: the CompNet trade module. European central bank, working paper n.1788.

Berthou, A. and Fontagné, L. (2016). Variable Trade Costs, Composition Effects and the Intensive Margin of Trade. *The World Economy*, 39(1):54–71.

Berthou, A. and Vicard, V. (2015). Firms' Export Dynamics: Experience Versus Size. *The World Economy*, 38(7):1130–1158.

Bodenstein, M. (2010). Trade elasticity of substitution and equilibrium dynamics. *Journal of Economic Theory*, 145(3):1033–1059.

Boz, E., Gopinath, G., and Plagborg-Møller, M. (2017). Global trade and the dollar. mimeo.

Buono, I. and Lalanne, G. (2012). The effect of the Uruguay round on the intensive and extensive margins of trade. *Journal of International Economics*, 86(2):269–283.

Burstein, A. and Gopinath, G. (2014). *International Prices and Exchange Rates*, volume 4 of *Handbook of International Economics*, chapter 0, pages 391–451. Elsevier.

Bussière, M., Gaulier, G., and Steingress, W. (2016). Global Trade Flows: Revisiting the Exchange Rate Elasticities. Banque de france working papers n.608.

Caliendo, L. and Parro, F. (2015). Estimates of the Trade and Welfare Effects of NAFTA. *Review of Economic Studies*, 82(1):1–44.

Casas, C., Diez, F. J., Gopinath, G., and Gourinchas, P.-O. (2016). Dominant Currency Paradigm. Nber working papers n. 22943.

Chaney, T. (2008). Distorted Gravity: The Intensive and Extensive Margins of International Trade. *American Economic Review*, 98(4):1707–1721.

Chatterjee, A., Dix-Carneiro, R., and Vichyanond, J. (2013). Multi-product Firms and Exchange Rate Fluctuations. *American Economic Journal: Economic Policy*, 5(2):77–110.

Corsetti, G. and Dedola, L. (2005). A macroeconomic model of international price discrimination. *Journal of International Economics*, 67(1):129–155.

Corsetti, G., Dedola, L., and Leduc, S. (2008). International Risk Sharing and the Transmission of Productivity Shocks. *Review of Economic Studies*, 75(2):443–473.

Darvas, Z. (2012). Real effective exchange rates for 178 countries: A new database.

di Mauro, F. and Pappadà, F. (2014). Euro area external imbalances and the burden of adjustment. *Journal of International Money and Finance*, 48(PB):336–356.

Drozd, L. A., Kolbin, S., and Nosal, J. B. (2014). Long-Run Price Elasticity of Trade and the Trade-Comovement Puzzle. Mimeo.

Eaton, J., Eslava, M., Kugler, M., and Tybout, J. (2007). Export Dynamics in Colombia: Firm-Level Evidence. NBER Working Papers 13531, National Bureau of Economic Research, Inc.

Fally, T. (2011). On the fragmentation of production in the u.s. mimeo.

Feenstra, R. C. (1994). New Product Varieties and the Measurement of International Prices. *American Economic Review*, 84(1):157–177.

Feenstra, R. C., Luck, P. A., Obstfeld, M., and Russ, K. N. (2014). In Search of the Armington Elasticity. NBER Working Papers 20063, National Bureau of Economic Research, Inc.

Fitzgerald, D. and Haller, S. (2014). Exporters and Shocks: Dissecting the International Elasticity Puzzle. NBER Working Papers 19968, National Bureau of Economic Research, Inc.

Fontagné, L., Martin, P., and Orefice, G. (2017). The International Elasticity Puzzle Is Worse Than You Think. CEPR Discussion Papers 11855, C.E.P.R. Discussion Papers.

Goldstein, M. and Khan, M. S. (1985). Income and price effects in foreign trade. In Jones, R. W. and Kenen, P. B., editors, *Handbook of International Economics*, Handbook of International Economics, chapter 20, pages 1041–1105. Elsevier.

