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The Great Trade Collapse and the Spanish Export Miracle: Firm-level Evidence from the Crisis*

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Abstract

We provide novel evidence on the micro-structure of international trade during the 2008 financial crisis and subsequent global recession exploring a rich firm-level data set from Spain. The analysis is motivated by the surprisingly strong export performance of Spain in the aftermath of the great trade collapse (dubbed by some as the "Spanish export miracle"). The focus of our analysis is on changes at the extensive and intensive firm-level margins of trade, as well as on performance differences (jobs, productivity, and firm survival) across firms that differ in their export status. We find no adverse effects of the financial crisis on foreign market entry or exit, but a considerable increase in the export intensity of firms after the financial crisis. Moreover, we find that those firms that entered the crisis as exporters (and continued exporting throughout the crisis years) were more resilient to the crisis than those firms that restricted their sales to the domestic market. Finally, in contrast to exporters, non-exporters experienced a significant deterioration in their total factor productivity, which led to an overall decline in the productivity of a significant number of industries in Spanish manufacturing.

JEL classifications: F10, F14, G01, D24.

Keywords: international trade, financial crisis, manufacturing, firm-level data, Spain.

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1 Introduction

The global recession that followed the 2008 financial crisis continues to place a heavy burden on several Eurozone member countries, in particular Greece, Italy, Portugal, and Spain. In the public debate it is often argued that the economic problems faced by these countries are due to their lack of "international competitiveness". This view has repeatedly been expressed, for instance, by several top-level politicians in Germany urging governments in the South to run tight budgets and implement "structural reforms".[1]

Figure 1 displays the evolution of export volumes for selected European countries and the US over the period 2007-2013. The figure uncovers a surprising fact, namely that Spain, a country deeply affected by the global financial crisis and the subsequent recession, performed considerably better on international markets than other economies in Europe. For example, from 2007 to 2013 exports from Italy and France *decreased* by 10% and 7%, respectively. In contrast, exports from Spain *increased* by 13% over the same period. This development (celebrated by some as "the Spanish export miracle"[2]) puts Spain ahead of not only other countries in economic turmoil, but also countries that quickly returned to economic growth after 2008, such as Germany and the UK. How is it possible that Spanish exports recovered so fast from "the worst financial crisis in global history"?[3] Why were Spain's exports so much more dynamic than those of other countries in Europe? What explains the Spanish export miracle?

<<Figure 1 about here>>

This paper tries to shed some light on these questions by offering a firm-level perspective on international trade in the Spanish manufacturing sector. The focal point of our analysis is the 2008 financial crisis and subsequent recession, which involved a sudden and more than proportional decline in global trade relative to global production – the so-called "great trade collapse" (Baldwin, 2009).[4] Our paper makes two contributions to the literature. First, we analyze export and import decisions of firms in order to understand how the crisis affected (i) the propensity of firms to access foreign mar-

[1] These arguments were among the key notes of the government statement given by German chancellor Angela Merkel on December 13th, 2012, in Berlin; see http://www.bundesregierung.de/ContentArchiv/DE/Archiv17/Regierungserklaerung/2012/2012-12-13-eu-rat.html.

[2] See, for example, the article "El *milagro* del sector exterior de España: admirable, pero con algunos claroscuros" published on May 10th, 2013, in the Spanish daily newspaper elEconomista.es.

[3] Then-Fed Chairman Ben Bernanke: "[. . .] September and October of 2008 was the worst financial crisis in global history, including the Great Depression." *The Financial Crisis Inquiry Report, 2011, p. 354.*

[4] Production in the manufacturing sector in Spain was in free fall in the first half of 2009. According to data from the Spanish Instituto Nacional de Estadística (INE), real industrial production contracted by 21.4% over that period relative to the first half of 2008. Annual industrial production in 2009 declined by 16.2% relative to 2008. For real manufacturing exports, the same number is 21.2%.

kets at all, and (ii) the volume of firms' exports and imports (as fractions of total sales and purchases, respectively). As it turns out, this distinction is extremely important for the purpose of our analysis, as it can help explain the fast recovery of Spanish exports in the aftermath of the financial crisis.

Second, we investigate differences in productivity and crisis resilience between firms that were exporting part of their production to foreign markets and those that were limiting themselves to the domestic market. In particular, we examine whether exporting could guard firms against the risks of declining productivity, job losses, and market exit throughout the post-crisis years. Such differences, if present, can make a case for considering export promotion policies, as they point towards the economy becoming less vulnerable to economic shocks through exporting. In addition, they can indicate changes in the allocation of scarce resources such as capital and labor, away from non-exporting firms and towards exporting firms, where they are put to more efficient use.

The main results of our analysis can be summarized as follows. First, we find no negative effect of the financial crisis and subsequent recession on foreign market entry and exit. To the contrary, there is now a larger share of firms involved in international trade, and firms have diversified their export portfolios to include more distant destinations outside the European Union. This is an important finding, as new exporters in Spain are more likely to engage in productivity-enhancing technology upgrading than non-exporters (Hanley and Pérez, 2012). In addition, our finding can allay potential concerns that valuable cross-border trade linkages at the micro-level have been destroyed by the financial crisis. Disruptions of trade linkages can indeed have long-lasting adverse effects on the economy (Monarch and Schmidt-Eisenlohr, 2015), and the fact that these disruptions were absent in the financial crisis explains why exports from Spain could recover so fast after 2008/09.

Second, while firms active in the export market saw their export volumes plummet in the financial crisis, this decline was not limited to exports, but rather, it was visible to the same extent in their domestic sales. This observation might seem surprising in light of the discussion about the great trade collapse. Moreover, the decline in exports was fully made up for (and even overcompensated) already by 2011. Those firms that entered the financial crisis as exporters have in fact been allocating ever larger shares of their production to foreign markets over the past few years. It is clear from our data that these firms have effectively compensated for the lack of domestic demand by expanding their businesses abroad. In this sense, firms in the Spanish manufacturing sector are on average more 'globalized' today than they were before the financial crisis.

Third, we find that it made a huge difference for key economic variables (jobs, productivity, and firm survival) whether or not firms had been active on export markets

when the crisis hit the Spanish economy. While all firms strongly reduced their output and laid off large numbers of workers during and after the financial crisis, firms that entered the crisis as exporters (and continued to export throughout the crisis years) saved more jobs, stayed more productive, and were more likely to survive. One of the more alarming findings is that non-exporters saw their total factor productivity deteriorate by 22% from 2007 to 2011. Exporters, in contrast, had about the same level of productivity in 2011 as they had in 2007. Our analysis also shows that for a significant number of industries the *aggregate* productivity in the Spanish manufacturing sector declined as a result of the crisis, which is likely to have negative consequences for future economic growth.

The analysis provided in this paper is a *micro-level* analysis emphasizing the role of firm heterogeneity in international trade during the crisis years. By using data from individual firms (rather than aggregate data for industries or countries), we are able to offer nuanced insights into the recent evolution of the manufacturing sector in Spain. However, an important development that has facilitated exports from Spain and that is visible at the *macro-level* is the recent evolution of "relative unit labor costs" (a measure of the overall competitiveness of an economy). Figure 2 shows that, unlike other Eurozone member countries such as Germany, Italy, or France, Spain has experienced a *steady decline* in relative unit labor costs since 2008. This means that Spain has become more competitive internationally through internal devaluation (i.e. wages growing less than productivity relative to other Eurozone member countries). Our paper shows that in the manufacturing sector it was exporting firms that contributed the most to this development, as these firms increased their output after 2009, while at the same time reducing both their employment and their real wages.

<<Figure 2 about here>>

Our paper contributes to the relatively small empirical literature that investigates firm behavior in response to the financial crisis with a focus on firms' trading activities. Two prominent studies in this literature using French and Belgian data are Bricongne et al. (2012) and Behrens et al. (2013), respectively, who carefully gauge the crisis-induced drop in international trade along the dimensions of firms, products, and trading partners. Closely related to our paper are Giri et al. (2014) and Álvarez and Sáez (2014), who provide evidence on exports and firm performance during and after the crisis using Mexican and Chilean firm-level data, respectively. Abreha et al. (2014) provide evidence from Denmark.[5] Studies with a particular focus on firm survival

[5] Correa-López and Doménech (2012) provide evidence for Spain. They discuss factors that contributed to the internationalisation of firms over the period 1990-2010. In contrast to their paper, we focus on the years surrounding the financial crisis, and we document, and analyze, differences in firm performance and crisis resilience in relation to firms' export activities.

over the crisis years depending on firms' trading activities are Costa et al. (2014) (using Italian data) and Görg and Spaliara (2013) (using UK data). More generally, our paper fits into the large empirical literature that takes up the issue of firm heterogeneity in international trade. Reviews of this literature can be found in Bernard et al. (2012) and Greenaway and Kneller (2007).

The rest of the paper is organized as follows. In the next section, we present the data used in our empirical analysis. In Section 3, we analyze the propensity of firms to engage in exporting and importing before, during, and after the financial crisis. In Section 4, we analyze how firms have been allocating their output across the foreign and the domestic market, and which share of their purchases they have chosen to source from abroad rather than domestically. In Section 5, we take up the issue of firm competitiveness and crisis resilience, and investigate performance differences depending on firms' exposure to the export market. Section 6 concludes.

2 Firm-level data

The primary data source for our analysis is the Encuesta Sobre Estrategias Empresariales (ESEE, or Survey on Business Strategies). The ESEE is an annual survey of about 2,000 Spanish manufacturing firms with 10 or more employees. It includes rich information on strategic firm decisions (such as pricing, international trade and investment activities, or innovation strategies) along with key items of firms' balance sheets as well as profit and loss statements. Importantly, the ESEE is a panel data set representative for the Spanish manufacturing sector at large and covering the period 1990-2012. This data set allows us to provide a comprehensive, high-resolution perspective on the micro-structure of international trade, and portray the evolution of Spanish manufacturing over the years before, during, and after the financial crisis. The initial sampling of the data in 1990 had a two-tier structure, combining exhaustive sampling for firms with more than 200 employees and stratified sampling for firms with 10-200 employees. In later years, special efforts have been devoted to minimizing the incidences of panel exit as well as to incorporating new firms in a way that preserves the representativeness of the data.[6]

The sample we use for our analysis is for the period 2005-2012 (unless indicated otherwise). It consists of an unbalanced panel of more than 3,100 firms, roughly 800 of which are observed throughout the entire period. The ESEE uses the main activity (industries at the 2-digit level of the NACE Rev. 2 classification)[7] as well as the size

[6] More detailed information on the design, management, and sampling properties of the survey are available from the Spanish SEPI foundation (Sociedad Estatal de Participaciones Industriales) at https://www.fundacionsepi.es/esee/en/epresentacion.asp.

