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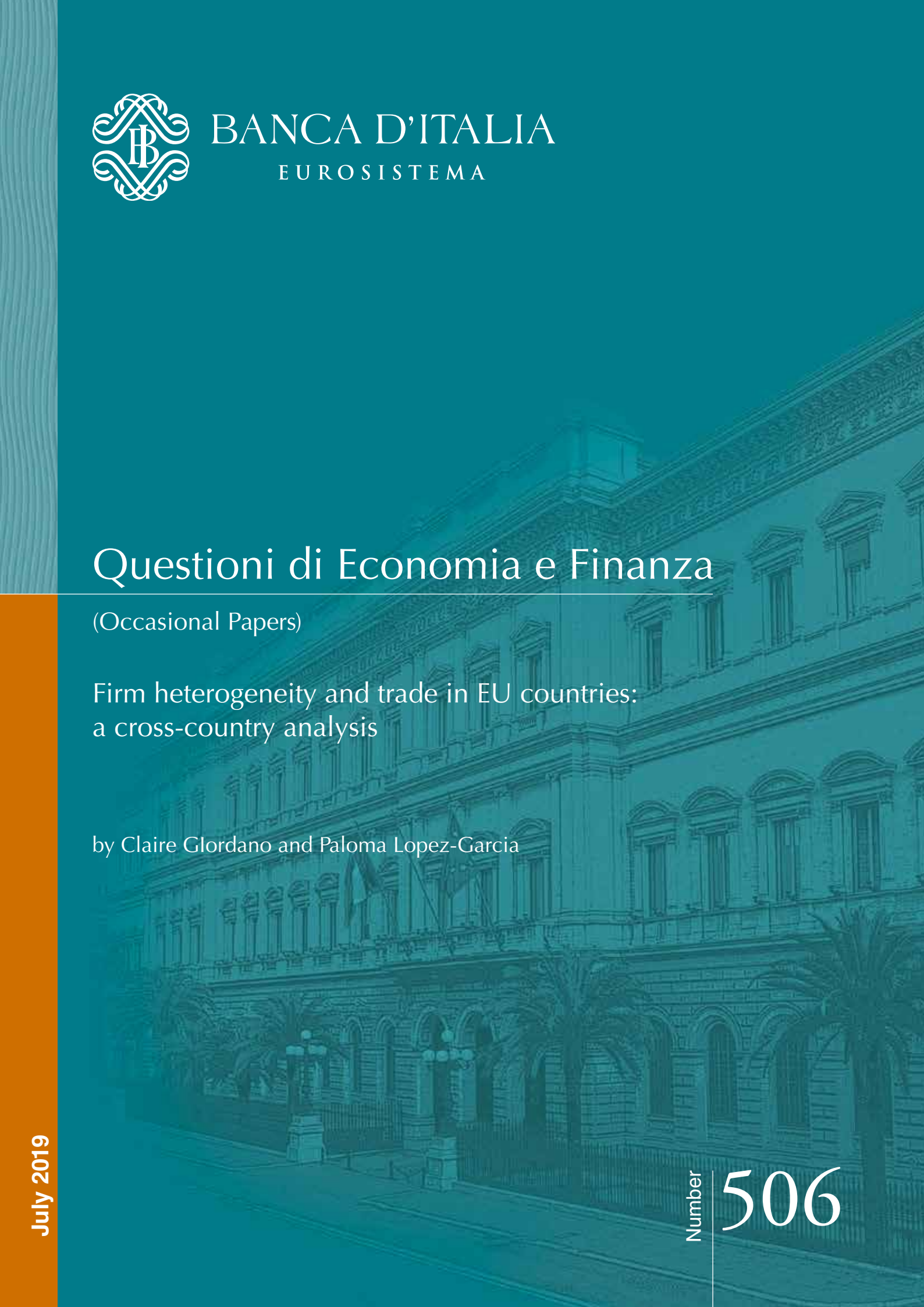

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FIRM HETEROGENEITY AND TRADE IN EU COUNTRIES: A CROSS-COUNTRY ANALYSIS

by Claire Giordano[*] and Paloma Lopez-Garcia[†]

Abstract

Firms are heterogeneous, even within narrowly defined sectors. This article surveys the relevant theoretical and empirical literature on firm heterogeneity and external trade. By innovatively exploiting rich cross-country micro-aggregated data sourced from the ECB Competitiveness Research Network (CompNet), this study investigates the main implications of firm heterogeneity for trade by EU countries, presenting a set of stylized facts. On the one hand, exporting firms are larger, more productive and pay higher wages than non-exporting firms. Indeed, only these firms are able to bear export costs arising from various factors, such as tariff and non-tariff trade barriers, the quality of the legal system or access to finance. Hence, only few enterprises actually export and the intensity of aggregate export concentration within a few large firms varies across countries and sectors. On the other hand, engaging in trade boosts individual firms' productivity growth via a number of channels and enhances allocative efficiency across firms, in turn increasing aggregate productivity growth. One of the main standard determinants of export growth, namely changes in the real effective exchange rate, impacts aggregate performance differently across countries depending on sectoral composition and on firm characteristics within a given sector.

JEL classification: F14, L25.
Keywords: trade, firm heterogeneity, productivity, real effective exchange rates.

Contents

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1. Introduction[1]

Owing to the increased availability of firm-level data, various empirical studies have documented the existence of large heterogeneity in performance across firms. In particular, enterprises are very different in terms of size, cost structure, profits and productivity, even within finely disaggregated sectors (Bartelsman and Dhymes, 1998; Bartelsman and Doms, 2000; Restuccia and Rogerson, 2008; Syverson, 2011).

This is also the case for EU countries, a set of which is shown in Figure 1. Amongst the old Member States (i.e. countries that joined the EU by 1995 at the latest) considered, the top 10 per cent most productive firms are on average between two to three times more productive than firms located at the bottom 10 per cent of the labour productivity distribution in the same sector, defined at the 2-digit level; this dispersion is even higher for new EU Member States.[2]

Moreover, the labour productivity distribution of firms is asymmetric as it displays notable skewness (Figure 2). In particular, productivity is more concentrated in the left-hand tail of the distribution where the low-productivity firms stand, although to a different extent across countries.

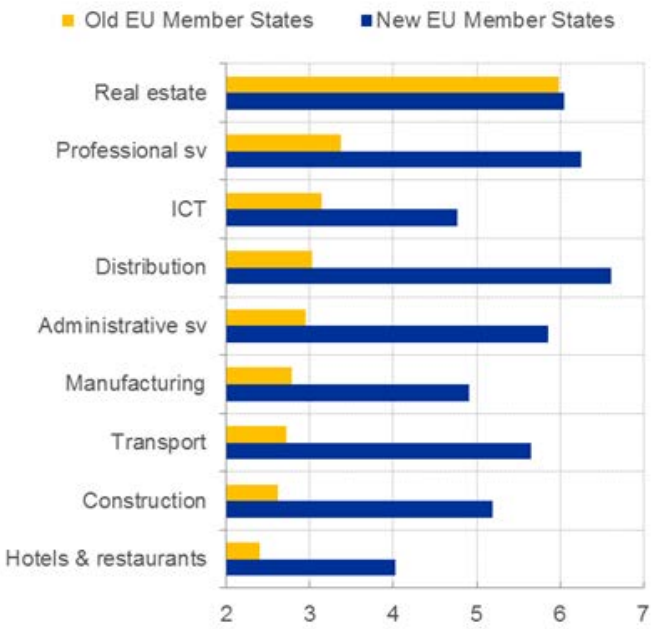
The acknowledgement of firm heterogeneity and its inclusion in economic models is changing the way economic analysis is conducted in a number of fields, ranging from the understanding of productivity drivers and wage inequality to international trade, to mention but a few topics. This article focuses on the implications of firm heterogeneity for external trade, based on the recent developments of the trade literature, and summarised in eight stylized facts. The analysis is based on a rich, comparable cross-country and micro-founded database covering 14 EU countries – including both the early and the late joiners – to our knowledge for the first time for such an ambitious purpose.

[1] We thank Matteo Bugamelli, Alberto Felettigh, Pavlos Karadeloglou, Ricardo Mestre, Roberta Serafini, Luigi Federico Signorini, Frank Smets, Joao Sousa and all participants of the CEBRA conference in Goethe University, Frankfurt-Am-Main held in August 2018 for useful comments on previous versions of this article. Moreover, we are grateful to Antoine Berthou for sharing his data with us. A previous version of this paper has been published as Giordano and Lopez-Garcia (2019). Any errors however are responsibility of the authors. The views represented herein are those of the authors, and not of the institutions represented.

[2] The levels of within-sector dispersion in Figure 1 are similar to those reported in Berlingieri, Blanchenay and Criscuolo (2017). Bartelsman, Haltiwanger and Scarpetta (2013) explain the differences in within-sector dispersion in productivity between Central and Eastern European countries and Western Europe with the fact that, during the initial years of the transition to market economies, which our period captures, low-productivity firms survived and coexisted with new, far more productive firms created in the private sector.

Figure 1. Within-sector dispersion in firm labour productivity in selected EU countries

(ratio of the labour productivity level of the top and bottom deciles of firms in each 2-digit sector, 2001-2013)

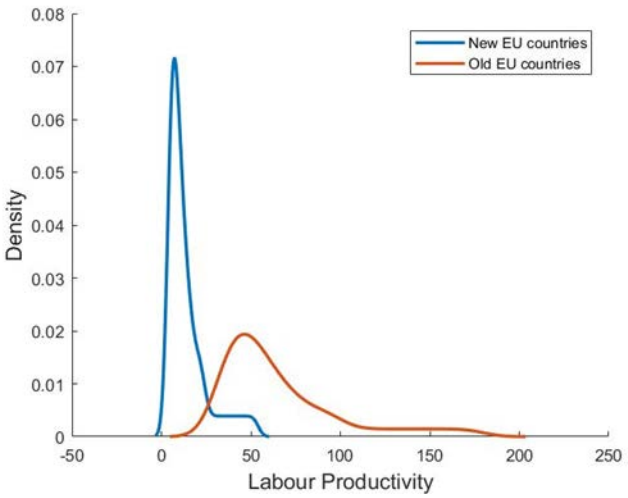


Sources: Authors' calculations based on CompNet data.

Notes: The old EU Member States are: Belgium, Denmark, Finland, France, Italy and Spain. The new EU Member States are: Croatia, Estonia, Hungary, Lithuania, Poland, Romania, Slovakia and Slovenia. The ratios in each 2-digit sector are aggregated to the macro-sector level using value-added shares; unweighted averages are taken across countries and years. 2013 data are not available for Lithuania, Hungary, Romania and Slovenia.

Figure 2. The labour productivity density function in manufacturing

(2002-2013)



Sources: Authors' calculations based on CompNet data.

Notes: The definition of old and new EU Member States is that in Figure 1. Unweighted averages are taken across countries and years. The Figure refers to the average over the period 2002-2012 in order to obtain a balanced sample of countries. Labour productivity is measured as real value added per employee and expressed in thousands of euros. The chart refers to firms with at least 20 employees in manufacturing.

The discussion is structured around two large topics. The first is the two-way link between firm productivity and trade. Indeed, exporters are the most productive firms in the economy in that only few firms are able to pay the fixed and variable costs of exporting (Melitz, 2003). In turn, trade

can boost both exporting firms' productivity and aggregate productivity. The channels are manifold, and include learning-by-exporting (for example, De Loecker, 2013; Bloom, Draca and Van Reenen, 2016) and learning and upgrading by sourcing better-quality imports (for instance, Amiti and Konings, 2007; Bas and Strauss-Kahn, 2015), as well as a better reallocation of production factors across firms (amongst others, Bernard and Jensen, 2004; Berthou et al., 2017).