Gopinath, G., Itskhoki, O., and Rigobon, R. (2010). Currency Choice and Exchange Rate Pass-Through. *American Economic Review*, 100(1):304–36.

Héricourt, J. and Poncet, S. (2015). Exchange Rate Volatility, Financial Constraints, and Trade: Empirical Evidence from Chinese Firms. *World Bank Economic Review*, 29(3):550–578.

Hooper, P., Johnson, K. H., and Marquez, J. R. (1998). Trade elasticities for G-7 countries. International Finance Discussion Papers 609, Board of Governors of the Federal Reserve System (U.S.).

Imbs, J. and Mejean, I. (2015). Elasticity optimism. *American Economic Journal: Macroeconomics*, 7(3):43–83.

Imbs, J. and Mejean, I. (2016). Trade elasticities. *Review of International Economics*, Forthcoming.

IMF (2014). Are global imbalances at a turning point? World economic outlook, chapter 4, october 2014, International Monetary Fund.

IMF (2015). Exchange rates and trade flows: disconnected? World economic outlook, chapter 3, september 2015, International Monetary Fund.

IMF (2016). 2016 External sector report. report, International Monetary Fund.

Li, H., Ma, H., and Xu, Y. (2015). How do exchange rate movements affect Chinese exports? A firm-level investigation. *Journal of International Economics*, 97(1):148–161.

Lopez-Garcia, P., di Mauro, F., and the CompNet Task Force (2015). Assessing european competitiveness: the new compnet microbased database. *ECB Working Paper series*, (1764).

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6):1695–1725.

Melitz, M. J. and Ottaviano, G. I. P. (2008). Market Size, Trade, and Productivity. *Review of Economic Studies*, 75(3):985–985.

Morin, M. and Schwellnus, C. (2014). An Update of the OECD International Trade Equations. Technical Report 1129, OECD Publishing.

Pappadà, F. (2011). Real Adjustment of Current Account Imbalances with Firm Heterogeneity. *IMF Economic Review*, 59(3):431–454.

Riad, N., Errico, L., Henn, C., Saborowski, C., Saito, M., and Turunen, J. (2012). Changing patterns of global trade. Strategy, Policy, and Review Department Discussion Paper 1201, The International Monetary Fund.

Rodriguez-López, J. A. (2011). Prices and Exchange Rates: A Theory of Disconnect. *Review of Economic Studies*, 78(3):1135–1177.

Ruhl, K. J. (2008). The International Elasticity Puzzle. Working Papers 08-30, New York University, Leonard N. Stern School of Business, Department of Economics.

Simonovska, I. and Waugh, M. E. (2014). The elasticity of trade: Estimates and evidence. *Journal of International Economics*, 92(1):34–50.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., and de Vries, G. J. (2015). An illustrated user guide to the world input-output database: the case of global automotive production. *Review of International Economics*, 23(3):575–605.

Appendix

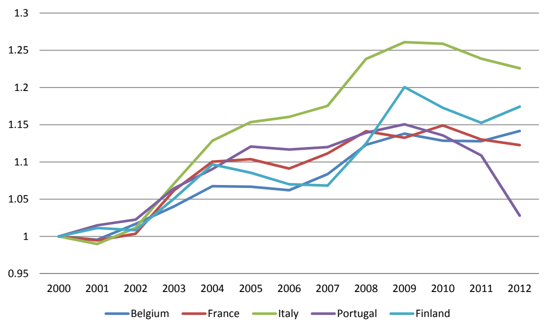
Table A1: Sectors covered

NACE code	Sector
10	Manufacture of food products
11	Manufacture of beverages
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of chemicals and chemical products
20	Manufacture of basic pharmaceutical products and pharmaceutical preparations
21	Manufacture of rubber and plastic products
22	Manufacture of other non-metallic mineral products
23	Manufacture of basic metals
24	Manufacture of fabricated metal products, except machinery and equipment
25	Manufacture of computer, electronic and optical products
26	Manufacture of electrical equipment
27	Manufacture of machinery and equipment
28	Manufacture of motor vehicles, trailers and semitrailers
29	Manufacture of other transport equipment
30	Manufacture of furniture
31	Other manufacturing
32	Repair and installation of machinery and equipment