[7] Until 2009, the survey defined industries according to the NACE Rev. 1 classification. We accom-

group of firms (in terms of the number of employees) as stratification variables. It distinguishes between 20 different industries and six different size groups defined by the average number of workers employed during the year: 10-20; 21-50; 51-100; 101-200; 201-500; >500. When applying regression methods in our analysis, we use fixed effects for the sampling strata (defined by pairs of industries and size groups) in order to guarantee consistent estimation of the parameters of interest. As far as the descriptive analysis is concerned, we employ sampling weights to account for the sampling scheme used to collect the data.[8] Summary statistics of the most important variables used in our empirical analysis can be found in Table A.1 in Appendix A.

A particularly important variable in our analysis is a firm's total factor productivity (TFP). We estimate TFP as a firm-specific and time-varying residual from industry-level production functions, which we estimate by the consistent three-step procedure proposed by Olley and Pakes (1996). This procedure derives from a dynamic model of firm behavior incorporating firm-specific productivity differences that exhibit idiosyncratic changes through time. In contrast to an alternative model proposed by Levinsohn and Petrin (2003), the model by Olley and Pakes (1996) takes into account the issue of sample selection due to firms entering and exiting the market. This is very important for the period of economic turbulence considered in our analysis. Moreover, the model tackles a potential endogeneity issue due to unobserved productivity shocks by using firm-specific capital investments as a proxy variable. We estimate industry-specific production functions based on ESEE data from 2000 to 2012, using annual information on a firm's value added, investment, capital stock, labor employment, and market exit decisions. Value added is the sum of the total production value plus other operating income (i.e., income from rent and leasing, industrial property, commissions, and certain services), minus the total expenditure on intermediate inputs and external services. Investment is the total investment value in real estate, construction, and equipment. The capital stock is the value of real estate, construction, and equipment. All value variables used in this estimation are expressed in constant 2010 prices using industry-level price indexes from INE. Labor employment is measured in effective work-hours. As regards exit decisions of firms, our data allow us to distinguish firms shutting down production from those staying in the market, but exiting the ESEE panel.[9]

A brief comment on the measure of labor employment that we use in our analysis seems in order. In contrast to many other firm-level data sets used in the literature, the ESEE data include an almost ideal measure of labor employment (effective work-

modate the two classifications based on concordance information provided by the SEPI foundation.

[8] Sampling weights are based on the composition of the population of Spanish firms in 2010, taken from the Instituto Nacional de Estadística (INE): http://www.ine.es/en/inebmenu/mnuempresasen.htm.

[9] Detailed results from these TFP estimations are available from the authors upon request.

hours). This reduces the possibility of measurement error and thus mitigates endogeneity concerns in the estimation of firm-level TFP. Since the ESEE data also include a more common measure of labor employment (the average number of workers a firm employs during a year), we can investigate different firm-level margins of labor adjustment, viz. the number of workers (or jobs) and the number of effective work-hours. Importantly, we find practically no differences in the within-firm variation between the two variables. This implies that reductions in effective work-hours at the firm-level are fully attributable to workers being laid off and jobs being lost.

While the focus of our analysis is on Spain, in one instance we also draw upon survey data from the EFIGE project, which was designed to enhance the understanding of firm behavior in Europe (Altomonte and Aquilante, 2012).[10] This data set enables us to compare firms in Spain with firms in six other European countries over the period 2008-2009: Austria, France, Germany, Hungary, Italy, and the UK. It includes 14,444 firms and, importantly, it is representative of manufacturing firms with more than 10 employees in these countries. The focus of the EFIGE data is on the experience and competition of firms in foreign markets, as well as their responses to the challenges posed by the financial crisis. Among the firm-level information included in the data set are: productivity; employment, innovation activities; international trade; and international investment.[11]

3 Foreign market entry and exit

What share of firms in the Spanish manufacturing sector is active on foreign markets? And how has this share developed over the recent period of financial and economic turmoil? When looking at the full sample of firms available in each year, we find that in the pre-crisis period 2005-2008 on average 46% of all firms were exporters, while 43% were importers; see the left part of Figure 3. We observe significant overlap between exporter and importer status, reflected in 30% of firms in 2005 being engaged in both exporting and importing at the same time (not depicted). This suggests that exporting and importing are complementary activities at the level of the firm, an issue that has been taken up in recent research and to which we will return below. What is surprising is the strong increase in the share of both exporting and importing firms in the years after 2009. By 2012, the shares of exporters and importers had both grown

[10] EFIGE stands for "European firms in a global economy: Internal policies for external competitiveness."

[11] Altomonte et al. (2012) provide a full-fledged analysis of firms in different countries based on the EFIGE data set. Crespo et al. (2011) use the data to specifically compare firms in Spain with firms in other European countries.

to all-time highs of 57% and 51%, respectively.[12]

While these numbers are suggestive of a growing tendency among firms to engage in international trade, they partly reflect firm entry into, and exit from, production, as well as changes in the sample composition due to attrition and re-sampling of new firms. For this reason, in the right part of Figure 3, we balance the sample on firms that are observed in each year from 2005 to 2012. This allows for a clean identification of changes at the extensive margin of international trade (i.e. foreign market entry and exit). The figure demonstrates that, whether we look at exporting or at importing, the financial crisis had a very limited impact at the extensive margin of international trade. We see that over the past few years there has actually been a growing tendency among firms to serve foreign markets. The share of exporters has been subject to a slight upward trend that was only shortly interrupted in 2010, in the aftermath of the financial crisis, but accelerated thereafter. In 2012, the share of exporters reached more than 51% (up from less than 47% in 2005). The numbers we find for importing are a bit different. Before the financial crisis the share of importers stood at about 47%. In 2009, the year following the peak of the financial crisis, the share decreased by one percentage point. Although it has been increasing in each year thereafter, it has not returned to its pre-crisis level by the end of the period covered in our data. At any rate, the overall changes that we find around the crisis years are hardly significant at all.

<<Figure 3 about here>>

Do these numbers mask important variation across export destinations? A regional decomposition of trade available for 2006 and 2010 suggests that this is not the case.[13] In Figure 4, where we balance the sample on firms that are observed in both years, we see very little time variation in export participation for most world regions that we can distinguish in our data (European Union; Latin America; Rest of the OECD; Rest of the World): 43-44% of all firms exported to the European Union, 12-13% exported to Latin America, and 17-18% exported to other OECD countries. This cross-sectional pattern is consistent with a gravity model of trade in which distance and market size play important roles. The most significant change over time can be observed for exports to the rest of the world, where export participation increased by more than one fifth (from 18% in 2006 to 22% in 2010). Hence, firms have started to penetrate new markets over the crisis years, and thus diversified their export portfolios. This observation is consistent with export diversification behavior observed for Danish firms, which started to enter new markets (especially Asian markets) in the recovery after the financial crisis (Abreha et al., 2014). We find similar changes over time for imports as

[12] This statement is based on the period 1990-2012 for which ESEE data are currently available; see http://www.fundacionsepi.es/investigacion/esee/sesee_det.asp?mnucap=9&mifichero=ce001.

[13] This information is available in ESEE data every four years.

we do for exports. However, the *level* of firms importing from regions other than the European Union is relatively low compared to that of exporters: in 2010 it was 3% for Latin America, 8% for other OECD countries, and 13% for the rest of the world.

<<Figure 4 about here>>

How do the numbers we find for Spain compare with those observed for other European countries? We find, perhaps surprisingly, that in 2008 among the countries covered in the EFIGE data set, export participation was lowest in Germany (41%) and France (45%), closely followed by Spain, while in Austria and the UK export participation was much higher (56%) and topped only by Italy (63%). German firms also report the lowest import participation, while Spain and Italy are at a similar level.[14] The highest import participation is found for Austria, France, Hungary and the UK, where about half of all firms engage in importing.

We next estimate a series of probability models for both exporting and importing. This allows us to narrow down the factors that were crucial for trade participation over the crisis years. To do so, we distinguish between those factors that are directly related to the financial crisis and the subsequent recession (i.e. macro-level changes taking place outside the firm and captured in our analysis by year dummies) and those related to the evolution of firm-specific characteristics (i.e. micro-level changes taking place inside the firm). The latter also capture indirect effects of the financial crisis (e.g. if some firms experienced a decline in their productivity over time). In order to account for, and exploit, possible complementarities between exporting and importing at the level of the firm, we estimate two equations simultaneously in a bivariate Probit framework (where the dependent variable in each equation is a binary variable). More specifically, we define two indicator variables, one for exporting, $\textit{Export}_{it}$, and one for importing, $\textit{Import}_{it}$. The variable $\textit{Export}_{it}$ is equal to one if firm i reports positive exports at time t (and zero otherwise), and accordingly for $\textit{Import}_{it}$. We assume that a firm exports if current and expected revenues from exporting are greater than costs:

$$\textit{Export}_{it} = \begin{cases} 1 & \text{if } \Pi_{it}^{e} > 0 \\ 0 & \text{otherwise,} \end{cases}$$

where Π_{it}^{e} is the unobserved (latent) net present value of current and expected profits from exporting. We assume that these can be linearly approximated as follows:

$$\Pi_{it}^{e} = \boldsymbol{\gamma}^{e} \cdot \mathbf{X}_{it}^{e} + \delta_{t}^{e} + \delta_{i}^{e} + \delta_{ks}^{e} + \varepsilon_{it}^{e}, \tag{1}$$

[14] As far as imports are concerned, the EFIGE data slightly underestimate trade participation, as the questionnaire is limited to imports in those goods and services that are used in the production process. We find an import participation rate of 40% for Spain in the EFIGE data.

where $\mathbf{X}_{it}^{e}$ is a column vector collecting time-varying firm characteristics, $\boldsymbol{\gamma}^{e}$ is a vector of parameters to be estimated, δ_{t}^{e} is a year fixed effect, δ_{i}^{e} is a firm-specific effect,[15] δ_{ks}^{e} is a constant specific to the industry-and-size-group corresponding to firm i in year t (with industries being indexed by k and size groups by s), and ε_{it}^{e} is a firm-and-year-specific stochastic profit shock. An expression similar to (1) is assumed for importing:

$$\Pi_{it}^{i} = \boldsymbol{\gamma}^{i} \cdot \mathbf{X}_{it}^{i} + \delta_{t}^{i} + \delta_{i}^{i} + \delta_{ks}^{i} + \varepsilon_{it}^{i}. \tag{2}$$

In contrast to much of the existing literature, we estimate the decisions of exporting and importing jointly. This strategy is motivated by recent evidence on fixed and sunk cost complementarity between the two activities (Kasahara and Lapham, 2013).[16] We thus assume that the stochastic profit shocks are drawn from a bivariate normal distribution:

$$\begin{bmatrix} \varepsilon_{it}^{e} \\ \varepsilon_{it}^{i} \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \chi \\ \chi & 1 \end{bmatrix} \right),$$

where χ is a parameter measuring the (residual) correlation between exporting and importing. Allowing (and testing) for $\chi > 0$ is important in our analysis, as it tells us whether a firm-specific negative effect of the crisis that directly affected one activity spilled over to the other activity (and thus entailed more harmful consequences than the direct effect alone).