The second trade-related implication of firm heterogeneity concerns the estimation of the relationship between exports and the real effective exchange rate (REER). In particular, the literature has found that there is strong heterogeneity across sectors and firms in elasticities of exports to movements in the REER. In particular, estimated elasticities depend on the underlying distribution of firm productivity and size. The reasons behind these findings are twofold: (i) large, more productive, firms respond to exchange rate fluctuations less strongly than smaller enterprises and this affects the intensive margin (i.e. the amount of goods exported by existing exporters) of export growth (for example, Amiti, Itskhoki and Konings, 2014; Berthou and Dhyne, 2018); and (ii) countries where a large mass of firms are close to the "productivity threshold", above which they start selling abroad, require smaller movements in the REER to achieve aggregate export gains because of the larger role of the extensive margin (i.e. the entry of new exporting firms into the market; for instance, see di Mauro and Pappadà, 2014).

The analysis in this article relies on the information compiled by the "Trade" and "Productivity" modules of the micro-aggregated database constructed in the context of the ECB Competitiveness Research Network (CompNet), which results from the merge at the firm level between information from balance sheets and on export activity. The database compiles several moments of the distribution of relevant indicators in a given country-sector-year in order to preserve the confidentiality of the data. This article generally covers 14 EU countries (Belgium, Denmark, Finland, France, Italy, Estonia, Czech Republic, Lithuania, Poland, Romania, Slovakia, Slovenia and Spain) and 23 manufacturing sectors over the period 2002-2013 (2012 for some countries), as shown in Table A1 in Annex 1.[3]

The structure of this paper is the following. Section 2 discusses the literature on the two-way link between productivity and trade, and provides related empirical evidence for the EU. Section 3 assesses the relationship between exports and REERs in EU countries, by focusing both on the intensive and the extensive margin of exports. Section 4 concludes.

[3] The "Productivity" module is available for the period 2001-2013, although it is unbalanced given delayed entry of some countries and availability of information until 2012 for countries obtained from the 4th vintage of CompNet data. This explains the different time coverage of different tables and Figures, according to the indicators considered. More information on the construction and coverage of the various modules and overall dataset is provided in Annex 1, as well as in Lopez-Garcia and di Mauro (2015) and in Berthou et al. (2015).

2. Productivity and trade: a two-way link

2.1 The role of firm productivity for trade

Until the 1990s, the standard trade theory assumed that firms were homogeneous within each economy (see Helpman, 1999 for a thorough review). Indeed, in neoclassical trade models welfare gains from trade arise from the increase in world production and consumption following the specialisation of countries in the industries where they have a comparative advantage (Ricardo 1817; Heckscher 1919; Ohlin 1933; Samuelson 1948). Specifically, countries export those products for which they have lower opportunity costs of production relative to other sectors and countries. In particular, Ricardo's (1817) theory, assuming that only labour is needed to produce output, predicts that a country exports goods where its labour productivity is relatively high. In addition to trade in products, trade in factor contents is also relevant: according to Samuelson's (1948) two-factor (labour and capital), two-sector (export and import-competing) version of the Heckscher-Ohlin theory, a country exports the good that is relatively intensive in using the production factor with which the country is relatively well endowed.

Later "new trade" models incorporated the empirical feature that countries exchange similar goods, implying that trade across countries also occurs within the same industry, by assuming increasing returns to scale, monopolistic competition and consumers' preference for variety. In these models, under a "representative firm" setting the gains from trade arise because trade liberalisation leads to an increase in market size, which allows firms to reduce production costs and widens the availability of cheaper varieties of goods (Krugman, 1980; Helpman and Krugman, 1985). All these models assume that countries rather than firms compete in global markets.

Pioneering plant-level studies pointed, however, to firm heterogeneity in performance, especially between exporting and non-exporting firms. In particular, by employing firm-level U.S. manufacturing data Bernard and Jensen (1995; 1997; 1999) documented large, significant gaps between exporters and non-exporters, in terms of size, productivity, capital and technological intensity and wages paid to their employees. Based on this empirical evidence, the so-called "new-new trade" theory acknowledges the presence of firm heterogeneity. Building on earlier theoretical models of firm size and dynamics (for example, Jovanovic, 1982 and Hopenhayn, 1992), Melitz (2003) offers a tractable framework on the link between trade and productivity, which has become the new cornerstone of trade theory (see also Bernard, Redding and Schott, 2007; Melitz and Ottaviano, 2008; Melitz and Redding, 2014). In this model atomistic firms need to pay a fixed cost for producing domestically, which is thereafter sunk. When they start operating, they produce horizontally differentiated varieties within the industry under conditions of monopolistic competition. Participation in export activities then requires the payment of an additional fixed cost, as well as a variable

"iceberg" cost.[4] This implies that firms will enter the market and produce, and eventually export, only if they find it profitable. Since profitability depends on the productivity level of each firm, only a fraction of firms, i.e. those above an endogenously determined "productivity threshold", will be able to enter the domestic market and produce, and only a fraction of these firms will in turn be able to overcome the even higher entry barrier to export. In order to obtain "selection into export status", the fixed export cost is assumed to be larger than the fixed production cost, so that in equilibrium a country's marginal exporters are more productive than its marginal producers.

In addition to the assumption on the nature of trade costs, Melitz's (2003) model also requires a constant elasticity of substitution demand system and assumes that productivity follows a Pareto distribution. However, a study based on CompNet data for 16 EU countries in the years 2001-2012 (Barba Navaretti et al., 2016) has shown how exporter competitiveness (measured as the residual of an export regression, once all possible destination markets' characteristics, trade costs and geographical, cultural and historical features are netted out) is positively correlated not only with average firm productivity, a "sufficient" statistic in a Pareto distribution, but also with other moments of the productivity distribution, namely with its dispersion and its asymmetry. Similarly, using US transaction-level data, Bonfiglioli, Crinò and Gancia (2018) show that the distribution, as well as the mean, of firm-level characteristics affect aggregate trade outcomes.[5]

The observed productivity premium for exporters raised the issue of whether the most productive firms "self-select" into trading activities *ex ante* or whether it is the participation in trading activities that increases their productivity after entry (for example, due to learning-by-exporting). Widespread empirical evidence on the existence of sunk entry costs to export and of persistence in export activities supports the former hypothesis,[6] suggesting that only the most productive firms within sectors find it profitable to incur these entry costs; the second hypothesis will be tackled further on.

Stylized fact #1: Firms that have just started to export are larger, more productive and pay higher wages than non-exporting firms in a given sector.

[4] According to the iceberg model (Samuelson, 1954), an exporter has to produce and ship $\tau > 1$ units for one unit to arrive on the export market. The excess $\tau - 1 > 0$ units shipped "disappear" during transit and thus constitutes a trade cost. Hence more valuable goods are more expensive to trade internationally as trade costs increase proportionally with the (exporter) value of the good.

[5] Bernard et al. (2018) develop a model which includes a much wider range of firm decision margins than those predicted by Melitz (2003): each firm can choose its production locations, export markets for each plant, the products to export from each plant to each market, the exports of each product from each plant to each market, the countries from which to source intermediate inputs for each plant and the imports of each intermediate input from each source country by each plant. These "global" firms are unlikely to be atomistic and therefore their pricing and product introduction decisions affect market aggregates; strategic market power is thus considered in this more comprehensive model. Moreover, a very recent strand of the literature has shown that fixed costs are more relevant at the product than at the firm level (Steingrass, 2018), but clearly this type of analysis requires highly granular, product-based data, which the CompNet databased does not cover.

[6] See amongst others, Roberts and Tybout (1997) for Colombia, Eaton, Kortum and Kramartz (2011) for France, Bernard and Wagner (2001) and Arnold and Hussinger (2005) for Germany, Castellani and Zanfei (2007) for Italy, Clerides, Lach and Tybout (1998) for Mexico and for Morocco, Damijan, Polanec and Prasnikar (2004) for Slovenia, Farinas and Martin-Marcos (2007) for Spain, Girma, Greenaway and Kneller (2004) for the U.K. and Bernard and Jensen (2004) for the U.S.

To test whether this is the case in the EU, we estimate country-specific exporter premia, defined as the *ceteris paribus* percentage difference of a given performance-related variable between exporters and non-exporters, as is standard in the trade literature (for example, Bernard and Jensen, 1995; Bernard et al., 2007; ISGEP, 2008). In particular, for each country we regress several performance indicators such as average labour productivity, size (in terms of employment) and wages of each type of firm on a dummy variable $Dnewexporter_{s,t}$ taking value one for new exporters and zero for non-exporters, after controlling for firm-specific characteristics ($controls_{s,t}$) and fixed effects. Hence, we only consider new exporting firms, defined in the CompNet database as those firms that export at time *t* and *t+1*, but did not sell abroad at time *t-1*, relative to non-exporting firms in the same sector.[7] The coefficient β attached to this dummy variable is then interpreted as the performance premia of firms that just entered international markets versus non-exporting firms in the same sector. The choice of focusing solely on new exporters reduces the risk that results are affected by possible *ex post* increases in productivity of exporting firms, and therefore provides evidence on whether the best-performing firms self-select into export markets. The regression is as follows:

(1) $\ln(performance)_{s,t} = \beta Dnewexporter_{s,t} + \gamma controls_{s,t} + \mu_s + \tau_t + \varepsilon_{s,t}$

where the controls include the size of the firm (measured as the number of employees in the labour productivity and wage regressions and as labour productivity in the size regression), μ_s are sectoral fixed effects, τ_t are time fixed effects, *s* indicates 2-digit sectors and *t* indicates years. OLS regressions with robust standard errors are conducted over the period 2002-2013, country by country. All β coefficients are statistically significant at conventional confidence intervals.[8] The performance premia (in percentage values) for each country are plotted in Figure 3 and confirm the existence of large differences in terms of average productivity (up to 50 per cent higher), size and wages between new exporting firms and non-exporting firms operating in the same 2-digit industry. As regards labour productivity specifically, the premia in Figure 3 are significantly more contained than those reported in Figure 1. Amongst various reasons, in Figure 3 it is noteworthy that productivity premia are estimated conditionally to a set of control variables, namely the size of firms and various fixed effects, whereas in Figure 1 computations provided do not take into account observed and unobserved heterogeneity. This reduction in exporter premia after controlling for heterogeneity is standard in the literature (for example, Bernard et al., 2007; ISGEP, 2008). In conclusion, the finding that new exporting firms already display an advantage in productivity compared to non-exporters supports the hypothesis of self-selection into export markets within the EU. This evidence, however, does not

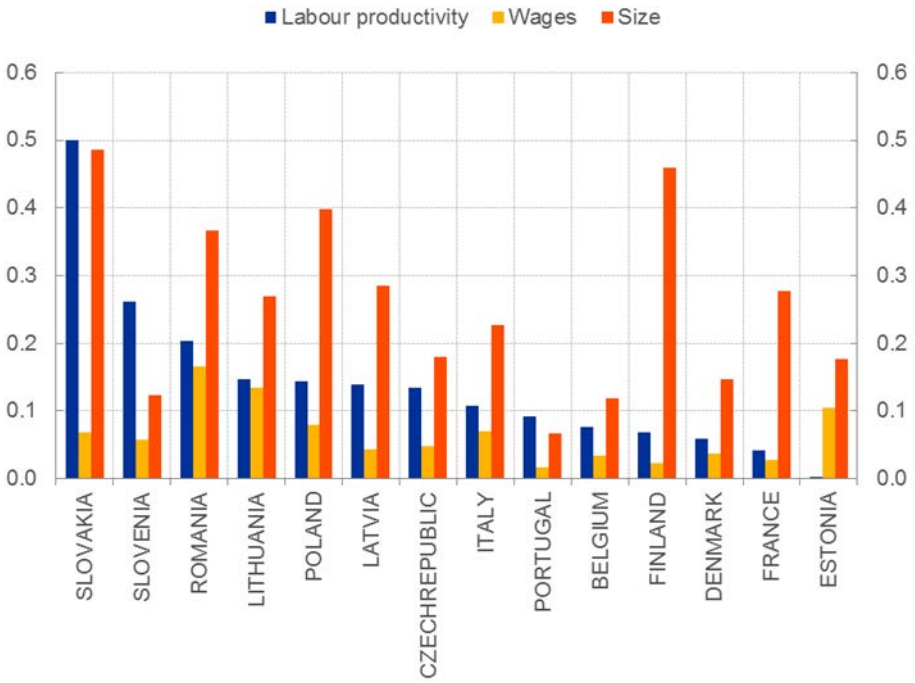
[7] Note that, according to the definition employed in the Compnet database, a firm may be classified several times as a "new" exporter, as long as it stays out of the international markets for two consecutive years.