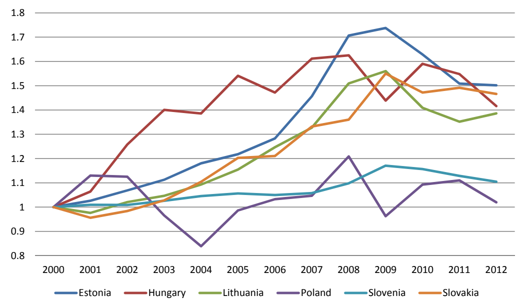
Figures

Figure 1: ULC-based real effective exchange rate variations

"Western" European countries



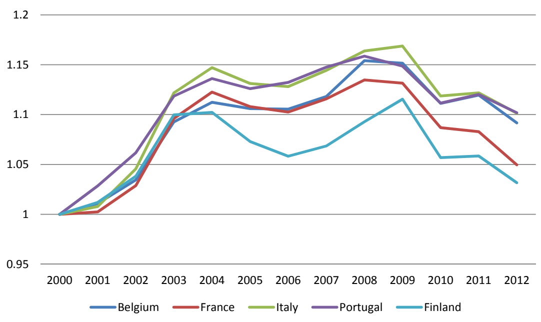
"Eastern" European countries



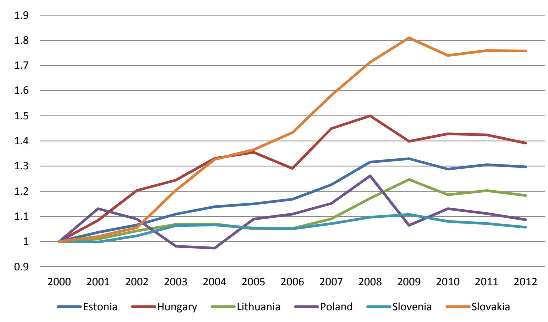
Note: Authors calculations based on Bruegel real effective exchange rates dataset (Darvas, 2012).