In the model described above, we are mostly interested in the year fixed effects, $\delta_{05}^{\ell}, \ldots, \delta_{12}^{\ell}, \ell \in \{e, i\}$, as these indicate changes in the profitability of exporting and importing over time that cannot be explained by the firm-specific variables collected in $\mathbf{X}_{it}^{\ell}$. The year fixed effects thus pick up the (net) macro-level effects driven by changes in both demand- and supply-side factors.[17] The variables contained in $\mathbf{X}_{it}^{\ell}$ are: labor productivity (value added over effective work-hours, in logs) to control for firm-level competitiveness[18]; capital intensity (capital assets over the number of workers, in logs); R&D intensity (R&D expenses over sales, in logs); skill intensity (number of graduate workers over total number of workers, in logs); foreign ownership (as dummy variables indicating the share of foreign capital in the firm's joint capital); multinational firm status (as a dummy variable indicating whether the firm

[15] We impose different assumptions on the firm-specific effect δ_{i}^{ℓ}, as we shall detail below.

[16] See Aristei et al. (2013) for another recent study that investigates the two-way relationship between exporting and importing.

[17] A potentially important supply-side factor is, for example, a tightening of credit constraints that would make it more difficult for firms to finance their trade activities. See Eppinger and Smolka (2015) for an attempt to identify the effects of credit constraints on firm-level exports using the financial crisis as a source of exogenous variation in credit conditions.

[18] With labor as the only factor of production, as in Melitz (2003), including labor productivity on the right-hand side is sufficient to control for the firm's level of competitiveness. Depending on the estimator used, we assume that firms face the same wage rate or the same changes in the wage rate over time.

is a multinational company (MNC)); the type of good produced (as dummy variables indicating final goods, intermediate goods, or undefined goods); and, in the case of exporting, internet presence (as a dummy variable indicating whether the firm is operating a webpage).[19] Including a dummy for internet presence in the equation for exports, but not for imports, is based on the idea that a webpage is important as part of the firm's marketing and distribution strategy but has no impact on the firm's purchasing and sourcing activities. Importantly, the fact that $\mathbf{X}_{it}^{e} \neq \mathbf{X}_{it}^{i}$ leads to efficiency gains in the estimation.

We report the marginal effects corresponding to this model in columns (1) and (2) of Table 1.[20] Statistical inference is based on robust standard errors clustered by firm, which allows for arbitrary forms of heteroskedasticity and takes care of the autocorrelation implied by the firm-specific effect δ_i^{ℓ} (treated as a random variable that is uncorrelated with the other covariates). Consistent with the data presented in Figure 3, there is no evidence for a decline in trade participation in the years surrounding the financial crisis (2007-2009). To the contrary, the results suggest that macro-level developments in the aftermath of the financial crisis (those beyond the influence of individual firms) have pushed firms into foreign markets. We find that the probability of exporting is 4.1 percentage points higher in 2012 than it was in 2005 (the baseline year). The same number for importing is 3.3 percentage points.

<<Table 1 about here>>

A statistically significant difference between pre- and post-crisis export participation is first visible in 2012. This difference cannot be explained by the firm-level characteristics that the literature has consistently identified to influence both exports and imports at the extensive margin (such as productivity), as these are controlled for in the estimation. Regarding these firm-specific control variables, we find that the results accord well with known stylized facts. For example, we find that those firms that are more productive as well as those more intensive in capital, R&D, and skills are more inclined to both exporting and importing. Moreover, we see large and significant differences (with a two-digit margin) between foreign-owned and domestically-owned firms, as well as between multinationals and non-multinationals. Finally, the results demonstrate strong firm-level complementarities between exporting and importing ($\hat{\chi} = 0.525$, significant at the one percent level).

One important limitation of the bivariate Probit model is that identification is based on between-firm variation in the data, and that the model thus assumes firm-specific

[19] Similar to Guadalupe et al. (2012), who use the same Spanish firm-level data as we do in this paper, we hold all prices constant (at their 2010 values) using industry-level price indexes from INE.

[20] We evaluate all marginal effects in this paper at the sample means of all regressors.

unobserved heterogeneity (denoted by δ_i^ℓ above) to be uncorrelated with the other covariates. However, it is likely that unobserved firm characteristics with strong serial correlation (such as managerial ability) not only affect a firm's decision to access foreign markets, but that they are also correlated with the other covariates in the model (e.g. productivity). Addressing this issue by estimating firm fixed effects in the Probit framework suffers from the incidental parameters problem and, thus, inconsistent estimation of all model parameters. We therefore estimate a system of seemingly unrelated regression equations with fixed effects (SUR FE), where each equation describes a linear probability model rather than a non-linear Probit model. On the one hand, this model may deliver implausible predictions for the trading probabilities outside the unit interval. On the other hand, it has the advantage of controlling for unobserved firm-specific heterogeneity through firm fixed effects. Identification of the parameters of interest then comes from within-firm variation in the data, i.e., changes in export and import participation over time.

The estimation results for the SUR FE model are given in columns (3) and (4) of Table 1. The main conclusions drawn from the bivariate Probit model are upheld in this model. In particular, there is no evidence that the financial crisis had a detrimental effect on export participation, but the likelihood of exporting significantly increased in 2011 ($+2.0$ percentage points relative to 2005) as well as 2012 ($+3.3$ percentage points) due to macro-level effects. The results obtained for importing are overall very similar, although the likelihood of importing declined somewhat in 2009/10 relative to 2008 (not significantly though). While the positive and significant (residual) correlation between exporting and importing is confirmed in the SUR FE model, the only firm-specific variable that consistently and significantly increases the likelihood of both exporting and importing is productivity. Hence, a firm that experiences a productivity gain over time is more likely to enter foreign markets.[21] This finding adds to the overwhelming evidence emphasizing the importance of firm heterogeneity in the study of international trade, and it is consistent with the seminal work by Melitz (2003) who studies the effects of trade liberalization in a general equilibrium model of international trade with heterogeneous firms.

Thus far any persistence in export status over time stems from possible autocorrelation in the independent variables (including firm fixed effects) and the errors. Similar to other firm-level data sets, persistence in export status is, indeed, a salient feature of our data. Balancing the panel on 1,037 firms that are observed in each year from 2005-2010, we find that 601 firms exported in each and every year, while 276 firms never

[21] There is strong evidence in the literature for self-selection of the more productive firms into exporting as well as importing; see e.g. Bernard and Jensen (1999), Smeets and Warzynski (2013), and Kohler and Smolka (2014). There is also some evidence for both exporting and importing to increase productivity; see e.g. De Loecker (2007), Halpern et al. (2011), and Feng et al. (2012).

exported. Hence, a vast majority of 84.6% of all firms maintained their export status throughout the six-year period considered.

There are at least two sources of persistence in export participation that we have not considered in the models described above and that are reviewed and modeled in Roberts and Tybout (1997) and Bernard and Jensen (1997). The first is learning by doing, meaning that the firm accumulates knowledge (through production and exporting) that reduces future production and export costs. The second are sunk costs for foreign market entry, for example in the form of information and distribution costs.[22] While we cannot separately identify these two channels, we may hypothesize based on the above considerations that the firm's maximum profit from exporting will depend positively on past export status:

$$\Pi^e_{it}(\textit{Export}_{it-1} = 1, \cdot) - \Pi^e_{it}(\textit{Export}_{it-1} = 0, \cdot) > 0.$$

In such a dynamic framework, a transitory shock to foreign demand due to the financial crisis would generate a negative effect on export participation that is distributed across future time periods (implying gradual adjustment of the probability to export). Of course, the larger the autoregressive parameter (i.e, the coefficient of the lagged dependent variable), the more 'severe' (i.e. long-lasting) is the effect.

While dynamic specifications of the models for both exporting and importing confirm a quantitatively important autoregressive component, they also suggest that the financial crisis had no statistically significant effect on trade participation (neither on exporting nor on importing); see the summary of this estimation in Figure 5.

<<Figure 5 about here>>

4 Export and import intensity

Next, we analyze the evolution of trade *volumes* (i.e. the intensive margin of international trade). Over the pre-crisis period, the average exporter was shipping goods and services worth 11.2 million € abroad (per year), and the average importer was purchasing goods and services worth 7.8 million € from abroad (per year). Figure 6 depicts real export values for those firms that were continuous exporters over the period 2005-2012 (left figure), and real import values for those that were continuous importers (right figure). The solid lines demonstrate that the financial crisis had a very strong negative effect at the intensive margin of international trade. Real trade values of both exporting and importing plummeted drastically from 2007 to 2009, but recovered partly in 2010, and further so in 2011. While exports had fully recovered by 2011,

[22] Similar ideas apply to importing.

imports had not returned to their pre-crisis level by 2012.

<<Figure 6 about here>>

How strong were the adjustments in 2008/09 compared to the concurrent drop in domestic turnover? The dashed lines in Figure 6 show that while imports experienced a much stronger decline than domestic purchases (-36% versus -22% from 2007 to 2009), the drop in domestic sales was equally pronounced as the drop in exports (-24%). Thus, speaking of a great trade collapse in the Spanish case, while justified for firm-level imports, seems misplaced when looking at firm-level exports. Most noteworthy, however, is the shift in sales that we observe in the years after 2010, away from the domestic market towards the foreign market. Within just two years exports *increased* by 29%. Domestic sales, in contrast, *decreased* by 28%. Hence, firms were compensating for the collapse in aggregate demand in Spain (in the course of the events associated with the euro crisis) by channeling their sales into the export market. Importantly, this observation has no correspondence on the import side, where domestic and foreign purchases were largely moving in parallel to one another.

We now use regression analysis to investigate the factors influencing the *trade intensity* of firms over the period 2005-2012. There are three reasons for using the trade intensity (the ratio of exports to sales or the ratio of imports to purchases) rather than the log of exports or imports in our estimation. First, the trade intensity is an important measure of globalization at the firm-level which indicates how strongly firms are integrated into the global economy through international trade. Secondly, the trade intensity is defined not only for exporters or importers, but also for firms that do not engage in international trade. This allows us to circumvent an obvious selection problem that arises when non-trading firms are excluded from the sample. Finally, and relatedly, we can use the full sample of firms to investigate how export and import intensity are intertwined by estimating the two equations (one for export intensity and one for import intensity) simultaneously. In addition, this approach leads to efficiency gains in the estimation.