[8] The only exceptions are Estonia for the labour productivity premium, Slovenia and Portugal regarding the size premium and Portugal, Latvia and Finland for the wage premium. Note, however, that the premia of all countries would be significant at the 1per cent level if no other firm characteristic were controlled for. For instance, Estonia's labour productivity premium of new exporters turns insignificant when firm size is controlled for, because in this country only very large firms are productive enough to become new exporters.

exclude that participation in trading activities also raises firm productivity at a later stage as a result, as will be discussed more thoroughly later on.

Figure 3. Performance premia of new manufacturing exporting *vis-à-vis* non-exporting firms in the same sector in selected EU countries

(percentage points)



Sources: Authors' calculations based on CompNet data.

Notes: See the main text for the details on the computation of the estimated premia.

Stylized fact #2: Fixed costs of exporting depend upon factors such as the quality of the legal system, access to finance and tariff and non-tariff trade barriers.

Participation in export activities and the size of export volumes depend on whether firms find it profitable to pay the trade costs and expand into foreign markets. Consistently with the gravity literature, in addition to standard time-invariant trade costs, such as geographical distance and language differences, examples of barriers to trade are infrastructure and logistic costs, distribution and marketing costs, availability of staff with skills to manage foreign networks, tariffs and non-tariff barriers, availability of credit, and the cost of obtaining information about foreign markets (amongst many studies, see, for example, Minetti and Chun Zhu, 2011 on the role of credit rationing and Fontagné et al., 2015 on the impact of tariffs and stringent non-tariff barriers in foreign markets on export performance).

To explore the possible determinants of fixed costs of trade in the EU, we start from the claim that in countries with high fixed trade costs new exporters need to be relatively more productive to enter international markets. Hence in the following exercise fixed trade costs will be approximated by the productivity premium of new exporters. For that purpose, using a variant of equation (1), where

premia are time-invariant, we estimate new exporters' productivity premia for each country-year. In other terms, we interact the dummy *D_newexporter* in equation (1) with a complete set of year dummies. The reason is that there might be time variation in the fixed cost of trade, particularly amongst those countries in our sample which joined the EU in 2004. Next, we assess their correlation with potential determinants of fixed trade costs. In particular, we run the following cross-country regressions using OLS with clustered standard errors, where *c* indicates the country and *t* indicates the year:

$$(2)\quad premium_{c,t} = \gamma X_{c,t} + \tau_t + C_{c,t} + \varepsilon_{c,t}$$

where $X_{c,t}$ is one of the following country-specific variables (see Annex 2 for a detailed definition and sources): soundness of the legal system, tariff and non-tariff trade barriers[9] and access to finance, which, by their nature, should affect firm-level fixed rather than variable costs of trade; τ_t are year dummies to capture common shocks; $C_{c,t}$ are controls and include year-on-year changes in the employment rate, capturing country-specific business cycles which may affect exporting and non-exporting firms differently, and the log of manufacturing value added, which captures the economic size of each country.[10] Table 1 shows the standardised coefficients of running the regression (2) on one variable $X_{c,t}$ at a time. Amongst the controls, value added is statistically significant and positive, implying that exporter premia are higher the larger the size of the manufacturing sector it operates in. Country-specific business cycle conditions, on the other hand, do not appear to be significant. Due to the fact that all variables in Table 1 are highly collinear, in a standard horse-race exercise, only one of them – compliance costs for exporting and importing – marginally retains its statistical significance when all regressors are included together in one regression (results available upon request).

In line with the existing literature it is found that fixed trade costs are decreasing with the soundness of the legal system and easiness of access to finance in the origin country, whereas they are increasing in tariff and non-tariff barriers.[11] These results are also consistent with studies showing that countries with lower GDP per capita, which generally is associated with lower-quality institutions, feature higher exporters' productivity premia because they have less integrated markets which allow non-exporters with low levels of productivity to survive (Hallward-Driemeier, Iarossi and Sokoloff, 2002). Hence in those economies, firms that are able to afford the costs associated with exporting tend to be much more productive than the average firm.

[9] Although we focus solely on EU countries, our proxies of trade and non-trade barriers, described in detail in Annex 2, present some variability across economies. In particular, they point to higher barriers in Central and Eastern European countries, especially at the beginning of the 2002-2013 period under analysis. Moreover, despite belonging to the EU, member countries may still impose non-tariff measures, as discussed in Kirpichev and Moral-Benito (2018).

[10] The latter variable is an attempt at introducing a gravity control. We also tried to include country dummies in order to account for country-specific firm characteristics that affect the productivity distribution; these fixed effects, however, wipe out the statistical significance of the determinants of trade costs, which vary little over time, and are therefore not included in our baseline specification. Indicators of labour and product market regulation have also been included in the baseline specification, but are found to be statistically insignificant.

[11] Clearly, it would be interesting to also test for the significance of the legal system and other institutional features in the destination country, in addition to the source country. Unfortunately, CompNet data do not include bilateral trade information and, therefore, the destination country cannot be identified.

Table 1. The link between country-level characteristics and fixed costs of trade

Explanatory variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Legal system										
Judicial independence	-0.356***									
Protection of property rights		-0.319**								
Contract enforcement			-0.106							
Impartial Courts				-0.307**						
Tariff and non-tariff trade barriers										
Revenue from trade taxes (% of X and M)					0.055					
Tariff and non-tariff barriers						0.388***				
Complicance costs of M and X							0.109			
Mean tariff rate								0.301**		
Access to finance										
Financial regulation									-0.199+	
Financial depth										-0.250***
Observations	77	77	77	77	77	77	77	77	77	145
R-squared	0.257	0.207	0.236	0.158	0.152	0.220	0.257	0.160	0.184	0.123

Sources: Authors' estimates based on CompNet data and Fraser Institute Indicators.

Notes: OLS regressions, as in equation (2), with clustered standard errors. Beta coefficients are standardised so that their magnitude is comparable across regressions. All regressions control for year fixed effects, manufacturing value added and aggregate employment growth. *** p<0.01, ** p<0.05, * p<0.10, + p<0.15.

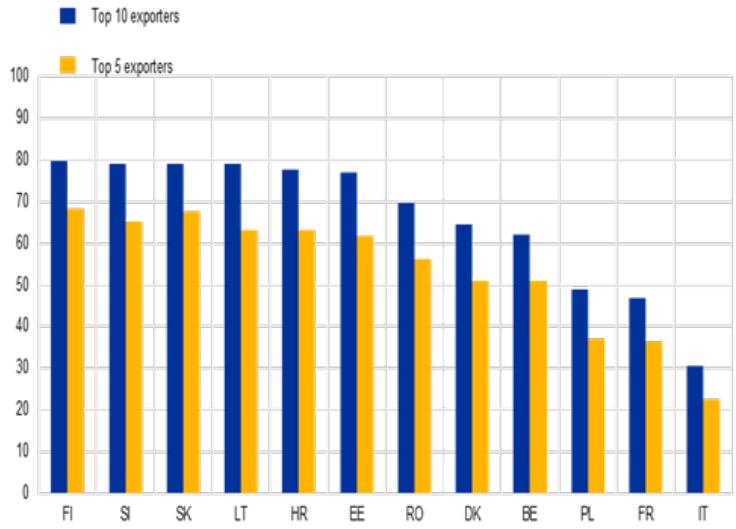
Stylized fact #3: Exports are concentrated in few firms, albeit to a different extent across countries and sectors.

The fact that firms have to pay both a variable and fixed cost for exporting implies that only the most productive firms in a given country or sector can afford to sell in international markets. Moreover, according to Figure 2 the productivity distribution is skewed in all countries, i.e. it features a large mass of low productive firms and few productive firms. Hence, the international performance of a given country will depend on the behaviour of a small number of exporting firms at the top of the distribution (the so-called "happy few" stylized fact advocated by Mayer and Ottaviano, 2011).[12]

In the EU it is found that, on average, the top exporters in a country (top-10 firms in terms of exporting value) account for about 50 to 80 per cent of aggregate exports, with the notable exception of Italy, where the concentration of exports in top exporters is lower (Figure 4). Even in large countries, such as France, the top exporters sell at least half of total exports, so the large concentration is not only explained by country size. There may be more subtle explanations, which we next explore.

[12] Other studies pointing to the fact that few, large firms shape country export patterns are Bernard, Jensen and Schott (2009), Freund and Pierola (2015) and Berthou et al. (2015). The more general conclusion that several macroeconomic questions can be clarified by looking at the behaviour of large firms can be found in Gabaix (2011) and in di Giovanni, Levchenko and Méjean (2014). Moreover, Autor et al. (2017) argue that if globalization or technological changes benefit the most productive firms in each sector, product market concentration will rise as sectors become increasingly dominated by "superstar" firms with high profits; therefore, aggregate outcomes (amongst which the evolution of the country's labour share on which the study focuses) will more intensely reflect the attributes of a handful of firms. However, more recently, and specifically referring to trade, Bonfiglioli, Crinò and Gancia (2018) find that heterogeneity, defined as a variation in characteristics across a large number of firms, explains variation in exports across countries and sectors to a higher extent than granularity, defined as exceptional performance in a small number of firms.

Figure 4. Share of manufacturing exports sold by top exporting firms, broken down by country
(average percentage shares in 2002-2013)



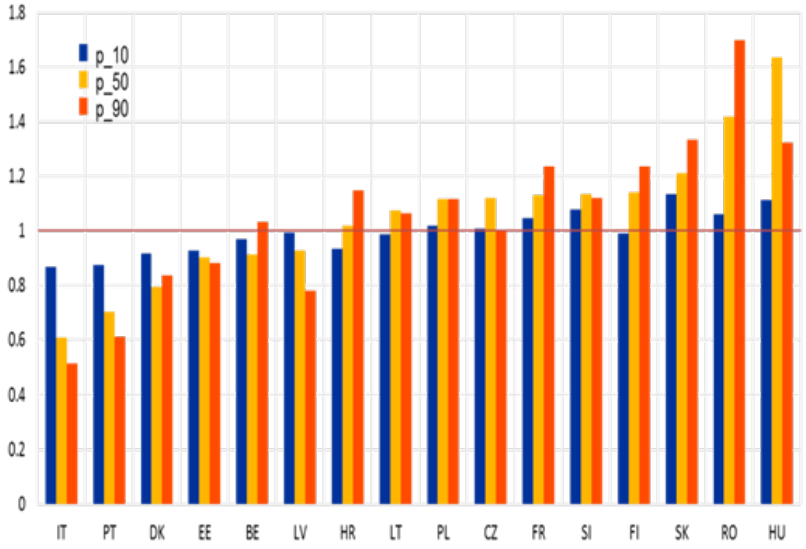
Sources: Authors' calculations based on CompNet data.
Notes: Top exporting firms are the top 5 or top 10 firms in each sector in terms of exporting value. Weighted averages are taken across sectors, where the weights are value-added shares in total manufacturing value added.