Figure 2: CPI-based real effective exchange rate variations

“Western” European countries

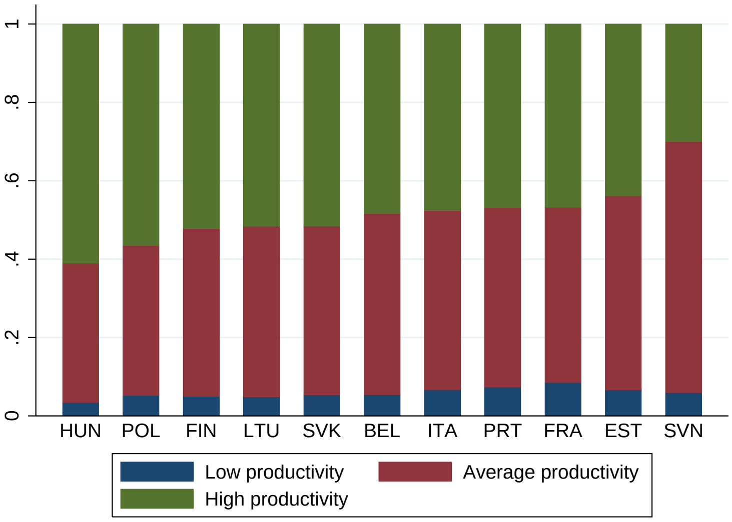


“Eastern” European countries



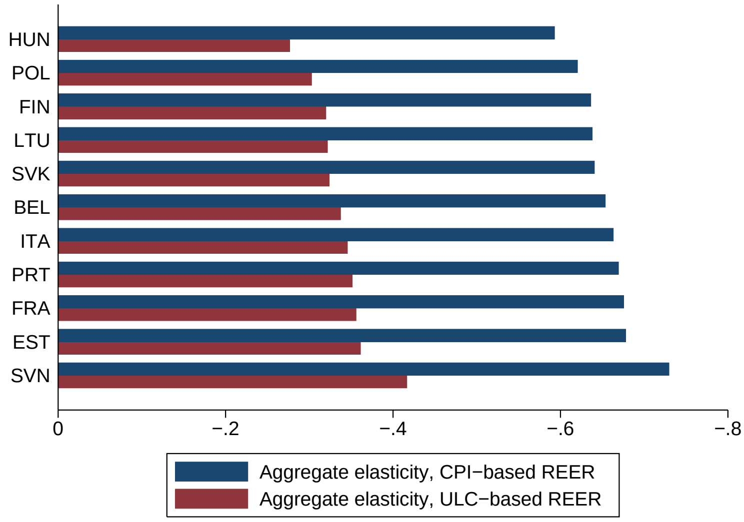
Note: Authors calculations based on Bruegel real effective exchange rates dataset (Darvas, 2012).

Figure 3: Distribution of export shares across firm productivity categories (within country)



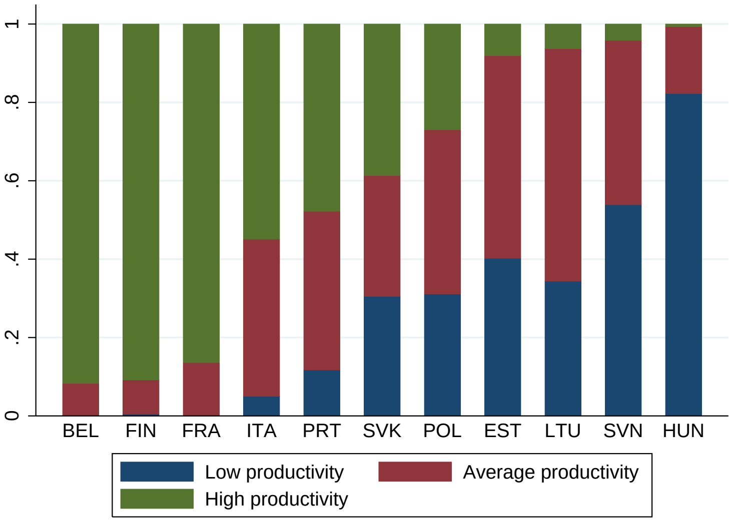
Note: Export shares by productivity category based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). Export shares calculated for the years 2006-2011.

Figure 4: Aggregate elasticities: influence of within-country export concentration



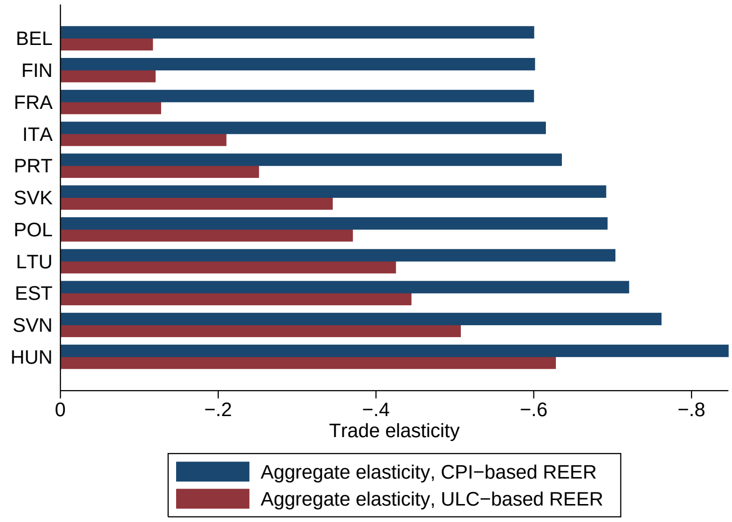
Note: Elasticities taken from the baseline estimation (Table 4). CPI-based REER elasticities : $\varepsilon_1 = -1.32$; $\varepsilon_2 = -0.82$; $\varepsilon_3 = -0.42$. CPI-based REER elasticities : $\varepsilon_1 = -0.90$; $\varepsilon_2 = -0.52$; $\varepsilon_3 = -0.10$. Authors calculations based on these elasticities combined with export shares for the years 2006-2011.