We estimate a SUR where the first equation is specified as:

$$\mathit{ExpInt}_{it} = \boldsymbol{\gamma}^e \cdot \mathbf{X}^e_{it} + \delta^e_t + \delta^e_i + \delta^e_{ks} + \varepsilon^e_{it}, \tag{3}$$

with ExpInt_{it} denoting the export intensity (exports over total sales) of firm i in year t, and accordingly for the second equation with ImpInt_{it} (imports over total purchases) as the dependent variable.[23] As we did above in the model for trade participation, we assume $E[\varepsilon^e_{it}\ \varepsilon^i_{jt}|\cdot] = 0$ whenever $i \neq j$, whereas $E[\varepsilon^e_{it}\ \varepsilon^i_{it}|\cdot] = \chi$. In a first

[23] The parameters in this equation are of course different from the ones in the previous equation, but for convenience we use the same notation as before.

specification, we treat the firm effects, δ_i^e and δ_i^i, as random variables that are not correlated with the other covariates, and thus exploit between-firm variation in the data. In a second specification, we relax this assumption and identify the parameters of interest from within-firm variation in the data.

Overall, the regression results we report in Table 2 are consistent with the evolution of trade intensities shown in Figure 6. Importantly, we do not find evidence that firms have become less trade intensive due to the financial crisis. To the contrary, we find a steady increase in the export intensity of firms over the post-crisis period 2009-2012, documented through positive estimates of δ_t^e with $\delta_t^e > \delta_{t-1}^e$ and $t = 09, \ldots, 12$. In the SUR model without firm fixed effects, the estimates of these coefficients are significantly different from zero (in a statistical sense) for $t \geq 10$, and roughly comparable to those obtained when firm fixed effects are controlled for. The rise in the export intensity observed in the data is not accompanied by a contemporaneous rise in import intensity.

<<Table 2 about here>>

To substantiate these results, we have also considered dynamic specifications of the model; see Figure 7. Most striking is the fact that according to these estimates the export intensity of firms has been on the rise ever since 2007 (and continuously so throughout the years of the financial crisis).

Notice that we include both exporters/importers and non-exporters/non-importers in the above estimations. An implicit assumption underlying this approach is that changes at the intensive margin of trade are governed by the same factors (and in the same way) as the extensive margin of trade. However, it is not clear theoretically why this should be the case. For example, in the Melitz (2003) model, the workhorse model of international trade with heterogeneous firms, the foreign and domestic sales of a firm react proportionally to changes in the firm's productivity, conditional on exporting. Hence, while productivity gains should increase the likelihood of a firm to export, they should not increase the export intensity of a firm that already exports.[24] Therefore, we have also followed an approach in which we model the selection into exporting and importing explicitly. We have done so using a two-stage Heckman selection model with skill intensity as an exclusion restriction in the first-stage equation. The results (not reported) indicate a selection bias for the export intensity (through a significant coefficient of the inverse mills ratio in the second-stage equation), but not for the import intensity. While the effects of a few control variables on export intensity, especially productivity, change with the selection correction, the year fixed effects

[24] This can help explain why productivity enters insignificantly in the fixed effects specification above, since changes in the export status over time are rare, while changes in the export intensity of exporters are abundant.

hardly change at all.[25]

<<Figure 7 about here>>

5 Firm competitiveness and crisis resilience

According to our data, in the pre-crisis period 2005-2008, exporting and importing firms alone were responsible for about 86% of total output, and about 75% of all jobs in Spanish manufacturing. These numbers are considerably higher in 2012 (92% for output and 82% for jobs), which attests to a growing importance of the global economy for the manufacturing sector in Spain. This development is partly explained by new firms entering foreign markets in recent years, but it might also be the result of an exceptional degree of competitiveness and crisis resilience of those firms that had already been active on foreign markets before the financial crisis occurred. Exploring this issue in greater detail is the purpose of this section.

Figure 8 depicts various measures of firm competitiveness and firm performance over the period 2007-2011 depending on the firm's export status. We look at four different firm characteristics that are informative for the analysis of firm behavior and firm outcomes in the financial crisis: real output; total factor productivity (TFP); hours worked; and (average) hourly wage paid by the firm. Moreover, we distinguish between different groups of firms, viz. continuous exporters (henceforth called exporters), export market entrants, firms leaving the export market, and continuous non-exporters (henceforth called non-exporters). To abstract from the effects of changes in sample composition, we balance the sample on firms that are observed in each year over the period considered. All values are normalized to one in 2007.

<<Figure 8 about here>>

There are several insights to be gained from this figure. First, firm output and employment were under strong pressure during the financial crisis and contracted sharply for all groups of firms (typically by large two-digit percentage numbers). Both exporters and non-exporters, for example, reduced their output by more than 25% from 2007 to 2009. Those firms leaving or entering the export market reduced their output even more drastically (by 38%). Since output was reduced more than proportionally compared to employment, labor productivity decreased for all groups of firms over the period 2007-2009. The changes in TFP over that same period, in contrast, are much more nuanced. We will return to this below.

[25] Productivity, while important for the decision to export, does not significantly affect the export intensity of a firm (conditional on exporting) according to our results.

Second, output and employment stabilized after 2009, but this development is fully attributable to both exporters and export market entrants. Non-exporters (along with those firms leaving the export market), in contrast, saw their competitive position erode further. Important for the discussion on the international competitiveness of Spanish exports, exporters were able to increase their labor productivity after 2009 by increasing their output while at the same time decreasing their employment. More generally, it turns out that a firm's export status is a good indicator for how well firms did both during and after the peak of the financial crisis, as exporters outperformed all other firms over the period 2007-2011.[26] The cumulative differences that we find between exporters and non-exporters are remarkable. For example, we find that non-exporters destroyed 27% of their jobs from 2007 to 2011, whereas for exporters the same number is 17%. Similarly, non-exporters produced 37% less in 2011 than in 2007; for exporters this number was 19%.

Third, the (nominal) hourly wage increased by approximately 7.5% from 2007 to 2008, and by a compound annual growth rate of about 2.3% thereafter. Overall, the evolution of wages is very similar across the four different groups of firms (including exporters and non-exporters). Importantly, although wage moderation efforts are visible in the wake of the financial crisis (i.e., after 2007), *real* wages continued to increase even after 2007, given a compound annual inflation rate of 1.6% over the period 2008-2011.[27] For exporters, real wages declined slightly after 2009, making Spanish exports appear more competitive internationally. Putting these insights together, we may reflect that the labor market adjusted first and foremost through a contraction in labor demand causing a sharp increase in involuntary unemployment. Owing to the dual nature of the Spanish labor market (highly protected permanent *vs.* poorly protected temporary workers)[28], this took the form of massive lay-offs of low- and medium-skilled workers in temporary work, rather than a reduction of the employment intensity of individual workers (as was the case in Germany, whose unemployment rate hardly increased at all through the crisis years).[29] This observation can entail negative effects on future economic growth, as the skills of unemployed workers erode substantially, especially for longer unemployment spells.[30]

[26] Interestingly, those firms that entered the export market in one of the years 2009-2012 performed weakest in terms of TFP and output *during* the financial crisis in 2008/09 (along with those firms exiting the export market), but strongest *after* the financial crisis (along with those firms exporting all the time).

[27] The inflation data are elicited from consumer price data provided by the OECD at http://stats.oecd.org/Index.aspx?DataSetCode=MEI_PRICES.

[28] This peculiarity of the Spanish labor market is heavily criticized by leading Spanish economists; see for instance chapter four in Garicano (2014).

[29] Burda and Hunt (2011) discuss this issue as "the German Labor Market Miracle".

[30] Gregory and Jukes (2001) provide empirical evidence on this mechanism by estimating the effect of unemployment on earnings following re-employment for British men over the period 1984-1994. However, one of the conclusions that can be drawn from their analysis is that human capital de-

Perhaps most astonishing, however, is the gap in the evolution of TFP between exporters and non-exporters. For exporters the level of TFP was about the same in 2011 as it was in 2007. For non-exporters, in contrast, the level of TFP had deteriorated by 22% in 2011 relative to 2007. Hence, over the crisis years non-exporters have lost part of their technical and managerial efficiency in the production process (i.e. their ability to transform inputs into outputs).[31] This is a remarkable observation that is likely to shape the dynamics of the Spanish manufacturing sector over the next couple of years. Relatedly, we have also used our firm-level estimates of TFP to compute changes in aggregate productivity by industry. Aggregate productivity is influenced not only by firm-level TFP, but also by the allocation of factors across firms. Low-productivity firms exiting the market and freeing up resources to be used by high-productivity firms leads to aggregate productivity gains. We have computed aggregate productivity as the market-share weighted average of firm-level TFP, and found interesting and strong heterogeneity in the evolution of aggregate TFP over the period 2005-2012, with some industries experiencing a dramatic decline in TFP in response to the financial crisis (such as the ferrous and non-ferrous metal industry), while others showing an overall positive performance (such as the plastic and rubber industry). While beyond the scope of this paper, analyzing these issues in more detail might prove fruitful in future research. The first study in this direction is Hospido and Moreno-Galbis (2015).

Figure 9 shows that market exit played a considerable role in the financial crisis and the subsequent recession, and that those firms entering the crisis as exporters (and staying in the export market) had higher chances to survive the crisis than those starting out as non-exporters. To focus on market exit rather than sample exit, in the right panel of the figure we restrict the sample to firms that are observed in each year from 2007-2011 (or the year of market exit). We define market exit as going out of business or terminating manufacturing activities (as opposed to sample exit due to firms that did not collaborate, did not respond to the questionnaire, or could not be localized). We find that out of 100 firms that were producing and selling *only* in the domestic market in 2007, 33 firms had exited the market by 2011. In contrast, out of 100 exporters observed in 2007, only 26 had exited the market over the following four years. For the sake of comparison, in the left panel of the figure we do the same exercise focusing on the period 2003-2007 (but using an otherwise equivalent sample configuration). We find that survival rates are higher in this earlier period and almost identical across

preciation is lowest for young and low-paid workers, and highest for middle-aged and high-paid workers. This could imply that future growth of the Spanish economy is less negatively affected than perhaps expected, as high-skilled workers experienced no increase in unemployment at all.

[31] One might be tempted to argue that (omitted) firm-specific input and output price changes are responsible for this observation. However, firm-level input and output pricing information available in ESEE data allow us to demonstrate that this is not the case, as we find virtually no differences in the evolution of prices between exporters and non-exporters; see Figure A.1 in Appendix A.

exporters and non-exporters.