One possible reason of this cross-country variation in export concentration is the relative size of exporting firms in each country. The case of Italy is paradigmatic. Figure 5 shows that exporting firms in Italy are smaller than the average in the rest of EU countries considered, after controlling for the sector of activity. This is particularly the case for the large exporting firms in Italy (those in the top 10 per cent of the size distribution of exporting firms), which are only half the size of the large exporting firms in the same sector in other countries (on the specific Italian case, see Bugamelli et al., 2018).

Another possible reason behind the wide disparity in export concentration is country-specific sector specialisation. The reason is that export concentration varies significantly across manufacturing sectors depending on the optimal scale of operation of firms, which in turn depends on sector-specific technological characteristics. Figure 6 shows that concentration is highest in sectors such as transport equipment and pharmaceuticals and lowest in, for example, the machinery and equipment and fabricated metals sectors. Figure 7 shows a positive correlation between the cross-country average export concentration and the median size of firms in each sector, which is a proxy of the required scale of operations in the sector.

Figure 5. Size of manufacturing exporting firms in each country relative to the EU average in the same sector

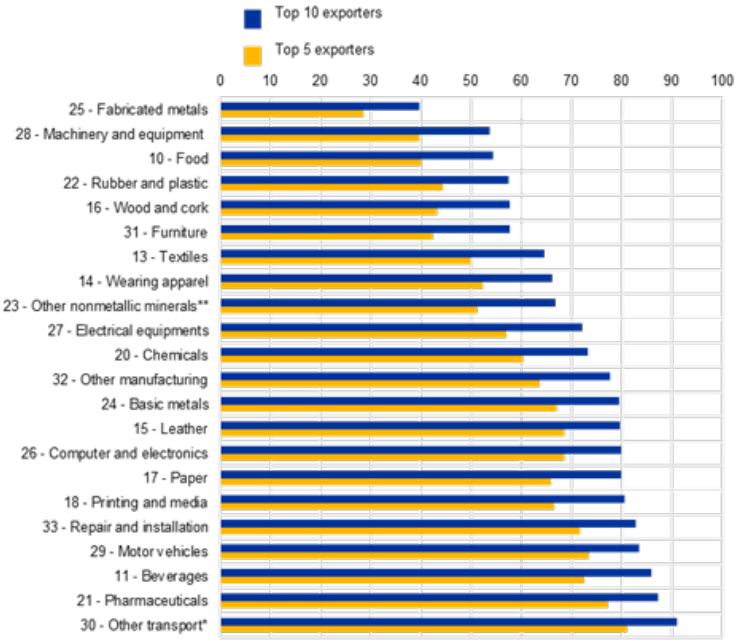
(ratio to the average size of exporting firms in the same sector in other countries, 2002-2013 averages)



Sources: Authors' calculations based on CompNet data.
Notes: Ratio of the size in terms of employees of firms in a given 2-digit manufacturing sector in a given size decile to the EU average, normalised to 1. p_10, p_50 and p_90 refer to a firm in the 10th, 50th and 90th decile of the size distribution, respectively.

Figure 6. Share of manufacturing exports sold by top exporting firms, broken down by sector

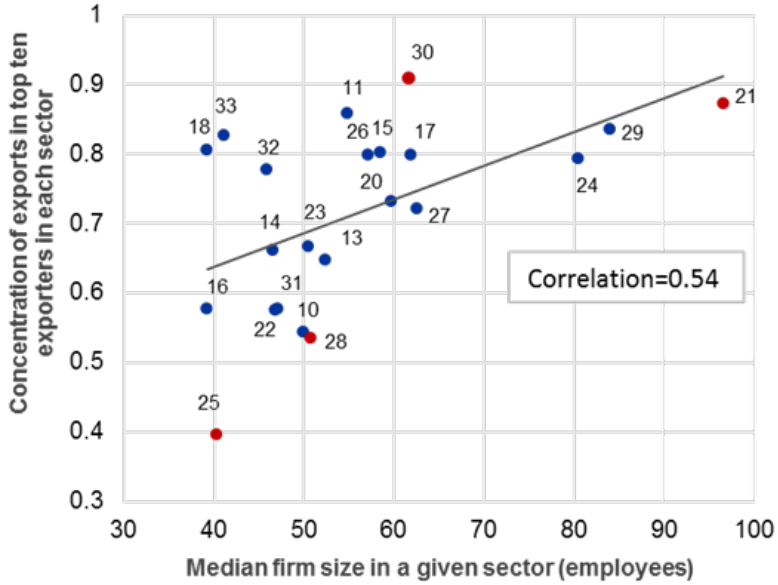
(average percentage shares in 2002-2013)



Sources: Authors' calculations on CompNet data.
Notes: Unweighted averages are taken across countries.*Manufacture of transport equipment net of motor vehicles. **Manufacture of non-metallic mineral products, such as glass, plastic, cement, etc.

Figure 7. Share of manufacturing exports sold by top exporting firms and median firm size in the sector

(average percentage shares in 2002-2013)



Sources: Authors' calculations on CompNet data.

Notes: Export shares of the top ten exporting firms in each manufacturing sector and median number of employees per company in a given sector. Unweighted averages are taken across countries. Sectors: 10. Food products; 11. Beverages; 13. Textiles; 14. Wearing apparel; 15. Leather and related products; 16. Wood and cork; 17. Article products; 18. Printing and media; 20. Chemicals; 21. Pharmaceuticals; 22. Rubber and plastic products; 23. Other non-metallic mineral products; 24. Basic metals; 25. Fabricated metal products; 26. Computer and electronics; 27. Electrical equipment; 28. Machinery and equipment; 29. Motor vehicles; 30. Other transports; 31. Furniture; 32. Other manufacturing; 33. Repair and installation of machinery. Sectors marked in red are sectors with the two highest (sectors 30 and 21) and lowest (sectors 25 and 28) average percentage shares of manufacturing exports sold by top exporting firms; see Figure 6).

2.2 The effects of trade on productivity

External trade can in turn affect the two components of aggregate productivity growth: (i) firms' own productivity growth; and (ii) the reallocation of production factors across firms.[13]

Stylized fact #4: Opening to trade increases within-firm productivity growth, thereby enhancing aggregate productivity growth.

Trade can increase within-firm productivity growth via several channels. First, exporting is associated with skills upgrading, particularly for domestic frontier firms. For example, Bustos (2011) finds an increased demand for skills after the creation of MERCOSUR. Furthermore, as firms become larger and start exporting, they expand their organizational capital inducing a greater need for more complex management structures, which in turn generally brings more skills (Bloom, Draca and Van Reenen, 2016). Exporting also generates opportunities for learning-by-exporting for firms and their workers (De Loecker, 2013). Demand factors also play an important role in inducing positive knowledge spillovers from exporting given that they enable firms to learn about more sophisticated

[13] In addition to firms' productivity, trade can also have beneficial effects on, for example, consumer spending and welfare. It can indeed lead to lower prices of consumer goods, which especially favours low- and middle-income groups who spend a larger share of their disposable income on standardised consumer items (see, for example, Broda and Weinstein, 2006; Carluccio, Gautier and Guilloux-Nefussi, 2018; Jaravel and Sager, 2018), and more generally leads to a greater variety of goods and services for all consumers. The analysis of these effects, however, goes beyond the scope of this paper.

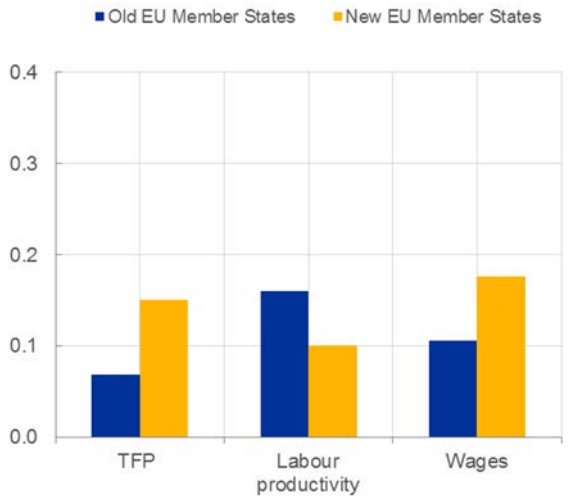
consumers and competitive markets. Accordingly, one explanation of the success of China in international markets is that Chinese firms invested in capability building to improve their product appeal and demand (Sutton, 2007; Schott, 2008; Brandt, Van Biesebroeck, and Zhang, 2012). Furthermore, Brambilla, Lederman and Porto (2012) show that firms exporting predominantly to high-income countries, which, according to Linder's (1961) hypothesis, demand higher-quality goods, use relatively higher levels of skills and pay higher wages than domestic firms or exporters to middle- or low-income countries.

Second, trade liberalisation might alter the decisions related to technology adoption and innovation. For example, if adopting a new technology requires the payment of a fixed cost, the most productive firms, which enjoy higher revenues, will be those adopting the most advanced technologies. Trade liberalisation, by increasing potential export revenues, allows more firms to access the export market and to upgrade their technology, given their productivity level. As a result, during a period of trade liberalisation, both incumbent and new exporters upgrade their technology faster than non-exporters. More specifically, Bonfiglioli, Crinò and Gancia (2016) develop a theoretical model that shows how export opportunities, by increasing the payoffs in the tail of the productivity distribution, induce firms to invest in bigger projects with more spread-out outcomes. Hence, export opportunities increase firm productivity by fostering innovation. Empirical evidence documents that both knowledge flows from international buyers and competitors and enhanced competition boost post-entry performance of new exporters, since exporters are more likely to innovate and to shift resources toward their most profitable products (Mayer, Melitz and Ottaviano, 2014). In particular, using French firm-level data, Mayer, Melitz and Ottaviano (2016) find that in response to positive demand shocks in export markets, multi-product firms skew their export sales towards their best performing products whilst dropping the least-performing products. The increased competition from demand shocks and the induced product mix reallocations are shown to significantly boost productivity growth within the firm.

As a result of trade, the productivity gap relative to new exporters or non-exporting firms thus tends to increase after entry into foreign markets. Figure 8 shows the relative advantage in terms of productivity, size and wage growth of exporting firms which have been operating in international markets for at least three years (the so-called "incumbent exporters" in the CompNet database) relative to new exporting firms operating in the same country, year and 2-digit industry, after controlling for country, sector and year fixed effects. Separate regressions have been run for the old and new EU members. In all cases differences between continuous and new exporters are significant and range from 0.07 percentage point additional annual TFP growth in old EU members (0.16 points in new EU members) to 0.16 points of additional labour productivity growth (0.10 points in new EU members).