Figure 5: Distribution of export shares across firm productivity categories (EU distribution)



Note: Export shares by productivity category based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). Export shares calculated for the years 2006-2011.

Figure 6: Aggregate elasticities: within and between-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 : $\varepsilon_1 = -0.7$; $\varepsilon_2 = -0.3$; $\varepsilon_3 = -0.1$. Authors calculations based on these elasticities combined with export shares for the years 2006-2011.

Tables

Table 1: Descriptive statistics: real effective exchange rate, exports and demand (2001-2011)

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

Note: Means reported, standard deviations in parentheses.

Table 2: Real effective exchange rate elasticity

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	$\Delta \ln V_{fikt}$					
REER var.	CPI-based REER			ULC-based REER		
$\Delta \ln \overline{REER}_{it-1}$	-0.825***	-0.843***	-0.833***	-0.498***	-0.502***	-0.546***
	(0.259)	(0.256)	(0.253)	(0.166)	(0.164)	(0.181)
$\Delta \ln \overline{REER}_{it-1} \times Euro_{it}$			-0.626			0.297
			(0.378)			(0.441)
$\Delta \ln \overline{D}_{ikt}$	1.205***	1.327***	1.313***	1.240***	1.366***	1.362***
	(0.186)	(0.198)	(0.203)	(0.192)	(0.202)	(0.199)
$Euro_{it}$	-0.060*	-0.058**	-0.021	-0.052	-0.050	-0.065
	(0.031)	(0.029)	(0.029)	(0.037)	(0.033)	(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×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: 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 3: Real effective exchange rate elasticity : current and past REER variations

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	$\Delta \ln V_{fikt}$					
REER var.	CPI-based REER			ULC-based REER		
$\Delta \ln \overline{REER}_{it}$	-0.167	-0.190	-0.020	-0.126	-0.129	-0.196
	(0.239)	(0.233)	(0.266)	(0.160)	(0.160)	(0.175)
$\Delta \ln \overline{REER}_{it-1}$	-0.819***	-0.837***	-0.833***	-0.495***	-0.500***	-0.579***
	(0.262)	(0.259)	(0.254)	(0.167)	(0.163)	(0.176)
$\Delta \ln \overline{REER}_{it-1} \times Euro_{it}$			-0.610			0.551
			(0.442)			(0.485)
$\Delta \ln \overline{D}_{ikt}$	1.218***	1.345***	1.315***	1.252***	1.380***	1.380***
	(0.187)	(0.200)	(0.209)	(0.190)	(0.201)	(0.200)
$Euro_{it}$	-0.063*	-0.061**	-0.022	-0.051	-0.049	-0.078*
	(0.032)	(0.029)	(0.036)	(0.035)	(0.032)	(0.044)
Observations	8,626	8,626	8,626	8,626	8,626	,8626
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×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: 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 4: REER elasticity and within-country heterogeneity

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.			$\Delta \ln V_{fikt}$			
REER var.		CPI-based REER			ULC-based REER	
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$	-1.321***	-1.345***	-0.930***	-0.907***	-0.877***	-0.833**
	(0.287)	(0.284)	(0.269)	(0.318)	(0.319)	(0.334)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$	-0.828***	-0.844***	-0.412**	-0.524***	-0.524***	-0.418**
	(0.191)	(0.190)	(0.181)	(0.145)	(0.145)	(0.185)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$	-0.423*	-0.440**		-0.105	-0.116	
	(0.216)	(0.217)		(0.176)	(0.175)	
$\Delta \ln \overline{D}_{ikt}$	1.205***	1.326***	1.062***	1.365***	1.239***	1.064***
	(0.108)	(0.115)	(0.116)	(0.115)	(0.108)	(0.116)
$Euro_{it}$	-0.060***	-0.058***		-0.050***	-0.052***	
	(0.018)	(0.018)		(0.019)	(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: 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.