<<Figure 9 about here>>

We next address the issue of performance differences between exporters and non-exporters in a more rigorous way using econometric methods. It is a well-known fact that exporters have a competitive edge over non-exporters. Bernard and Jensen (1999) and others have shown that exporters are on average more productive than non-exporters, have higher sales, employ more workers, and pay higher wages. These differences have been quantified in terms of so-called *exporter premia*. We estimate exporter premia for TFP, output, and hours worked based on the Spanish firm-level data, and we document the evolution of these premia over the financial crisis and subsequent global recession. We also identify (and quantify) the advantage of exporters regarding the likelihood to survive the crisis. Following the methodology established in the literature, we estimate variants of the following econometric model:

$$\textit{Performance}_{it} = \lambda_t \cdot \textit{Export}_{it} + \boldsymbol{\theta} \cdot \mathbf{Z}_{it} + \rho_t + \rho_{ks} + \epsilon_{it}, \tag{4}$$

where $\textit{Performance}_{it}$ is one of the following four variables: TFP (in logs); output (total production value, in logs); hours worked (in logs); and survival (as a dummy variable indicating whether the firm survives in the market or shuts down production). As above, the variable $\textit{Export}_{it}$ is a dummy variable for positive exports, λ_t represents the coefficients of interest (with $t = 05, \ldots, 12$), ρ_t is a year fixed effect, ρ_{ks} is an industry-size-group fixed effect, and ϵ_{it} is the error term. The vector $\mathbf{Z}_{it}$ collects a number of firm-specific and time-varying control variables, and the vector $\boldsymbol{\theta}$ includes the corresponding parameters to be estimated. With this setup the estimation allows us to describe the evolution of *conditional* performance differences between exporters and non-exporters (if any), as we control for the industry-size-group cluster into which the firm falls, as well as a common set of firm-level characteristics (largely identical to the ones used in the previous section).

Figure 10 demonstrates that exporters were not only outperforming non-exporters throughout the whole period of analysis, but also magnified their competitive advantage in the aftermath of the financial crisis. For example, in 2007 exporters were on average 5% more productive than non-exporters. This same difference had widened to 20% by 2012. Similarly, in 2007 exporters on average produced 20% more than non-exporters; in 2012 this difference stood at more than 50%. Exporters have also increased their employment premium over the past couple of years (from 6% in 2007 up to 15% in 2012), and they had a significantly higher survival probability in 2008, the year of the financial crisis (with a margin of more than 3 percentage points).

<<Figure 10 about here>>

Notice that these estimation results accord well with the evolution of TFP, output, and hours worked depicted in Figure 8. Hence, differences in the exporter premia over time, as shown in Figure 10, can be attributed to within-firm adjustments rather than changes in the industry composition (due to market entry and exit, or switching into, and out of, exporting).

6 Conclusion

We explore a rich firm-level data set from Spain to provide novel evidence on firm behavior during and after the 2008 financial crisis. Motivated by the surprising export performance of Spain in the aftermath of the great trade collapse, we investigate changes at the extensive and intensive firm-level margins of trade, as well as performance differences (jobs, productivity, and firm survival) between exporting and non-exporting firms. We find that the number of firms that were forced to exit the export market due to the crisis is negligible, and that firms scaled up their export businesses as a result of poor domestic demand, especially in the years after 2010. Moreover, we find a growing performance gap between exporters and non-exporters, which shows that exporters proved to be much more resilient to the economic challenges they were facing during the crisis. Exporters now account for a larger share of output and jobs, and they contribute more to aggregate productivity than they did before the financial crisis. However, in a significant number of industries aggregate productivity has decreased as a result of the financial crisis and subsequent recession. As such, our findings are of direct relevance for the ongoing political debate about the current and future economic situation in Spain.

We conclude by pointing out some interesting similarities between the current economic situation in Spain and the situation observed more than a decade ago in Germany.[32] From the mid-1990s and into the 2000s, Germany suffered from high unemployment and poor economic growth. However, relative unit labor costs had set out to decrease in 1995, boosting German exports through a gradual improvement of the country's competitive position in the global economy. The same seems to be currently happening in Spain. At the time of the financial crisis, Germany had already been the world champion of exports for several years, economic growth had returned, and unemployment had been brought down. Germany had transformed itself from the "sick man of Europe" into an "economic superstar" (Dustmann et al., 2014).

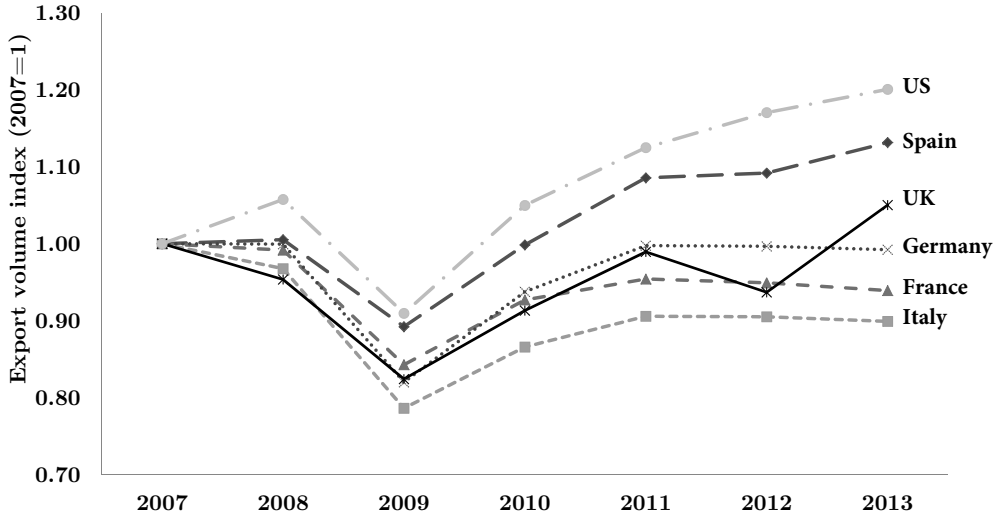
A compelling narrative behind this development, advanced by Dustmann et al. (2014), is that German labor market institutions were flexible enough to allow for a significant decentralization of the wage-setting process, away from the industry-level

[32] See also the article "Spain's economy: Not yet the new Germany," published on March 9th, 2013, by The Economist.

towards the firm-level. This decentralization, largely triggered by the fall of the iron curtain and the pressures of economic globalization, translated into a considerable decline in real wages at the lower end of the wage distribution, and, ultimately, to a more competitive economy. It was one of the principal aims of the 2012 labor market reform in Spain to widen the scope of collective bargaining at the firm-level (OECD, 2013). Future research must show whether this reform can contribute to a better-functioning labor market that can mimic the German success, and further enhance the international competitiveness of Spanish exports.

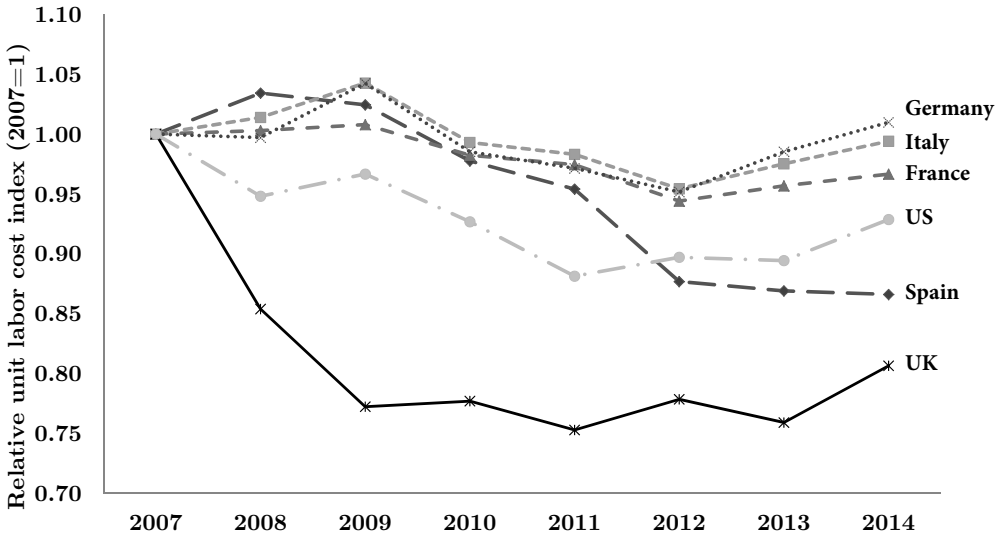
Figures and tables

Figure 1: Export volumes, 2007-2013†



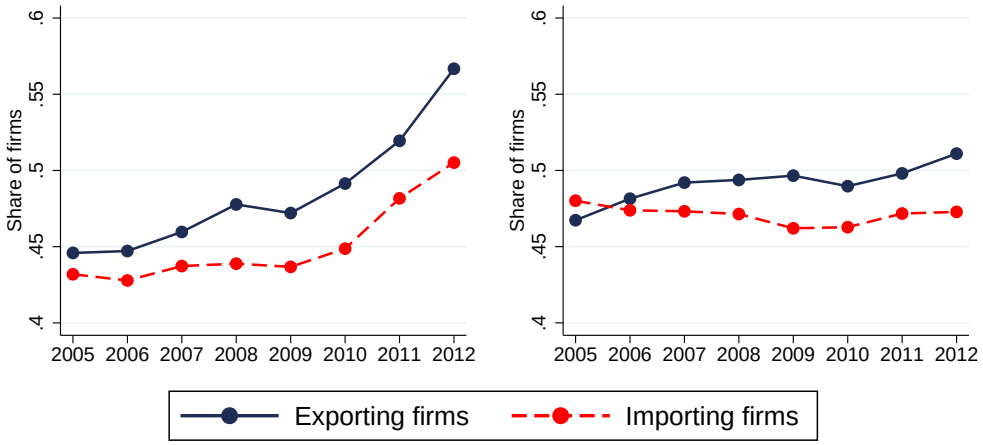
†Note: The data are taken from the World Development Indicators (WDI) provided by the World Bank.