Figure 8. Growth of manufacturing incumbent exporters relative to new exporters in the same sector in the EU

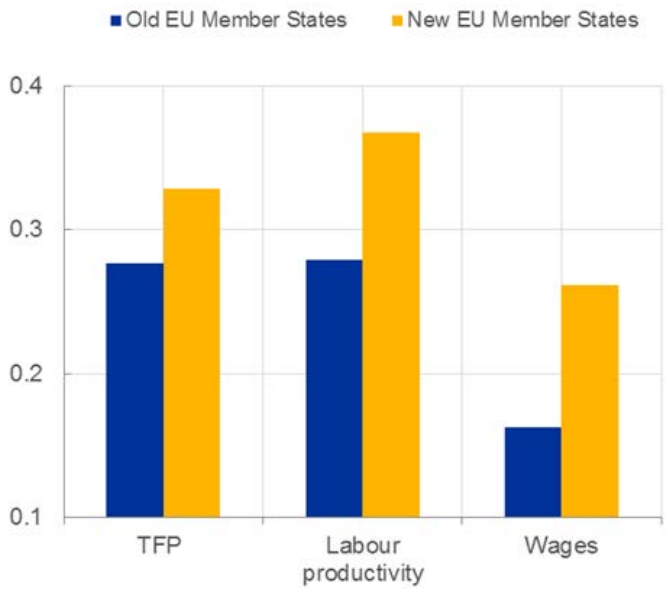
(growth premia of incumbents relative to new exporters; 2002-2013 average)



Sources: Authors' calculations based on CompNet data.
Notes: Unweighted averages across countries; weighted averages across 2-digit sectors, where the weights are value-added shares; average in the period 2002-2013.

Figure 9. Growth of manufacturing incumbent importers relative to non-importers in the same sector in the EU

(growth premia of importers relative to non-importers; 2002-2013 average)



Sources: Authors' calculations based on CompNet data.
Notes: Unweighted averages across countries; weighted averages across 2-digit sectors, where the weights are value added shares; average in the period 2002-2013.

Another channel via which trade boosts firm productivity growth is the import of a wider range of cheaper and/or higher quality intermediate inputs, in turn due to imperfect substitution between domestic and foreign goods, which can lead to higher domestic value added growth, higher

productivity growth and higher quality final goods (Markusen, 1989; Grossman and Helpman, 1991). Recent firm-level evidence confirms the quantitative importance of this input channel for a number of countries, both emerging and advanced, in particular for Chile (Kasahar and Rodrigue, 2008), China (Bas and Strauss-Kahn, 2015), France (Bas and Strauss-Kahn , 2014), Hungary (Halpern, Koren and Szeidl, 2015), India (Topolova and Khandelwal, 2011) and Indonesia (Amiti and Konings, 2007).[14] Moreover, based on cross-country cross-sector time series, Ahn et al. (2016) find that the impact of the input variety and quality channels that underpin input tariff liberalisation on productivity is much stronger than the pro-competition effect of output tariff liberalisation, suggesting that trade liberalisation in upstream sectors matters more for sector-level productivity than liberalisation in the sector itself, especially when FDI barriers are reduced simultaneously. Figure 9 confirms that importing firms grow, in terms of productivity, up to 0.4 percentage points more per year than firms sourcing from domestic providers. This is more than double the growth advantage of continuing exporters versus new exporters shown in Figure 8, hence confirming the relative importance of the import channel for technology diffusion.

The relatively higher wage growth in both importing and continuous exporters also confirms the findings in Koren and Csillag (2011) and MacGarvie (2006), which show that sophisticated machinery and capital goods require highly trained technicians, once they have been imported by a firm. In particular, using data from Hungary for the period 1994-2004, Koren and Csillag (2011) construct a measure of exposure to imported machines combining data on workers' occupations with information on imported products. The study finds that, all other things equal, the wage of workers increases by about 3 per cent after a firm purchases the imported machinery.

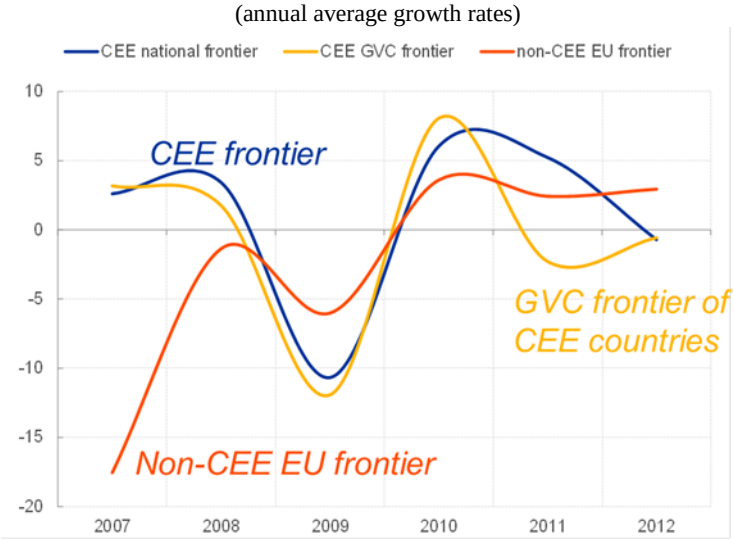
Furthermore, technology tends to flow faster and more easily as a result of the interconnections established in global value chains (GVCs). These production arrangements link together multiple firms, usually located in different countries, in similar ways to intra-group investment and trade. Following Andrews, Criscuolo and Gal (2016), Chiacchio, Gradeva and Lopez-Garcia (2018) use CompNet data for nine Central and Eastern European (CEE) countries merged with information from WIOD input-output tables to examine the role of GVCs as a driver for the diffusion of technology created at the frontier. The study differentiates between two groups of firms in CEE countries: the most productive firms in the sector, i.e. the national frontier firms, directly participating in GVCs, and their local suppliers, indirectly benefitting from technology diffusion through domestic networks. The main results confirm the importance of GVCs for the technology upgrade of firms in EU catching-up economies and establishes that the most important channel for technology diffusion are the backward linkages of host countries, that is, the incorporation of foreign value added to the

[14] Istat (2017) finds that Italian "two-way traders", i.e. firms that both import and export, are larger and have a higher labour productivity than firms that simply export. This is unsurprising given that exporting and importing decisions are interdependent in that incurring the fixed exporting cost increases firm revenue, which makes it more likely that the firm will find it profitable to incur the fixed cost of sourcing inputs from any given country. This study does not, however, investigate whether these premia are a result, or a pre-requisite, of this type of internationalization setup.

host country's exports. Drawing on the results of Chiacchio, Gradeva and Lopez-Garcia (2018), Figure 10 shows the close co-movement between TFP growth of the CEE national frontier firms and the so-called "CEE GVC frontier" which includes the most productive firms in country-sectors in Western Europe with tight GVC links with CEE host economies.

Figure 10. TFP growth of the "frontier" firms and their global value chain (GVC) partners in selected central and eastern European (CEE) EU countries and other EU countries

(annual average growth rates)



Sources: Chiacchio, Gradeva and Lopez-Garcia (2018) based on CompNet and WIOD (2016) data.
Notes: The TFP frontier refers to the unweighted average annual TFP growth of the top 20 per cent of productive firms in each 2-digit sector. The GVC frontier is the weighted average of total TFP of the most productive firms in non-CEE EU countries, with weights based on the share of imported intermediates of each CEE country-sector pair from each non-CEE EU country. The CEE EU countries are Bulgaria, the Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia; the non-CEE EU countries are Belgium, Denmark, Germany, Spain, France, Italy, Austria, Portugal and Finland.

Stylized fact #5: Opening to trade also fosters a more efficient allocation of resources across firms, in turn again increasing aggregate productivity growth.

Trade can also improve the allocation of production factors across firms, which in turn contributes significantly to aggregate productivity growth. Productivity gains from opening to trade may indeed accrue disproportionately to larger and more productive firms, enabling them to gain market share and enhancing aggregate productivity. In particular, as predicted by Melitz (2003), trade liberalisation leads to an increase in export market sales of high-productivity exporting firms, by lowering trade costs. Moreover, the most productive non-exporting firms find it profitable to engage in export activities and to expand to take advantage of the larger foreign market, whereas the least efficient, non-exporting producers tend to exit the market as increased import competition contracts their revenues. Production inputs are, therefore, reallocated towards more productive firms, which leads to an increase in aggregate productivity through a change in industry composition.

The empirical literature has found robust evidence that the reallocation effect across producers stemming from exposure to international trade significantly boosts aggregate productivity.

Based on U.S. census data for 1983-1992, around 40 per cent of aggregate TFP growth was found to result from increasing output shares of the more productive, exporting firms (Bernard and Jensen, 2004). Half of this effect came about because of within-sector reallocation of resources and the other half stemmed from cross-sector reallocation. Similarly, according to CompNet data referring to 14 EU countries in 1998-2011, an increase in export demand was associated with a rise in total manufacturing productivity, of which about one third accrued from within-sector labour reallocation (Berthou et al., 2017).[15]

Table 2 confirms these findings for EU countries by generally showing a positive and significant correlation between sector allocative efficiency and openness to trade, after controlling for country, sector, time and country-year fixed effects. Allocative efficiency is measured in three different ways, depending on the productivity indicator and market share used in each case. The TFP OP gap (first put forward by Olley and Pakes, 1996) refers to the sector covariance between a firm's TFP and its value added share in the sector; the higher this covariance, the larger the size of the most productive firms, the greater the sector's allocative efficiency. The labour productivity OP gap instead measures the sector covariance between firm's labour productivity and its employment sector share. Finally, the capital OP gap is the sector covariance between a firm's capital productivity and its share in sector tangible capital. Sector openness to trade, in turn, is measured by the share of exporting firms in the sector (which accounts for the extensive margin of trade, which we will discuss more thoroughly in Section 3) and by the share of sector's exporting value in the total of the country. Each openness measure is also turned into a dummy taking the value one if the sector is more exposed to international competition than the median in a given country- year.

[15] The importance of the reallocation effect in boosting aggregate productivity is not only limited to advanced economies. For example, in the aftermath of trade liberalisations in Chile, roughly two thirds of the observed rise in aggregate productivity was found to be the result of reallocation from the least to the most efficient producers (Pavcnik, 2002). Based on evidence for Taiwan, Edmond, Midrigan and Xu (2015) find that opening up to trade strongly increases competition and reduces resource misallocation, measured by the dispersion in mark-ups across firms, up to one-half, thereby significantly boosting aggregate productivity.

Table 2. Trade and sectoral allocative efficiency

	DEPENDENT VARIABLE:											
EXPLANATORY VARIABLES:	TFP OPGAP				Labour productivity OPGAP				Capital productivity OPGAP			
Dummy=1 if share of exporting firms>median	0.049**				0.008				0.049*			
	(0.0249)				(0.0124)				-0.025			
Share of exporting firms		0.082				0.045				0.303***		
		(0.123)				(0.051)				(0.105)		
Dummy=1 if share of export value>median			0.136***				0.060***				-0.033	
			(0.034)				(0.015)				(0.030)	
Share of export value				1.083***				0.610***				0.015
				(0.350)				(0.144)				(0.278)
Constant	0.541***	0.498***	0.428***	0.458***	0.135***	0.112***	0.084***	0.086***	-0.313***	-0.466***	-0.288***	-0.316***
	(0.066)	(0.103)	(0.078)	(0.077)	(0.026)	(0.039)	(0.028)	(0.030)	(0.060)	(0.0882)	(0.072)	(0.0687)
Country / sector / year /country-year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1,572	1,572	1,572	1,572	2,190	2,190	2,190	2,190	2,178	2,178	2,178	2,178
R-squared	0.432	0.428	0.455	0.459	0.337	0.337	0.363	0.382	0.472	0.477	0.469	0.467

Sources: Authors' calculations based on CompNet data.
Notes: All regressions control for country, sector, year and country-year fixed effects. Countries included are the Czech Republic, Estonia, Latvia, Poland, Slovakia ,Slovenia, Belgium, France and Italy. The definitions of the dependent and explanatory variables are provided in the main text. *** p<0.01, ** p<0.05, * p<0.10, + p<0.15.