Table 5: REER elasticity and within-country heterogeneity: alternative thresholds

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.			$\Delta \ln V_{fikt}$			
REER var.		CPI-based REER			ULC-based REER	
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$	-1.189***	-1.212***	-0.700***	-0.770***	-0.743***	-0.619**
	(0.243)	(0.241)	(0.209)	(0.251)	(0.251)	(0.259)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$	-0.833***	-0.852***	-0.319*	-0.593***	-0.592***	-0.421**
	(0.207)	(0.205)	(0.178)	(0.162)	(0.162)	(0.182)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$	-0.516***	-0.528***		-0.164	-0.178	
	(0.199)	(0.199)		(0.157)	(0.156)	
$\Delta \ln \overline{D}_{ikt}$	1.204***	1.325***	1.061***	1.365***	1.239***	1.064***
	(0.108)	(0.115)	(0.116)	(0.115)	(0.108)	(0.116)
$Euro_{it}$	-0.060***	-0.058***		-0.050***	-0.052***	
	(0.018)	(0.018)		(0.019)	(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: 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.

Table 6: Real effective exchange rate elasticity: Two-way traders

	(1)	(2)	(3)	(4)
Dep. var.	$\Delta \ln V_{fikt}$			
REER var.	CPI-based REER		ULC-based REER	
$\Delta \ln \overline{REER}_{it-1}$	-1.395***		-1.436***	
	(0.376)		(0.386)	
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$		-1.888***		-1.759***
		(0.421)		(0.511)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$		-1.080***		-1.144***
		(0.388)		(0.388)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$		-0.682		-0.936**
		(0.420)		(0.457)
$\Delta \ln \overline{REER}_{it-1} \times Sharetwoway_{fikt-1}$	0.623	0.038	1.781***	1.279**
	(0.461)	(0.481)	(0.560)	(0.600)
$\Delta \ln D_{ikt}$	1.152***	1.123***	1.229***	1.216***
	(0.116)	(0.116)	(0.116)	(0.117)
$Euro_{it}$	-0.064***	-0.064***	-0.057***	-0.055***
	(0.018)	(0.018)	(0.019)	(0.019)
$twoway_{fikt-1}$	-0.011	0.006	-0.045*	-0.031
	(0.023)	(0.023)	(0.024)	(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: 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.

Table 7: Real effective exchange rate elasticity: switchers

	(1)	(2)	(3)	(4)
Dep. var.	$\Delta \ln V_{fikt}$			
REER var.	CPI-based REER		ULC-based REER	
$\Delta \ln \overline{REER}_{t-1}$	-0.800***		-0.402***	
	(0.192)		(0.146)	
$\Delta \ln \overline{REER}_{it-1} \times P1-prod_{fikt}$		-1.296***		-0.776**
		(0.298)		(0.330)
$\Delta \ln \overline{REER}_{it-1} \times P2-prod_{fikt}$		-0.807***		-0.433***
		(0.201)		(0.155)
$\Delta \ln \overline{REER}_{it-1} \times P3-prod_{fikt}$		-0.400*		-0.027
		(0.223)		(0.182)
$\Delta \ln \overline{REER}_{it-1} \times Shareswitch_{fikt-1}$	-2.434	-2.137	-9.319*	-8.985
	(5.540)	(5.515)	(5.656)	(5.635)
$\Delta \ln \overline{D}_{ikt}$	1.207***	1.206***	1.242***	1.241***
	(0.108)	(0.107)	(0.108)	(0.108)
$Euro_{it}$	-0.060***	-0.060***	-0.052***	-0.052***
	(0.018)	(0.018)	(0.019)	(0.019)
$Switch_{fikt-1}$	0.053	0.045	0.254	0.249
	(0.191)	(0.190)	(0.213)	(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: 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.