Figure 2: Relative unit labor costs, 2007-2014†



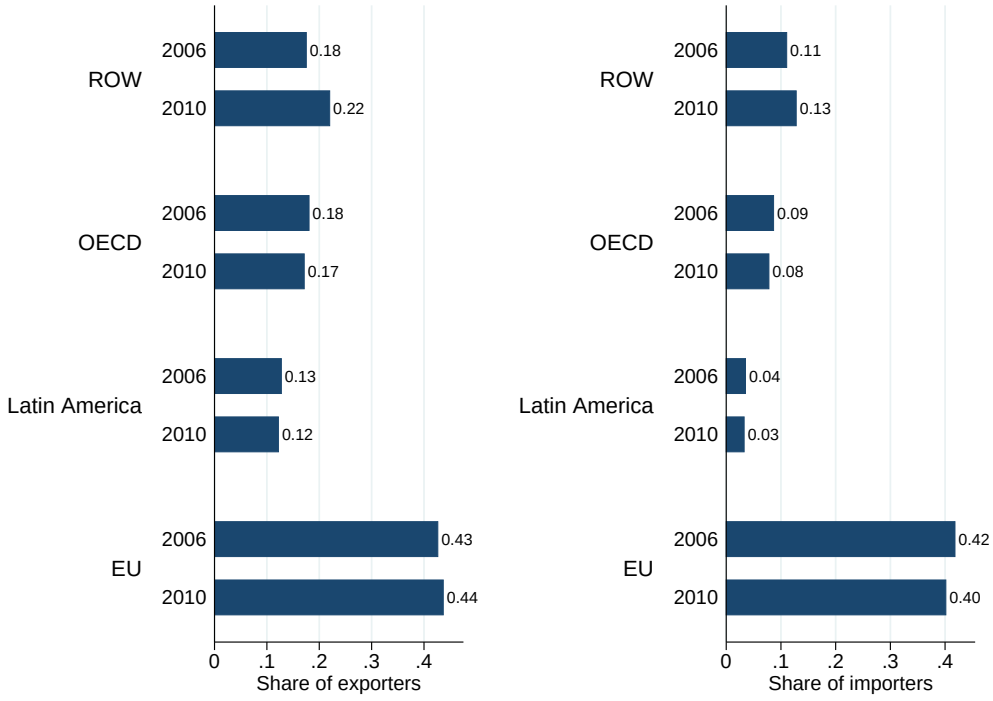
†Note: Competition-weighted relative unit labor costs for the overall economy in dollar terms. Competition weights take into account the structure of competition in both export and import markets of the goods sector of 49 countries. An increase in the index indicates a real effective appreciation and a corresponding deterioration of the competitive position. The index accounts for annual shifts in the composition of trade flows. For details on the method of calculation, see OECD Economic Outlook Sources and Methods at http://www.oecd.org/eco/sources-and-methods.htm.

Figure 3: Trade participation, 2005-2012†



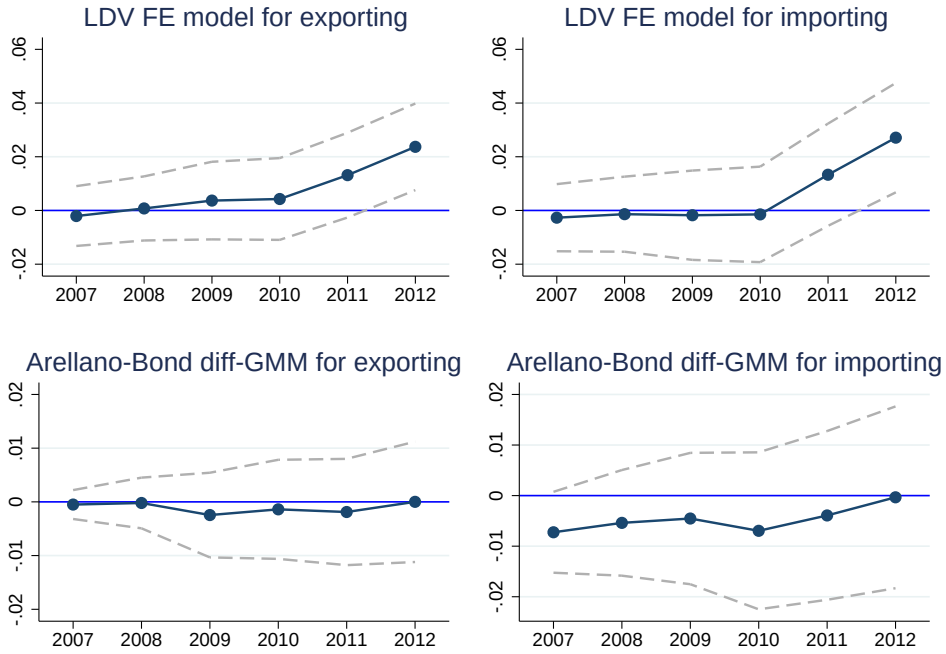
†Note: In the left figure we use the full sample of firms, whereas in the right figure we balance the sample on 782 firms that are observed in each year from 2005 to 2012. Sampling weights apply.

Figure 4: Trade participation by region, 2006/10†



†Note: The sample is balanced on 1,247 firms observed in both years 2006 and 2010. In this sample, 780 (780) firms reported positive exports (imports) in 2006, and 797 (770) reported positive exports (imports) in 2010. Sampling weights apply.

Figure 5: Dynamic probability models for trade participation[†]

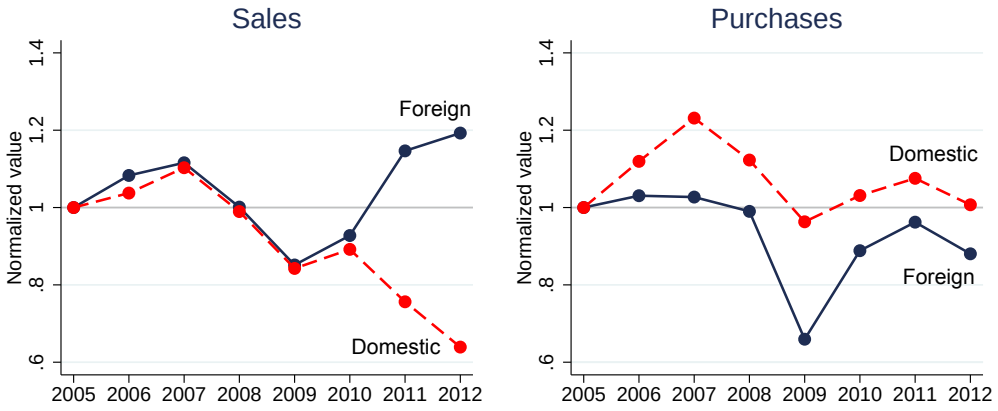


[†]Note: This figure shows estimated coefficients of year dummies in dynamic probability models for exporting (left-hand side) and importing (right-hand side), respectively, alongside 90% confidence intervals. The effects are changes in the probability to export/import relative to 2006. The model for exporting is specified as follows:

$$Export_{it} = \rho^e \cdot Export_{it-1} + \boldsymbol{\gamma}^e \cdot \mathbf{X}^e_{it} + \delta^e_t + \delta^e_i + \delta^e_{ks} + \varepsilon^e_{it},$$

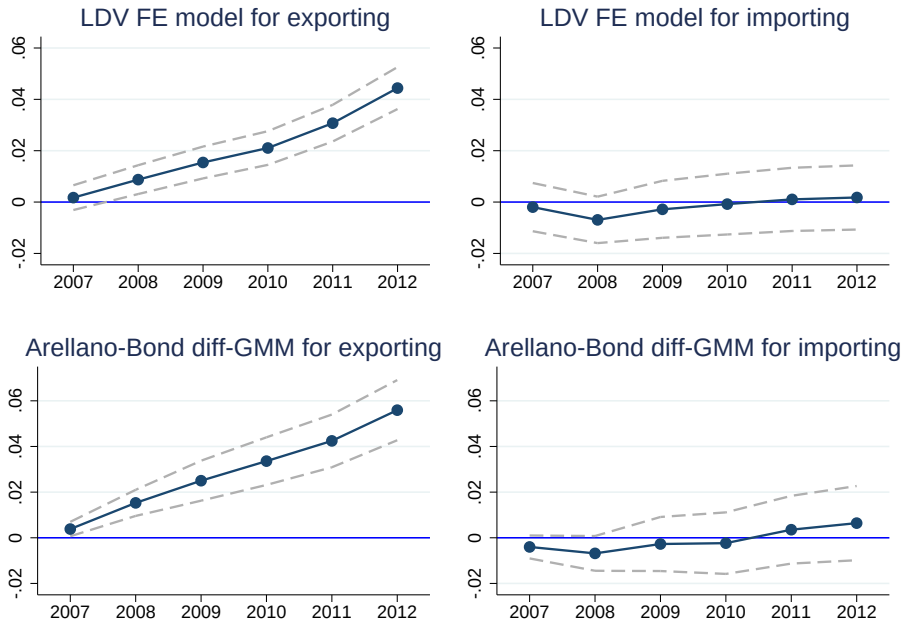
and accordingly for importing. The LDV FE models are standard fixed effects (FE) models with the right-hand side of the equation including the lagged dependent variable (LDV). In these models we apply the within-transformation to the data in order to get rid of the firm fixed effects δ^e_i and δ^i_i, respectively. The Nickell bias for the autoregressive parameter, $\rho^\ell, \ell \in \{e, i\}$, is $\text{plim}_{N\to\infty}(\widehat{\rho} - \rho) \approx \frac{-(1+\rho)}{T}$, with $T = 7$ in our application (running from $t = 06, \ldots, 12$). Hence, estimates of ρ^ℓ in the LDV FE models serve as lower bounds for the true parameter values. We find estimates of $\rho^e \approx 0.237$ and $\rho^i \approx 0.193$ (both significant at the one percent level) in the LDV FE models. In the first-differenced general method of moments (diff-GMM) approach by Arellano and Bond (1991), the model is estimated in first differences to cancel the firm fixed effects. In addition to the lagged dependent variable, we treat labor productivity, capital intensity and foreign ownership as endogenous variables, and R&D and skill intensity along with MNC status as pre-determined variables. Lagged levels of the dependent variable, the predetermined variables, and the endogenous variables are used to form GMM-type instruments. We allow for the maximum number of lags for use as instruments. To accommodate heteroskedasticity, we use the two-step version of the diff-GMM estimator. We find estimates of $\rho^e \approx 0.381$ and $\rho^i \approx 0.373$ (both significant at the one percent level) in the diff-GMM models. Neither for exporting ($p = 0.9019$) nor for importing ($p = 0.4973$) can we reject the null hypothesis that the overidentifying restrictions are valid (Hansen specification test of the instrument condition). For both exporting and importing, the Arellano-Bond test for zero autocorrelation in first-differenced errors of order one is rejected ($p = 0.000$), while that of order two cannot be rejected ($p = 0.1723$ for exporting and $p = 0.7564$ for importing). Hence, the diff-GMM model is valid.

Figure 6: Sales and purchases, 2005-2012[†]



[†]Note: In the left (right) figure, the sample is balanced on 456 (412) firms that are continuously exporting (importing) over the period 2005-2012. Foreign & domestic sales (left figure) as well as foreign & domestic purchases (right figure) are normalized to one in 2005. Prices are held constant over time. Sampling weights apply.