3. Firm heterogeneity and the elasticity of exports to real effective exchange rates

Aggregate export dynamics depend on a number of factors, one of which is the change in a country's price competitiveness, in turn commonly measured by the real effective exchange rate (REER): an improvement in price competitiveness, measured by a REER depreciation, generally leads to higher export growth.

Stylized fact #6: The elasticity of exports to changes in the REER varies across sectors and across firms.

Analyses based on macroeconomic data have pointed to a low reactivity of exports to REERs, or to Harmonised Competitiveness Indicators (HCIs) for euro-area countries, suggesting an incomplete pass-through or "exchange rate disconnect", as well as vast country heterogeneity.[16] The sensitivity of exports to REERs appears, however, to be higher when it is estimated on more granular data. Indeed, export elasticities estimated using sector- or firm-level data and then aggregated at the country level are significantly larger in absolute value than macro-elasticities (see Table 3 and references therein), as are sector-aggregated import elasticities (see, for example, Imbs and Mejéan, 2008; Felettigh and Federico, 2010; Corbo and Osbat, 2013).[17]

[16] The elasticity of exports of euro-area countries to HCIs in macroeconomic analyses is generally smaller than one (Goldstein and Khan, 1985; Christodoulopoulou and Tkačevs, 2014; Giordano and Zollino, 2016 and 2017; Bugamelli et al., 2018).

[17] Referring to Table 3, Corbo and Osbat (2013) estimate Armington elasticities of substitution for 106 manufacturing industries, based on monthly Eurostat product-level COMEXT data for the period 1995-2009 and then aggregate them to a country estimate using country-specific weights. Import and export elasticities are then retrieved as (1-the Armington elasticity). Christodoulopoulou and Tkacevs (2014) estimate standard export and import long-run elasticities using quarterly national account Eurostat data from 1995 to 2013 and a wide range of HCIs, based on different price and cost indices. In principle, trade elasticities computed using aggregated data should reflect the weighted average of the sectorial elasticities, as long as residuals are well-behaved. However, Imbs and Mejéan (2015) among others shows that this is not the case and results in aggregation bias. More concretely, the estimation of elasticities based on aggregate data presumes: i) the same reaction of trade volume across goods, regardless of the degree of substitution between domestic and foreign goods (in reality, a homogenous good will react more strongly to exchange-rate movements); and ii) that each good accounts for the same import share in a country's basket. As in the real world this is not the case because of heterogeneity, residuals will be correlated with the regressors, thus biasing the coefficients, and therefore the estimated elasticities, downwards.

Table 3. Elasticity estimates based on macro and sectoral data

	Macro elasticity of exports of goods to HCIs	Sector aggregated export elasticity of goods to relative unit value of exports and imports
AT	-0.85	-3.0
CY	-0.03	-5.4
EE	-0.78*	-6.9
FI	-2.41*	-2.5
FR	-0.79*	-3.4
DE	-0.50*	-4.3
GR	0.55	-3.6
IE	-0.45	-2.3
IT	-0.33*	-2.4
MT	-2.66*	-4.0
NL	-0.39*	-2.7
PT	-1.12*	-3.1
SK	-0.43	-3.3
SI	0.00	-3.4
ES	-0.55*	-2.5

Sources: Christodoulopoulou and Tkacevs (2014) for macro elasticities and Corbo and Osbat (2013) for sector-aggregated elasticities.
Notes: * denotes significance at least at a 10 per cent confidence level. See footnote 26 for details on how these elasticities are computed.

We contribute to this existing set of findings by employing CompNet data and by estimating, in particular, the following regression, country by country:

$$\Delta totexports_{s,t} = \alpha + \beta_1 \, \Delta fdemand_{s,t} + \beta_2 \, \Delta reer_{s,t} + FE + \varepsilon_{s,i,t} \quad (3)$$

where the dependent variable is the year-on-year log change in the total export value of all exporters in sector *s* and time *t* of a given country. Variables are respectively the log change in foreign demand and that in the REER/HCI of the same country-sector in the same time period; in particular, the latter are taken with a one-year lag, consistently with the literature that finds a delayed effect of REER movements on exports (for example, Christodoulopoulou and Tkačevs, 2014; Giordano and Zollino, 2016 and 2017; Bugamelli et al., 2018). Exports are sourced from CompNet. The foreign demand variable is taken from Berthou et al. (2017), which provides an exogenous indicator of foreign demand addressed to each country-sector-year.[18] The sectorial REER/HCI variable, deflated with the producer price index, is sourced from Dozovic (2017). Estimation is obtained by applying Pesaran and Smith's (1995) Mean Group (MG) estimator. For a given country, this procedure estimates

[18] In particular, this is similar to a Bartik instrument, constructed on WIOD data, which exploits information about the initial export structure of each country-sector and foreign partners' total imports in these sectors, following a similar methodology developed in Berman, Berthou and Héricourt (2015). We are very grateful to Antoine Berthou for sharing these data with us.

regression (3) for each sector, allowing therefore for heterogeneous elasticities across sectors, and then averages the estimated elasticities across sectors.

Standard results of an increase in foreign demand and/or a depreciation in the REER/HCI boosting exports are reported in Table 4.[19] Although not strictly comparable due to the fact that CompNet export data are in value terms whereas the elasticities reported in the second column of Table 3 are based on volumes and those in the third column on unit values, it is clear that our estimates generally lie in between the macro and the genuinely micro results given the micro-aggregated underlying nature of the CompNet dataset, they are, however, still biased to the downside.

Table 4. REER/HCI elasticity estimates by country based on CompNet micro-aggregated data

	DEPENDENT VARIABLE: Δ total export value of all exporters							
EXPLANATORY VARIABLES	Belgium	Italy	France	Lithuania	Finland	Poland	Hungary	Romania
Δ foreign demand (t/t-1)	0.7323***	0.9918***	0.8285***	1.4655***	1.1944***	1.1819***	1.1430***	1.0199***
	(0.0468)	(0.0300)	(0.0290)	(0.1058)	(0.0416)	(0.0794)	(0.0487)	(0.0661)
Δ REER (t-1/t-2)	0.2709***	-0.7916***	-0.9272***	-1.3932***	-0.9679***	0.2265***	0.2223+	-0.1480**
	(0.0920)	(0.0789)	(0.0763)	(0.1461)	(0.2244)	(0.0746)	(0.1597)	(0.0734)
Constant	-0.0296***	-0.0186***	-0.0450***	0.0425***	-0.0257***	0.0301***	0.0289***	0.0417***
	(0.0035)	(0.0028)	(0.0028)	(0.0130)	(0.0045)	(0.0051)	(0.0048)	(0.0081)
Sector / year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	976	1456	1438	922	965	500	803	957
Root mean-squared error	0.317	0.131	0.060	0.130	0.074	0.156	0.056	0.138

Source: Authors' estimations.
Notes. Country-specific mean-group estimation results of equation (3). Robust standard errors in parentheses. .*** p<0.01, ** p<0.05, * p<0.10, + p<0.15.

In addition, estimated trade elasticities are very heterogeneous across sectors. For example, the standard deviation of import elasticities across 4-digit manufacturing industries in Germany has been found to be nearly 4 (Corbo and Osbat 2013). The sectoral composition of a country's exports therefore significantly affects the role of the REER in explaining aggregate export performance. For instance, Auer and Sauré (2011) show that Swiss exports are heavily concentrated in price-insensitive sectors, explaining the low reactivity of aggregate Swiss exports to changes in the REER.

Table 5 reports estimation results of regression (3) on the dataset described above, now estimated sector by sector; MG estimation is again employed, this time to allow for country slope heterogeneity. On average in the panel of EU countries reported in Table 4 sectoral REER elasticities

[19] The few exceptions are Belgium, Poland and, possibly, Hungary, for which the REER elasticity is actually positive, yet small in absolute terms. This could be due to the fact that these countries import a significant amount of intermediate inputs, also to produce their exports, which could explain the sign of the REER elasticity. Indeed, according to WIOD data, these three countries' manufacturing share of imported intermediate goods out of total intermediate goods was over 40 per cent on average in the 2002-2013 period, against for example approximately 25 per cent in Italy. Note that the fit of the specification (inversely proxied by the root mean-squared error) is the worst in the cases of Belgium and Poland, potentially suggesting an omitted variable bias, where the omitted variable could be the participation in global and/or regional value chains. Table 6, pooling all countries, shows that indeed higher participation in GVC could turn positive the sign of the REER coefficient.

are generally statistically significant and negative, albeit with different magnitudes across sectors.[20] In other terms, there is large sectoral heterogeneity in the REER elasticity within countries, even inside the EU.

Table 5. REER/HCI elasticity estimates by sector based on CompNet micro-aggregated data

DEPENDENT VARIABLE: Δ total export value of all exporters										
EXPLANATORY VARIABLES	Food products	Beverages	Textiles	Wearing apparel	Leather	Wood	Paper	Printing	Chemicals	Pharmaceuticals
Δ foreign demand (t/t-1)	0.7279***	0.9520***	1.1704***	1.1905***	1.4506***	1.0508***	1.1428***	1.0948***	1.5033***	0.0172
	(0.0404)	(0.1150)	(0.0539)	(0.0786)	(0.1530)	(0.0312)	(0.1332)	(0.1483)	(0.0634)	(0.0709)
Δ REER (t-1/t-2)	-0.5467***	0.1013	-0.4792***	0.3142+	-1.7139***	-1.1329***	-0.9307***	-0.1120	-0.3232**	-0.7268***
	(0.0900)	(0.3212)	(0.1814)	(0.2360)	(0.2599)	(0.2567)	(0.3155)	(0.2640)	(0.1353)	(0.1338)
Constant	0.0060**	-0.0034	-0.0553***	-0.0973***	0.0124***	0.0144*	-0.0005	0.0096	-0.0297***	0.0546***
	(0.0027)	(0.0169)	(0.0063)	(0.0063)	(0.0043)	(0.0083)	(0.0058)	(0.0144)	(0.0060)	(0.0115)
Country / year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	559	368	491	522	430	527	479	415	458	333
Root mean-squared error	0.077	0.135	0.169	0.115	0.124	0.080	0.109	0.151	0.100	0.178

DEPENDENT VARIABLE: Δ total export value of all exporters										
EXPLANATORY VARIABLES	Rubber	Other non-metallic minerals	Basic metals	Fabricated metals	Computer equipment	Electrical equipment	Machinery and equipment	Motor vehicles	Furniture	Other manufacturing
Δ foreign demand (t/t-1)	1.0500***	1.0023***	1.1230***	0.7246***	0.3514***	1.0077***	0.9611***	1.4207***	0.7869***	0.7457***
	(0.0220)	(0.0706)	(0.0435)	(0.0254)	(0.1023)	(0.0972)	(0.0159)	(0.0216)	(0.0830)	(0.1737)
Δ REER (t-1/t-2)	0.0334	-0.7146***	-0.3035***	-0.0021	-0.5509***	-0.4174***	0.1620	0.1034	-1.1597***	0.9933***
	(0.0540)	(0.1371)	(0.0903)	(0.1214)	(0.0675)	(0.1090)	(0.2182)	(0.5158)	(0.2718)	(0.2561)
Constant	0.0139+	-0.0127+	-0.0124**	0.0298***	-0.0446***	-0.0102+	0.0214***	0.0019	-0.0004	0.0060
	(0.0085)	(0.0084)	(0.0053)	(0.0063)	(0.0064)	(0.0073)	(0.0062)	(0.0080)	(0.0073)	(0.0095)
Country / year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	531	511	425	586	479	484	562	479	503	445
Root mean-squared error	0.073	0.189	0.087	0.110	0.210	0.109	0.092	0.089	0.123	0.464

Source: Authors' estimations.