Table 8: Real effective exchange rate elasticity: upstreamness

	(1)	(2)	(3)	(4)
Dep. var.	$\Delta \ln V_{fikt}$			
REER var.	CPI-based REER		ULC-based REER	
$\Delta \ln \overline{REER}_{t-1}$	-0.835***		-0.496***	
	(0.180)		(0.134)	
$\Delta \ln \overline{REER}_{it-1} \times P1 - prod_{fikt}$		-1.328***		-0.873***
		(0.286)		(0.319)
$\Delta \ln \overline{REER}_{it-1} \times P2 - prod_{fikt}$		-0.838***		-0.522***
		(0.190)		(0.145)
$\Delta \ln \overline{REER}_{it-1} \times P3 - prod_{fikt}$		-0.434**		-0.115
		(0.215)		(0.175)
$\Delta \ln \overline{REER}_{it-1} \times Upstreamness_{fikt-1}$	-0.255	-0.248	-0.144	-0.135
	(0.156)	(0.156)	(0.182)	(0.182)
$\Delta \ln \overline{D}_{ikt}$	1.196***	1.195***	1.232***	1.232***
	(0.107)	(0.107)	(0.107)	(0.107)
$Euro_{it}$	-0.061***	-0.061***	-0.052***	-0.052***
	(0.019)	(0.018)	(0.019)	(0.019)
$Upstreamness_{fikt-1}$	-0.009	-0.009	-0.013	-0.014
	(0.021)	(0.021)	(0.021)	(0.021)
Observations	8,626	8,626	8,626	8,626
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: 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.

Table 9: REER elasticity: interaction with firm-level productivity

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.				$\Delta \ln V_{fikt}$		
REER var.		CPI-based REER			ULC-based REER	
$\Delta \ln \overline{REER}_{it-1}$	-1.148***	-1.067***		-1.155***	-1.007***	
	(0.259)	(0.266)		(0.290)	(0.295)	
$\Delta \ln \overline{REER}_{it-1} \times lnlprod_{fikt-1}$	0.154*	0.103	0.231**	0.282***	0.216**	0.235**
	(0.088)	(0.092)	(0.104)	(0.101)	(0.103)	(0.117)
$\Delta \ln \overline{D}_{ikt}$	1.199***	1.319***	1.060***	1.225***	1.346***	1.059***
	(0.108)	(0.115)	(0.117)	(0.108)	(0.115)	(0.117)
$lprod_{fikt-1}$	0.005	0.033*	0.007	0.002	0.029	0.006
	(0.006)	(0.018)	(0.006)	(0.006)	(0.018)	(0.006)
$Euro_{it}$	-0.068***	-0.070***		-0.057***	-0.060***	
	(0.019)	(0.019)		(0.019)	(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: 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.

Table 10: REER elasticity: interaction with productivity groups (cross-country distribution)

	(1)	(2)	(3)	(4)
Dep. var.	$\Delta \ln V_{fikt}$			
REER var.	CPI-based REER		ULC-based REER	
$\Delta \ln \overline{REER}_{it-1} \times P1 - lprod_{kt}$	-0.945***	-0.942***	-0.770***	-0.751***
	(0.195)	(0.195)	(0.162)	(0.165)
$\Delta \ln \overline{REER}_{it-1} \times P2 - lprod_{kt}$	-0.577***	-0.646***	-0.322**	-0.348**
	(0.203)	(0.199)	(0.156)	(0.155)
$\Delta \ln \overline{REER}_{it-1} \times P3 - lprod_{kt}$	-0.591**	-0.676**	-0.053	-0.112
	(0.268)	(0.271)	(0.210)	(0.216)
$\Delta \ln \overline{D}_{ikt}$	1.246***	1.382***	1.264***	1.398***
	(0.107)	(0.113)	(0.107)	(0.113)
$lprod_{fikt-1}$	0.003	0.021	0.002	0.021
	(0.006)	(0.019)	(0.006)	(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: 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.