Figure 7: Dynamic models for trade intensity[†]

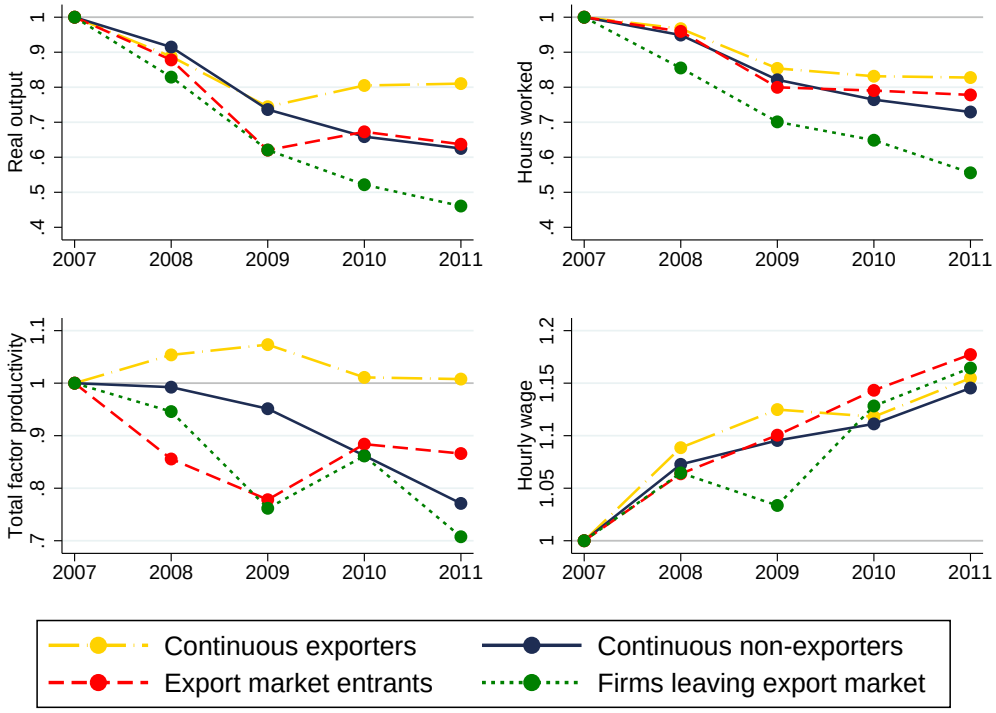


[†]Note: This figure shows estimated coefficients of year dummies in dynamic models for the export intensity (left-hand side) and the import intensity (right-hand side), respectively, alongside 90% confidence intervals. The effects are changes in the export intensity/import intensity relative to 2006. The model for exporting is specified as follows:

$$\mathit{ExpInt}_{it} = \rho^e \cdot \mathit{ExpInt}_{it-1} + \boldsymbol{\gamma}^e \cdot \mathbf{X}^e_{it} + \delta^e_t + \delta^e_i + \delta^e_{ks} + \varepsilon^e_{it},$$

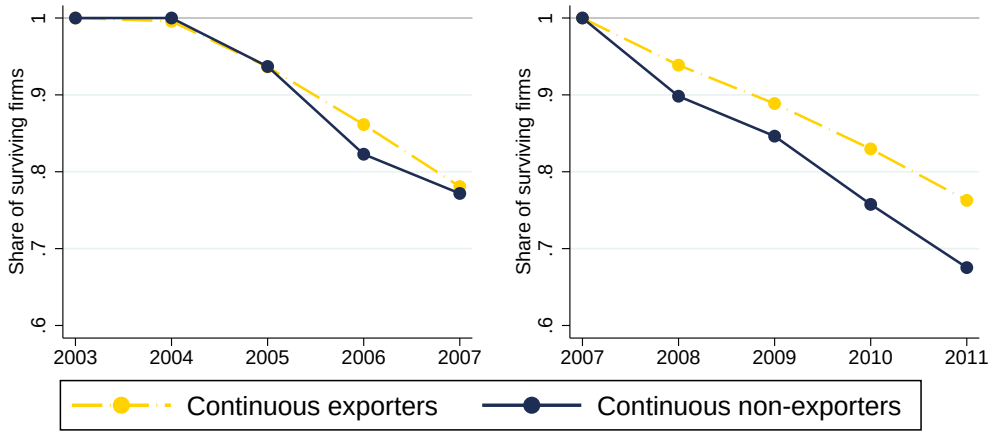
and accordingly for importing. The LDV FE models are standard fixed effects (FE) models with the right-hand side of the equation including the lagged dependent variable (LDV). In these models we apply the within-transformation to the data in order to get rid of the firm fixed effects δ^e_i and δ^i_i, respectively. The Nickell bias for the autoregressive parameter, $\rho^\ell, \ell \in \{e, i\}$, is $\text{plim}_{N\to\infty}\,(\widehat{\rho} - \rho) \approx \frac{-(1+\rho)}{T}$, with $T = 7$ in our application (running from $t = 06, \ldots, 12$). Hence, estimates of ρ^ℓ in the LDV FE models serve as lower bounds for the true parameter values. We find estimates of $\rho^e \approx 0.220$ (significant at the one percent level) and $\rho^i \approx 0.013$ (not statistically significant) in the LDV FE models. In the first-differenced general method of moments (diff-GMM) approach by Arellano and Bond (1991), the model is estimated in first differences to cancel the firm fixed effects. In addition to the lagged dependent variable, we treat labor productivity, capital intensity and foreign ownership as endogenous variables, and R&D and skill intensity along with MNC status as pre-determined variables. Lagged levels of the dependent variable, the predetermined variables, and the endogenous variables are used to form GMM-type instruments. We allow for the maximum number of lags for use as instruments. To accommodate heteroskedasticity, we use the two-step version of the diff-GMM estimator. We find estimates of $\rho^e \approx 0.180$ and $\rho^i \approx 0.037$ (both significant at the one percent level) in the diff-GMM models. Neither for exporting ($p = 0.3585$) nor for importing ($p = 0.1217$) can we reject the null hypothesis that the overidentifying restrictions are valid (Hansen specification test of the instrument condition). For both exporting ($p = 0.000$) and importing ($p = 0.013$), the Arellano-Bond test for zero autocorrelation in first-differenced errors of order one is rejected, while that of order two cannot be rejected ($p = 0.7029$ for exporting and $p = 0.1513$ for importing). Hence, the diff-GMM model is valid.

Figure 8: Firm competitiveness and crisis resilience, 2007-2011†



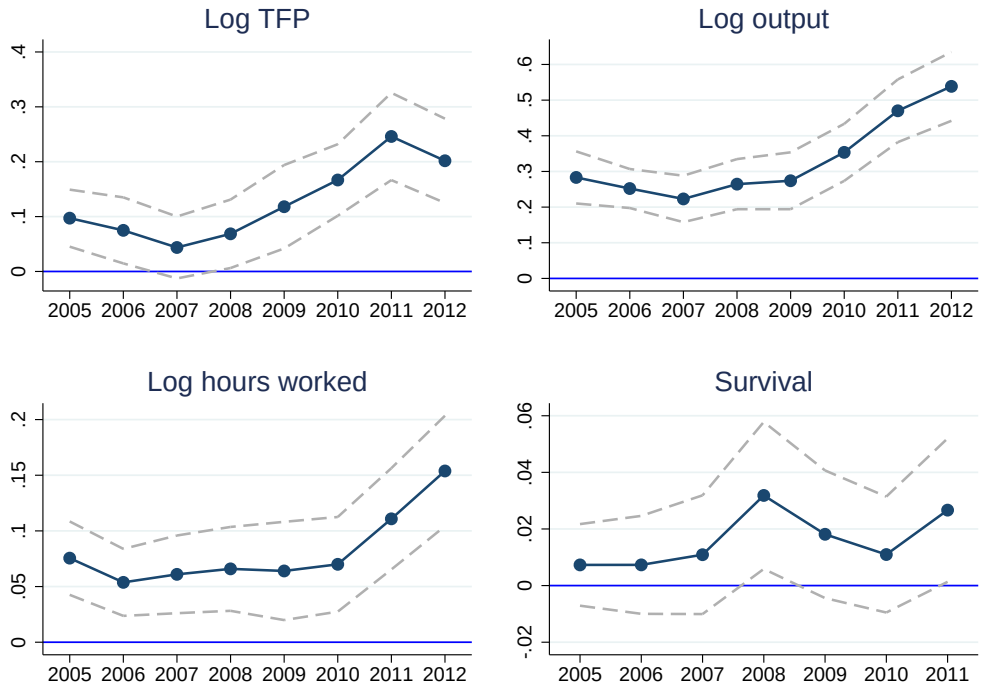
†Note: The sample is balanced on firms that are observed in each year from 2007 to 2011. Continuous exporters are 671 firms that export in each of the years 2005 to 2012 (if observed); continuous non-exporters are 310 firms that do not export in any of the years 2005 to 2012 (if observed); export market entrants start exporting in one of the years 2009 to 2012 and stay in the export market after entry (43 firms); firms leaving the export market stop exporting in one of the years 2009-2012 and do not re-enter after exit (21 firms). All variables are normalized to one in 2007. Sampling weights apply.

Figure 9: Firm survival, 2003-2007 & 2007-2011[†]



[†]Note: In the left figure, the sample is restricted to firms observed in each year from 2003 to 2007 (or the year of market exit); continuous exporters are 707 firms that export in each of the years 2001 to 2008 (if observed); continuous non-exporters are 333 firms that do not export in any of the years 2001 to 2008 (if observed). In the right figure, the sample is restricted to firms observed in each year from 2007 to 2011 (or the year of market exit); continuous exporters are 881 firms that export in each of the years 2005 to 2012 (if observed); continuous non-exporters are 462 firms that do not export in any of the years 2005 to 2012 (if observed).

Figure 10: Exporter premia, 2005-2012[†]



[†]Note: The figure shows estimates of λ_t in Equation (4) for $t = 05, \ldots, 12$ (along with 95% confidence intervals). These estimates can be interpreted as year-specific exporter premia for the variables indicated in the subfigures. For total factor productivity (TFP), output, and hours worked, the exporter premia are given in percentages. For survival, the premium is given in percentage points. The estimated premia are conditional on the share of foreign capital in the firm's joint capital ($0\%; > 0\%$ & $\leq 50\%; > 50\%$), the firm's capital intensity, R&D intensity, skill intensity, type of good produced (intermediate good; final good; not defined), multinational status, as well as the industry-and-size-group cluster to which the firm belongs. Confidence intervals derive from robust standard errors clustered by firm.