Notes. Sector-specific mean-group estimation results of equation (3). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10, + p<0.15.

Stylized fact #7: The intensive margin of exports is found to react less to REER fluctuations the larger the market power in a given sector and the more import-intensive the exports.

REERs may also affect the two margins of aggregate export performance to a different extent, which can also explain the large cross-sector heterogeneity in REER elasticities. Medium-run export dynamics can indeed be decomposed into the "intensive margin" of exporters (the changes in foreign sales of existing exporting firms) and the "extensive margin" (the entry of new exporters). Hence a REER depreciation, to the extent that it lowers the sunk cost of exports, can both boost sales abroad of existing exporters and facilitate the entry of new exporters. The underlying micro-economic structure of each sector matters in determining the reaction of export volumes to changes in exchange rates via these two channels.

[20] The positive sign and/or statistical insignificance that comes up in some sectors could either be due to the lower number of observations (e.g. beverages) and/or to the fact that some sectors may be on average more dependent on imported intermediate goods, such as wearing apparel and fabricated metals, which can flip the expected negative sign of the REER elasticity.

Starting with the intensive margin, Berthou and Dhyne (2018) find that large and more productive exporting firms exhibit up to three times lower elasticities to CPI-deflated REER movements and up to eight times lower elasticities to unit labour cost-deflated elasticities than the smaller, less productive exporting firms. This result is based on the estimation of export elasticities to REERs by firm-level productivity quartile on CompNet data for 11 EU countries in the period 2001-2011. Comparable results are also found in Demian and di Mauro (2015).

Hence, the overall reactivity of exports to REER fluctuations is lower the larger the concentration of exports in fewer, larger, highly productive firms. One possible explanation of the different reactivity of firms to exchange rate shocks is that firms have heterogeneous pricing-to-market strategies: in particular, the larger, more productive enterprises tend to absorb exchange rate changes by varying their mark-up, which leads to a weaker reaction of their export volumes. There is indeed strong evidence of heterogeneous pricing-to-market strategies, for example, in France (Berman, Martin and Mayer, 2012). Multi-products firms are also less sensitive to REER movements: in response to negative exchange rate shocks, firms pull out their least productive products from the export markets and concentrate on their more productive goods (Dekle, Jeong and Kiyotaki, 2015; Mayer, Melitz and Ottaviano, 2016). More import-intensive exporters, which are usually the largest and most productive firms even amongst exporters, adjust their export prices less to changes in exchange rates, since they face offsetting exchange rate effects on their marginal costs of production; this low reactivity to REER developments is further reinforced by the fact that these exporters also have high export market shares and hence large mark-ups (Amiti, Itskhoki and Konings, 2014).[21] Based on Belgian firm-level data, in this study it is found that if small exporters barely adjust their producer prices and fully pass on the exchange rate movements to foreign consumers, larger exporters offset nearly half of changes in exchange rates by adjusting their prices. These results have important implications for aggregate pass-through since large exporters account for a huge share of exports, as seen already in Figure 4. Finally, large firms may be able to resort to exchange rate hedging via financial instruments which may not be available or are too costly for small firms. Moreover, using data on Japanese firms, Dekle and Ryoo (2007) find that firms hedge less in industries in which an exchange rate depreciation is correlated with loosening financing constraints. In industries in which a currency depreciation is correlated with tightening financing constraints, firms hedge more, to insulate their cash flows from exchange rate shocks.

With respect to the intensive margin, we estimate the following dynamic export regressions on CompNet data for 12 EU countries in the years 2001-2012:

$$\Delta avgeexports_{s,i,t} = \alpha + \beta_1 \, \Delta fdemand_{s,i,t} + \beta_2 \, \Delta^{-} reer_{s,i,t} + \beta_3 \, y_{s,i,t} + \beta_4 \, \Delta^{-} reer_{s,i,t} * y_{s,i,t} + FE + \varepsilon_{s,i,t} \quad (4)$$

[21] In other terms, a firm's import intensity and destination-specific export market share are a sufficient statistic for its exchange rate pass-through, with the former proxying for marginal cost sensitivity to exchange rates and the latter proxying for mark-up elasticity.

where the dependent variable is the year-on-year log change in the average export value of incumbent exporters only in sector *s*, country *i* and time *t*. The first two explanatory variables are respectively the log change in foreign demand and the negative log change in the REER/HCI of the same country-sector in the same time period and *y* is either a measure of concentration in a given sector (denoted *C10* below) or an indicator of GVC participation. Similarly to exports, the concentration measures are taken from CompNet. Foreign demand and sectorial REER/HCIs are the same as those employed to estimate equation (3). We here include negative changes in the REER/HCI in order to single out the effect of real depreciations, given the often documented asymmetric response of exports to REER movements. Finally, the GVC participation indicator is taken from the OECD TiVA database as an average of the backward participation indicator (i.e. foreign value added embodied in exports, as a percentage of total gross exports of the exporting country) and of the forward participation indicator (i.e. domestic value added embodied in foreign exports, as a percentage of total gross exports of the source country).

Results in Table 6, obtained by OLS with sector, country and time fixed effects, point to a real depreciation in a country-sector being linked to an increase in average exports of an already exporting firm in that sector (column 1).[22] Moreover, higher growth in sectorial foreign demand is associated with a larger rise in the average exports of a firm in that sector. These are standard results. Real depreciations are then found to boost average firm exports less the more concentrated the sector (so indirectly, both the larger the size of firms and the higher their mark-ups; column 2). Furthermore, elasticities are lower (in absolute value) the more integrated the firms in the sector are in GVCs (column 3), and actually could turn positive, more generally confirming the results in Amiti, Itskhoki and Konings (2014).[23]

[22] The correlation is statistically weak in this regression, but becomes more robust when sectoral characteristics are taken into account. Interestingly, this effect is contemporaneous. A similar analysis on the extensive margin, which we discuss further on, finds a significant negative correlation between this other margin and a REER depreciation, albeit with a one-year lag. Indeed, it is presumably easier and quicker for an already exporting firm to increase its foreign sales than for a non-exporting firm to start exporting, in the face of a REER depreciation.

[23] When both concentration and GVC measures are included together, they lose statistical significance, plausibly due to multicollinearity.

Table 6. The link between real depreciations and the intensive margin of trade

	(1)	(2)	(3)
EXPLANATORY VARIABLES	DEPENDENT VARIABLE: Δ average export value of continuing exporters		
Δ foreign demand (t/t-1)	0.56***	0.52***	0.53***
	(0.169)	(0.186)	(0.168)
Δ - REER (t/t-1)	-0.51+	-0.98***	-1.91**
	(0.345)	(0.290)	(0.769)
C10 (t)		0.02	
		(0.126)	
Δ - REER (t/t-1) * C10 (t/t-1)		0.58**	
		(0.282)	
GVC participation (t-1)			0.28*
			(0.143)
Δ - REER * GVC participation (t/t-1)			3.60*
			(2.122)
Constant	-0.14	-0.14+	-0.06
	(0.120)	(0.105)	(0.053)
Country / sector / year fixed effects	YES	YES	YES
Observations	1,207	1,087	1,206
R-squared	0.2013	0.1931	0.2045

Source: Authors' estimations.

Notes. Panel fixed-effects estimation results of equation (4). Robust standard errors in parentheses. .*** p<0.01, ** p<0.05, * p<0.10, + p<0.15.

Stylized fact #8: The larger the mass of firms that are close to the "productivity threshold", the higher the reactivity of the extensive margin of exports to changes in the REER.

Turning to the extensive margin, a depreciation of the REER in a given country will trigger higher demand for its tradable goods, thus leading to a decrease in the "productivity threshold" of exporting firms, i.e. the threshold above which it becomes feasible for firms to enter export markets. The larger the mass of firms close to this threshold in a given country, the higher the probability that new firms will be able to enter foreign markets when price competitiveness improves. Using CompNet data, di Mauro and Pappadà (2014) show that the thickness of the right tail of the productivity distribution affects the extent to which the extensive margin of trade contributes to the increase in aggregate exports. This result is, however, valid only in static terms. Indeed, given that the "productivity threshold" cannot be measured, it is not that straightforward which summary statistic of the productivity distribution is the most relevant to proxy the mass of firms that could start exporting in the face of a REER shock.

For this exercise we have decided to approximate the productivity threshold to start exporting with the average TFP of new exporters, in a given country-sector-year. We next argue that the closer

to this threshold is the average productivity of non-exporters in that same country-sector-year, the more firms will find it profitable to start exporting after a REER depreciation.

In order to test this hypothesis, we construct the ratio of TFP of non-exporters to new exporters for each country-sector year sourced from CompNet and estimate the following regression:

$$Number\ of\ new\ exporters_{s,i,t} = \alpha + \beta_1\ \Delta fdemand_{s,i,t} + \beta_2\ \Delta^{-}reer_{s,i,t-1} + \beta_3\ rTFPno\_new_{s,i,t-1} + \beta_4\ \Delta^{-}reer_{s,i,t-1} \times rTFPno\_new_{s,i,t-1} + FE + \varepsilon_{s,i,t} \quad (5)$$

where the dependent variable is the number of new exporting firms in sector *s*, country *i* and time *t*, the first two explanatory variables are respectively the change in foreign demand and the negative change in the REER of the same country-sector in the previous period and *rTFPno_new* is a the ratio of average TFP of non-exporters to new exporters in the same country, sector and year. The larger the ratio, the closer is the productivity of non-exporters to the required exporting threshold. Panel OLS with country, sector and time fixed effects are employed. Results in the first column of Table 7 confirm the standard findings that a depreciation in the REER is correlated with a rise in the number of exporting firms, albeit with a two-year delay. The second column includes the interaction of the depreciation in the REER with the relative TFP of non-exporters, which is statistically significant and negative, suggesting that the higher the mass of firms "available" to enter the export market, the larger the positive impact of a REER depreciation on the number of exporters.

Table 7. The link between real depreciations and the extensive margin of trade

	(1)	(2)
EXPLANATORY VARIABLES	DEPENDENT VARIABLE: Number of new exporters	
Δ foreign demand (t/t-1)	0.38	0.52
	(0.325)	(0.414)
Δ - REER (t-2/t-3)	-2.33***	5.56
	(0.669)	(5.023)
Δ - REER (t-1/t-2) * ratio TFP no_new (t-1)		-11.01*
		(5.844)
ratio TFP no_new (t-1)		-0.11
		(0.165)
Constant	2.24***	2.26***
	(0.146)	(0.177)
Country / sector / year fixed effects	YES	YES
Observations	598	388
R-squared	0.682	0.759

Source: Authors' estimations.

Notes. Panel fixed-effects estimation results of equation (4). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10, + p<0.15.

Ultimately, the overall sensitivity of aggregate exports to changes in the REER will depend on the relative importance of the intensive versus extensive margins of exports. The existing empirical literature is inconclusive with respect to the relative importance of these two channels, since it varies across sectors, the considered time-span and the granularity of the employed data (see, for example, Helpman, Melitz and Rubenstein, 2008; Crozet and Koenig, 2008; Fernandes et al., 2018). However, the intensive margin is generally found to matter more than the extensive margin in advanced economies (Campa, 2004; Besedeš and Prusa, 2011; Bugamelli, Linarello and Serafini, 2018).

4. Concluding remarks

This paper reviews some implications of firm heterogeneity for external trade. Indeed, the availability of firm-level data has unveiled the vast heterogeneity of performance across firms even within narrowly defined sectors and has led to the development of theoretical models which accommodate for this heterogeneity. By using the comparable cross-country micro-aggregated CompNet database available for 14 EU economies, this paper uncovers and confirms eight stylized facts underlying the recent trade literature, for the first time to our knowledge for such a wide country sample.