Table 11: Impact of REER on aggregate trade margins

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln X_{ikt}$	$\Delta \ln N_{ikt}$	$\Delta \ln \overline{x}_{ikt}$	$\Delta \ln X_{ikt}$	$\Delta \ln N_{ikt}$	$\Delta \ln \overline{x}_{ikt}$
REER var.	CPI-based REER			ULC-based REER		
$\Delta \ln \overline{REER}_{it}$	-0.521*	-0.238***	-0.283	-0.592***	-0.284***	-0.308*
	(0.272)	(0.077)	(0.284)	(0.155)	(0.043)	(0.162)
$\Delta \ln \overline{D}_{ikt}$	0.671***	0.061	0.609***	0.686***	0.069	0.617***
	(0.160)	(0.045)	(0.166)	(0.159)	(0.044)	(0.166)
Euro_{it}	-0.035*	0.056***	-0.091***	-0.033	0.057***	-0.090***
	(0.021)	(0.006)	(0.022)	(0.021)	(0.006)	(0.021)
Observations	1,797	1,797	1,797	1,797	1,797	1,797
R-squared	0.328	0.454	0.271	0.333	0.464	0.272
Country FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes

Note: estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). $\Delta \ln \overline{REER}_{it}$ 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. X_{ikt} is the aggregate value of exports in country i and sector k. N_{ikt} is the number of exporters. $\overline{x}_{ikt}$ is the average value of exports.

Table 12: Impact of REER on aggregate trade margins : productivity interactions

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln X_{ikt}$	$\Delta \ln N_{ikt}$	$\Delta \ln \overline{x}_{ikt}$	$\Delta \ln X_{ikt}$	$\Delta \ln N_{ikt}$	$\Delta \ln \overline{x}_{ikt}$
REER var.	CPI-based REER			ULC-based REER		
$\Delta \ln \overline{REER}_{it}$	-1.240***	-0.636***	-0.605	-0.781***	-0.448***	-0.333*
	(0.367)	(0.102)	(0.383)	(0.181)	(0.050)	(0.189)
$\Delta \ln \overline{REER}_{it}$ × Top exporters$_{it}$	1.050***	0.580***	0.470	0.568**	0.494***	0.074
	(0.360)	(0.101)	(0.375)	(0.280)	(0.077)	(0.292)
$\Delta \ln \overline{D}_{ikt}$	0.676***	0.064	0.612***	0.687***	0.070	0.617***
	(0.159)	(0.044)	(0.166)	(0.159)	(0.044)	(0.166)
Euro$_{it}$	-0.038*	0.055***	-0.092***	-0.035*	0.056***	-0.090***
	(0.021)	(0.006)	(0.022)	(0.021)	(0.006)	(0.022)
Observations	1,797	1,797	1,797	1,797	1,797	1,797
R-squared	0.332	0.465	0.272	0.334	0.477	0.272
Country FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes

Note: estimations based on the CompNet trade module data for 11 European countries (Belgium, Estonia, Finland, France, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia). $\Delta \ln \overline{REER}_{it}$ 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. X_{ikt} is the aggregate value of exports in country i and sector k. N_{ikt} is the number of exporters. $\overline{x}_{ikt}$ is the average value of exports. Top exporters$_{it}$ is a dummy variable which takes the value 1 when country i has exporters ranked among the top 10% of exporters in terms of productivity in at least one sector among the sample of 11 countries, and 0 otherwise.

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Editor

Jan Smets
Governor of the National Bank of Belgium

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