Table 1: Probability model for trade participation[†]

	Bivariate Probit Model		SUR Fixed Effects Model	
	Exports	Imports	Exports	Imports
VARIABLES	(1)	(2)	(3)	(4)
YEAR_06	-0.00705	0.00493	0.00795	0.0178***
	(0.00716)	(0.00785)	(0.00547)	(0.00670)
YEAR_07	-0.00861	-0.00418	0.00954	0.0160**
	(0.00830)	(0.00895)	(0.00616)	(0.00757)
YEAR_08	-0.00443	-0.00198	0.00984	0.0184**
	(0.00937)	(0.00966)	(0.00648)	(0.00787)
YEAR_09	-0.00775	-0.0143	0.00975	0.0114
	(0.0107)	(0.0107)	(0.00719)	(0.00851)
YEAR_10	0.00143	-0.0196*	0.00900	0.0116
	(0.0113)	(0.0116)	(0.00697)	(0.00876)
YEAR_11	0.0197	0.00959	0.0200***	0.0280***
	(0.0121)	(0.0122)	(0.00738)	(0.00899)
YEAR_12	0.0413***	0.0325**	0.0327***	0.0430***
	(0.0126)	(0.0128)	(0.00773)	(0.00979)
Labor productivity (in logs)	0.0491***	0.0658***	0.0152***	0.0213***
	(0.00813)	(0.00794)	(0.00485)	(0.00637)
Capital intensity (in logs)	0.0403***	0.0471***	-0.00330	-0.0274***
	(0.00684)	(0.00591)	(0.00792)	(0.00972)
R&D intensity (in logs)	1.247***	1.589***	-0.0410	-0.00201
	(0.366)	(0.320)	(0.161)	(0.239)
Skill intensity (in logs)	0.0602	0.127***	-0.000915	-0.0314
	(0.0394)	(0.0437)	(0.0204)	(0.0286)
Multinational dummy	0.261***	0.112***	0.00214	0.0594**
	(0.0313)	(0.0259)	(0.0170)	(0.0274)
Type of good: intermediate good	0.0586***	0.00684	0.0171	0.0277
	(0.0185)	(0.0173)	(0.0139)	(0.0171)
Type of good: not defined	-0.0229	-0.0591***	0.00800	0.0363**
	(0.0181)	(0.0164)	(0.0135)	(0.0179)
Foreign ownership: > 0% & <= 50 %	0.0492	0.00723	-0.0256	-0.00551
	(0.0588)	(0.0478)	(0.0272)	(0.0360)
Foreign ownership: > 50%	0.212***	0.174***	0.00840	0.0180
	(0.0289)	(0.0263)	(0.0182)	(0.0184)
Internet dummy	0.124***		0.0308**	
	(0.0127)		(0.0124)	
IndustryXsize-group fixed effects	Yes		Yes	
Firm fixed effects	No		Yes	
Number of observations	14,887		13,209	
Number of firms	2,860		2,601	
Cross-equation correlation	0.525***		0.112***	
R2			0.0074	0.0128

[†]This table presents estimated marginal effects on both export and import probabilities obtained from fitting a bivariate Probit model (columns (1) and (2)), as well as a system of seemingly unrelated regression equations (SUR) with fixed effects (columns (3) and (4)). The dependent variables are dummy variables indicating positive exports or imports, respectively. For dummy variables as regressors we report the effects of a discrete change from zero to one. In the bivariate Probit model, marginal effects are evaluated at the sample means of all regressors. Robust standard errors (clustered by firm) are given in parentheses. *,**,*** denote significance at the 10%, 5%, 1% levels, respectively.

Table 2: Model for trade intensity[†]

	SUR Model		SUR Fixed Effects Model	
	Export intensity	Import intensity	Export intensity	Import intensity
VARIABLES	(1)	(2)	(3)	(4)
YEAR_06	-0.00269	-0.00634	-0.00158	0.000374
	(0.00354)	(0.00872)	(0.00252)	(0.00889)
YEAR_07	-0.00498	-0.0128	-0.00153	-0.00418
	(0.00418)	(0.00897)	(0.00257)	(0.00890)
YEAR_08	-0.00519	-0.0145	-0.000343	-0.00468
	(0.00493)	(0.00947)	(0.00294)	(0.00851)
YEAR_09	0.00105	-0.0126	0.00567*	-0.00306
	(0.00585)	(0.00971)	(0.00302)	(0.00797)
YEAR_10	0.0106*	-0.0144	0.00870***	-0.00252
	(0.00633)	(0.00993)	(0.00319)	(0.00788)
YEAR_11	0.0260***	-0.00520	0.0198***	-0.000207
	(0.00691)	(0.0101)	(0.00346)	(0.00778)
YEAR_12	0.0452***	-0.00318	0.0358***	0.000431
	(0.00760)	(0.0103)	(0.00399)	(0.00788)
Labor productivity (in logs)	0.0111**	0.0299***	-0.000116	0.00602**
	(0.00538)	(0.00411)	(0.00259)	(0.00299)
Capital intensity (in logs)	0.0281***	0.0221***	0.00428	-0.00311
	(0.00401)	(0.00339)	(0.00304)	(0.00550)
R&D intensity (in logs)	0.533***	0.385**	0.0765	0.231
	(0.179)	(0.187)	(0.0760)	(0.310)
Skill intensity (in logs)	-0.0232	0.0405**	-0.00536	0.00632
	(0.0189)	(0.0176)	(0.0122)	(0.0124)
Multinational dummy	0.110***	0.0265*	0.00137	0.0194*
	(0.0182)	(0.0140)	(0.0125)	(0.0112)
Type of good: intermediate good	0.0402***	-0.0145	0.00210	-0.0233
	(0.0106)	(0.0114)	(0.00700)	(0.0173)
Type of good: not defined	0.0366***	-0.0281***	0.00584	-0.00175
	(0.00981)	(0.0107)	(0.00726)	(0.0122)
Foreign ownership: > 0% & <= 50 %	0.00137	0.0195	0.00902	0.00277
	(0.0343)	(0.0244)	(0.0181)	(0.0236)
Foreign ownership: > 50%	0.104***	0.209***	0.00732	0.0436
	(0.0168)	(0.0154)	(0.0146)	(0.0294)
Internet dummy	0.0352***		-0.00251	
	(0.00828)		(0.00510)	
IndustryXsize-group fixed effects	Yes		Yes	
Firm fixed effects	No		Yes	
Number of observations	14,902		13,209	
Number of firms	2,861		2,601	
Cross-equation correlation	0.1148***		0.0146*	
R2	0.370	0.289	0.0276	0.0042

[†]This table presents estimated coefficients from fitting a system of seemingly unrelated regression equations (SUR) for export and import intensities (both without and with firm fixed effects). The dependent variables are export and import intensities, respectively. Robust standard errors (clustered by firm) are given in parentheses. *,**,*** denote significance at the 10%, 5%, 1% levels, respectively.

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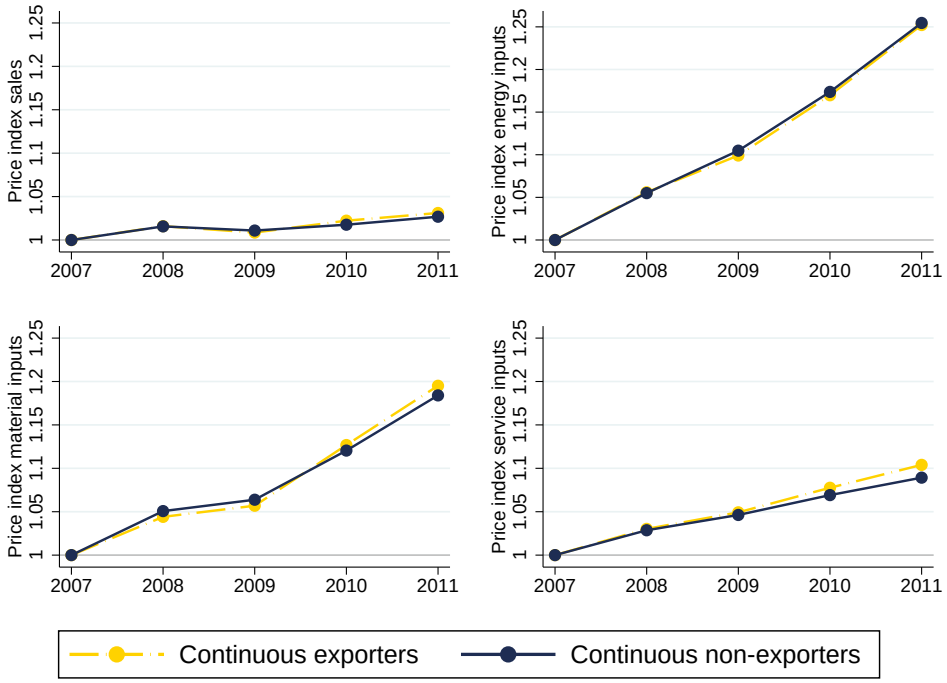
A Appendix

Table A.1: Summary statistics (not weighted)

Variable	Obs.	Mean	Std. Dev.	Min	Max
Export value (1,000 EUR in prices of 2010)	15,074	26,443	208,439	0	7,920,464
Domestic sales (1,000 EUR in prices of 2010)	15,074	39,060	168,733	0	6,207,229
Import value (1,000 EUR in prices of 2010)	15,051	16,417	124,840	0	3,780,449
Domestic purchases (1,000 EUR in prices of 2010)	15,048	35,744	179,316	0	5,463,883
Exporter dummy	15,074	0.64	0.48	0.00	1.00
Importer dummy	15,051	0.63	0.48	0.00	1.00
Market exit	12,432	0.03	0.18	0.00	1.00
Multinational dummy	15,074	0.09	0.29	0.00	1.00
Foreign ownership: =0%	15,060	0.85	0.36	0.00	1.00
Foreign ownership: >0% & <=50%	15,060	0.02	0.14	0.00	1.00
Foreign ownership: >50%	15,060	0.13	0.34	0.00	1.00
Labor productivity (in logs)	14,935	12.27	1.69	2.80	19.16
Capital intensity (in logs)	15,043	4.36	1.14	-2.30	9.01
R&D intensity (in logs)	15,042	0.01	0.03	0.00	2.65
Skill intensity (in logs)	14,629	0.19	0.25	0.00	2.76
Type of good: final good	14,743	0.16	0.37	0.00	1.00
Type of good: intermediate good	14,743	0.26	0.44	0.00	1.00
Type of good: not defined	14,743	0.57	0.49	0.00	1.00
TFP (in logs)	14,914	-0.04	0.63	-8.91	3.07
Output (in logs)	15,074	15.89	1.97	10.04	22.79
Hours worked (in logs)	15,051	11.56	1.42	7.50	17.03
Hourly wage (in logs)	14,996	2.85	0.41	0.40	4.83
Internet dummy	15,060	0.77	0.42	0.00	1.00

Figure A.1: Evolution of firm-level output and input prices, 2007-2011[†]



[†]Note: The sample is balanced on firms that are observed in each year from 2007 to 2011. Continuous exporters are 671 firms that export in each of the years 2005 to 2012 (if observed); continuous non-exporters are 310 firms that do not export in any of the years 2005 to 2012 (if observed). All variables are normalized to one in 2007. Sampling weights apply.

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Nr. 119 (April 2015)
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Andrea Bellucci / Alexander Borisov / Germana Giombini / Alberto Zazzaro

Nr. 120 (April 2015)
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Peter S. Eppinger / Nicole Meythaler / Marc-Manuel Sindlinger / Marcel Smolka