New exporting firms are larger, more productive and pay higher wages than non-exporting firms (*Fact #1*). There is indeed evidence of significant premia in terms of size, wages and labour productivity of new exporting firms relative to non-exporting firms operating in the same sector in selected EU countries. This suggests that only the most productive and largest firms can actually afford to bear trade costs, and thus self-select into exports. Fixed costs of exporting depend, among other factors, on the quality of the domestic legal system, access to finance and tariff and non-tariff trade barriers (*Fact #2*). Improvements in firm productivity, as well as reductions in exogenous trade costs, can have substantial positive effects on firms' sales and therefore on aggregate exports. For example, by improving institutional quality and by eliminating trade barriers, a higher number of firms could bear the cost of exporting.

Overall exports are concentrated in few firms, albeit to a different extent across countries and sectors (*Fact #3*). Therefore, the behaviour of a handful of enterprises can have a significant impact on a country's aggregate (external) performance; focusing on average, "representative" firms misses out on this granularity.

Opening to trade increases within-firm productivity growth (*Fact #4*), and therefore aggregate productivity, via several channels (learning-by-doing; increase in innovation; rise in the quality of inputs). Trade liberalisation also increases aggregate productivity by fostering a more efficient allocation of production factors across firms (*Fact #5*).

An important determinant of export growth is the change in the real effective exchange rate (REER). The reactivity of exports to changes in the REER is affected by firm heterogeneity, which is

only picked up by granular data. Indeed, in the literature trade elasticities are found to vary across sectors and across firms (*Fact #6*). The microstructure of the economy also affects the way REER movements impact on the two components of aggregate export performance, namely the "intensive" and the "extensive margin" of exports. In particular, the intensive margin of exports, i.e. the average exports of existing exporters, is found to react less to REER fluctuations the larger their market power in a given sector and the more import-intensive their exports (*Fact #7*). Moreover, the smaller the mass of firms close to the "productivity threshold" above which they start to export, the lower the reactivity of the extensive margin of exports, i.e. the entry of new exporters, to changes in the REER (*Fact #8*). The overall effect of changes in the REER on aggregate external performance thus depends on several factors, such as firm characteristics, the productivity distribution within sectors and the composition of sectors within the total economy, as well as on the relative importance of the intensive and extensive margins.

Annex 1. CompNet data and country/year coverage

The Competitiveness Research Network (CompNet) was founded by the EU System of Central Banks in 2012 to bring together the work and expertise of economists working on competitiveness-related issues. The purpose was to improve the analysis of competitiveness, understood in a broad sense, by exploiting macro, micro and global value chain information. The main output of the network has been, and still is, to produce comparable cross-country firm-based information that underlies the analyses conducted by the participating institutions as well as the research community.

Since 2012 CompNet has evolved and been enlarged, increasing the number of stakeholders which now include, besides the European Central Bank and a number of National Central Banks of the ESCB, the European Commission, the European Investment Bank and the European Bank for Reconstruction and Development. The Halle Institute for Economic Research and the Tinbergen Institute, two European research institutes renowned for their expertise in productivity analysis, also actively participate in the project, with the Halle Institute also cooperating in a number of important tasks like the preparation of the statistical code, the collection of data, and the provision of other services. Another important development has been the involvement as data providers of a number of National Statistical Institutes and other national research centres with access to firm-level data.

The CompNet dataset is based mainly on administrative data from firm registries and provides harmonised cross-country information on the main moments of the sector distribution (mean, median, standard deviation, deciles of the distribution, etc.) for a number of variables related to firm performance and competitiveness. From the beginning CompNet adopted the so-called "distributed micro-data approach" as developed by Bartelsman, Haltiwanger and Scarpetta (2004). In this approach a common protocol is used to extract relevant information, aggregated in such a way to preserve confidentiality, from existing firm-level datasets available within each National Central Bank (NCB) or National Statistical Institute (NSI) but keeping much of the richness of the underlying firm-level information. The common methodology harmonizes industry coverage, variable definitions, estimation methodologies and sampling procedures, as much as the underlying raw data allows it. Details are documented in Lopez-Garcia and di Mauro (2015), Berthou et al. (2015), Aglio et al. (2018) and Lopez-Garcia (2018), to which we refer.

This paper uses information from the 4th and 5th vintages of the dataset, the most recent vintages available at the time of writing. In February 2019 CompNet released the 6th vintage, including information for a similar number of countries until 2015. The new vintage incorporates several improvements relative to the previous rounds in terms of to both the content and the procedure of data collection. However the number of indicators collected in the "Trade" module, heavily employed in this paper, is small. In particular, the value of exports is not measured and this makes it

currently impossible to reproduce the analysis in this paper with the more updated data. The next vintage of the CompNet dataset, which should be available in early 2020, will again include all the main trade indicators.

Table A1 shows the share of firms and employment covered by the merged 4th and 5th vintages of CompNet in each country. The first two columns refer to the coverage of the population of similar firms, i.e. non-financial corporations with employees operating in the business economy, whereas columns 3 and 4 refer to the coverage of the corresponding national accounts aggregates.

The coverage of this specific paper, in terms of countries and years, is instead illustrated in Table A2. Cross-country comparable trade data are not available for Spain, which is therefore dropped from all trade-related Figures and regressions. Moreover, 54 2-digit sectors in the non-financial business economy according to the NACE rev.2 system are considered. For presentation purposes in the paper, results are often aggregated to nine 1-digit sectors (macro-sectors), by using value-added shares.

Finally, CompNet collects all indicators for two distinct samples of firms: (1) non-financial corporations with at least one employee (full sample); and (2) non-financial corporations with at least 20 employees (20E sample). The reason is that some countries do not sample small firms (these are the cases of France, Poland and Slovakia). To be able to compare those countries with the rest of CompNet participants, all information is collected considering only firms with at least 20 employees in all countries. Furthermore, that sample is population weighted so that the distribution of firms in the sample resembles the distribution of firms in the population by macro-sector and size class. For comparability reasons we only use the 20E sample in the analysis of this paper, unless otherwise indicated.

Table A1. CompNet dataset's firm and employment coverage

	Coverage vs. similar population of firms (OECD)[1]		Coverage vs. National Accounts (Eurostat)[4]	
Country	**Average No. of firms per year**	**Total employment**	**Value added**	**Total employment**
Belgium	23%	79%	33%	40%
Czech Republic	6%	70%	17%	39%
Denmark	40%	86%	37%	50%
Estonia	67%	90%	7%	28%
Finland	44%	83%	42%	48%
France[2]	86%	89%	46%	63%
Hungary[3]	44%	88%	20%	50%
Italy	11%	65%	20%	34%
Lithuania[3]	27%	43%	20%	46%
Poland[2]	76%	91%	24%	58%
Romania[3]	70%	47%	29%	37%
Slovakia[23]	91%	95%	NA	29%
Slovenia[3]	31%	85%	NA	46%
Spain	18%	47%	51%	30%

Notes: (1) Coverage is computed over the period 2004-2007, with the exception of Portugal (2006-2007). Data of the population of firms with at least 1 employee come from the OECD Structural Business Statistics repository; (2) France, Poland and Slovakia provide information only for firms with 20 employees or more. The coverage is computed over the population of firms with 20 employees or more; (3) Coverage of the whole economy (not only private firm sector) is computed for 2005, with the exception of Portugal for which 2006 is used instead. Eurostat data comes from National accounts: series nama_gdp_c and nama_aux_pem, respectively.

Table A2. CompNet country/year coverage for this article

Productivity module	**BE** (2002-2013), **DK** (2002–2013), **EE** (2002-2013), **ES** (2002–2013), **FI** (2002-2013), **FR** (2002–2013)**, **HR** (2002-2013), **HU** (2003 – 2012)*, **IT** (2002-2013), **LT** (2002-2011)*, **PL** (2005–2013)**, **RO** (2003–2012)*, **SI** (2002-2012)*, **SK** (2002–2013)**
Trade module	**BE** (2002-2013), **DK** (2002-2013), **EE** (2002-2013), **FI** (2002-2013), **FR** (2002-2013)**, **HR** (2002–2013), **HU** (2003 – 2012)*, **IT** (2002–2013), **LT** (2002-2011)*, **PL** (2005–2013)**, **RO** (2003-2012)*, **SI** (2002–2012)*, **SK** (2002-2013)**

Notes: (*) indicates countries for which only the 4th vintage of the CompNet dataset is available, with data until 2012. For the rest of the countries the 5th vintage is available with data up until 2013. (**) is available only for firms with 20 or more employees. Differences in the country/year coverage may arise for specific indicators within each module.

Annex 2. Variable definitions

Variables*	Definition	Source
Legal System		
Judicial independence	This component is taken from the Global Competitiveness Report question: "Is the judiciary in your country independent from political influences of members of government, citizens, or firms?"	World Economic Forum, Global Competitiveness Report
Protection of property rights	This component is taken from the Global Competitiveness Report question: "Property rights, including over financial assets, are poorly defined and not protected by law or are clearly defined and well protected by law"	World Economic Forum, Global Competitiveness Report
Contract enforcement	This component is based on the World Bank's Doing Business estimates for the time and money required to collect a debt. The debt is assumed to equal 200% of the country's per-capita income where the plaintiff has complied with the contract and judicial for (1) the time cost (measured in number of calendar days required from the moment the lawsuit is filed until judgment is rendered in his favour. Zero to-10 ratings were constructed payment); and (2) the monetary cost of the case (measured as a percentage of these two ratings were then averaged to obtain the final rating for this sub-component).	World Bank, Doing Business.

Tariff and non-tariff barriers to trade		
Revenue from trade taxes (% of X and M)	This sub-component measures the amount of tax on international trade as a share of exports and imports.	IMF, Government Finance Statistics Yearbook; International Monetary Fund, International Financial Statistics.
Tariff and non-tariff barriers	This sub-component is based on the Global Competitiveness Report survey question: "In your country, tariff and non-tariff barriers significantly reduce the ability of imported goods to compete in the domestic market? "	World Economic Forum, Global Competitiveness Report
Mean tariff rate	This sub-component is based on the unweighted mean of tariff rates. The formula used to calculate the zero-to-10 rating for each country was: (Vmax − Vi) / (Vmax − Vmin) multiplied by 10. Vi represents the country's mean tariff rate. Vmin and Vmax were set at 0% and 50%, respectively. This formula will allocate a rating of 10 to countries that do not impose tariffs. As the mean tariff rate increases, countries are assigned lower ratings. The rating will decline toward zero as the mean tariff rate approaches 50%. (Note that, except for two or three extreme observations, all countries have mean tariff rates within this range from 0% to 50%.)	World Trade Organization, World Tariff Profiles
Complicance costs of M and X	This sub-component is based on the World Bank's Doing Business data on the time (i.e., non-money) cost of procedures required to import a full 20-foot container of dry goods that contains no hazardous or military items. Countries where it takes longer to import or export are given lower ratings.	World Bank, Doing Business.

Access to finance		
Financial regulation	Data on credit-market controls and regulations were used to construct rating intervals. Countries with interest rates determined by the market, stable monetary policy, and reasonable real-deposit and lending-rate spreads received higher ratings.	World Bank, World Development Indicators; International Monetary Fund, International Financial Statistics.
Financial depth	This is given by the financial resources provided to the private sector by domestic money banks and other financial institutions as a share of GDP	International Financial Statistics (IFS), International Monetary Fund (IMF)
* All indicators were rescaled so that a positive increase reflects an increase in the actual underlying measure (e.g. the higher the financial regulation indicator the more intense is regulation in that specific country).		

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