



Essays on International Trade: Firm Heterogeneity,  
Economic Crisis and International Business Cycle  
Transmission

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*Para a Laura*

# Biographical Note

I was born on the 21st of August in Espinho, Portugal. In 2001 I was admitted to the Faculty of Economics in Porto, where I graduated 5 years later. After that I was lucky enough to find a job that allowed me to travel around the world and be paid for it. After 9 years working in Management Consulting in more than 20 countries in 4 different continents, I returned to my Alma Mater as a PhD candidate.

While enrolled in the PhD, I was also a lecturer at the Institute for Political Studies, Catholic University in Lisbon, Portugal, and at the New Economics University, Hanoi, Vietnam. I had a daughter and became the president of the newly created party Iniciativa Liberal, which gained parliamentary representation in October 2019. I also regularly wrote on national newspapers. Life is what happens while you are busy writing your thesis.

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I spent 10 years as a student in the Faculty of Economics of Porto (FEP). FEP was essential for my education both as an economist and as person. I cherished each day I had the privilege to be associated with FEP, its professors and staff.

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# Abstract

This thesis comprises three essays on the influence of international trade in a small open economy such as Portugal, using an empirical approach to answer three research questions. First, what is the profile of the Portuguese trading sector? Second, what drove the increase in exports during the economic crisis of 2009-14? Third, how does trade contribute to international business cycle transmission?

In the first essay, we study the profile of Portuguese trading firms and examine the main differences of these firms against non-trading firms. We find that trading firms are larger and more productive, and that trade is very concentrated in a small number of firms, even more than in other countries and more than was previously thought for Portugal. We also find that being in a monetary union and sharing a language are the main factors associated with the establishment of international trade links by firms.

In the second essay, we find that the export propensity among Portuguese firms increased during the “Great Recession”, but it was those firms previously exporting that contributed the most to the “Export miracle” during the crisis. We also find that this increase was, at least partially, a direct reaction of firms to the reduction in domestic demand endured during that period, having replaced domestic demand with exports.

In the third essay, we develop a theoretical model and find empirical support for a different role of imports and exports in the business cycle comovement. The strength of interdependence is associated with the intensity with which a firm exports to a country, but in the case of imports, interdependence is not associated with import intensity. This confirms the conclusion from the previous essay that exports are substitutes of domestic sales. Imported inputs, on the

other hand, tend to complement domestically sourced inputs.

**JEL Classification Codes: F12, F13, F14, F43, F44**

**Keywords: international trade, firm heterogeneity, transaction data, business cycle transmission**

# Resumo

Esta tese é composta por três ensaios sobre a influência do comércio internacional numa pequena economia aberta como Portugal, recorrendo a uma abordagem empírica para responder a três questões de investigação. Primeiro, qual é o perfil das empresas portuguesas que fazem trocas internacionais? Segundo, o que impulsionou o aumento das exportações durante a crise económica de 2009-14? Terceiro, como é que o comércio internacional contribui para a transmissão dos ciclos económicos?

No primeiro ensaio, estudamos o perfil das empresas portuguesas envolvidas em comércio internacional, examinando as principais diferenças destas empresas face às restantes. Verificamos que as empresas envolvidas em comércio internacional são maiores e mais produtivas e que o comércio internacional está, ainda mais do que noutros países e mais do que se pensava anteriormente para Portugal, muito concentrado num pequeno número de empresas. Também descobrimos que estar na mesma união monetária e compartilhar um idioma são os fatores mais fortemente associados ao estabelecimento de vínculos comerciais por parte das empresas.

No segundo ensaio, verificamos que a propensão exportadora das empresas portuguesas aumentou durante a “Grande Recessão”, mas foram as empresas que já exportavam anteriormente que mais contribuíram para o aumento das exportações. Verificamos também que esse aumento é, pelo menos em parte, uma reação das empresas à redução da procura interna, tendo as empresas substituído a procura interna pelas exportações.

No terceiro ensaio, desenvolvemos um modelo teórico e encontramos suporte empírico para um papel distinto das importações e exportações na transmissão dos ciclos económicos.

O peso desta interdependência está associado à intensidade com que uma empresa exporta para um país, mas no caso das importações, a interdependência não está associada à intensidade importadora. Isso confirma a conclusão do ensaio anterior de que as exportações são substitutos das vendas internas. As importações, por outro lado, tendem a ser complementares aos consumos domésticos.

**Códigos de Classificação JEL: F12, F13, F14, F43, F44**

**Palavras-chave: comércio internacional, heterogeneidade, dados transacionais, transmissão de ciclos económicos**

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# Chapter 1

## Firms in international trade: a portrait of Portuguese trading firms

**Abstract:** This paper presents a detailed profile of Portuguese trading firms using a data panel merging firm and international trade transaction level data, uncovering evidence confirming the recent trade theories on firm heterogeneity and testing empirically predictions of the gravity equation applied to International Trade. Trade in Portugal is even more concentrated and propensity to trade even lower than previous studies for Portugal suggested. Trading firms are larger, more productive and more capital intensive than non-trading firms. Those firms trading with more countries and trading more products account for most of the international trade in Portugal. Using a simplified gravity equation, and taking advantage of the specific situation of Portugal, I find that having a common language has a similar effect in terms of facilitating trade as having a common currency, and has a separate contribution than that of having a recent colonial link.

**JEL codes:** F12, F13, F14

**Key words:** firm heterogeneity, transaction data, international trade

## 1.1 Introduction

Traditional trade theories explained the profile of international trade with comparative advantages and factor endowment. As country level trade data was made available in the 1970s, it became clear that existing theories were unsatisfactory since most trade was intra-industry and between similar countries. A new trade theory emerged, which assumed imperfect competition and consumers' taste for variety. After that, in the 90s, international trade data at firm level became available, revealing that only a small fraction of firms, the largest and most productive, export, and that trade induces intra-industry resource reallocation. That brought a new revolution to the International Trade Theories in what came to be known as the "New New Trade Theory". Seminal papers on the role of firms in trade such as Melitz (2003), Bernard, Jensen, Redding, and Schott (2007) and Eaton, Kortum, and Kramarz (2011) gave rise to several empirical papers for different countries attempting to understand the magnitude of the effects identified in those theoretical models. The later convergence between heterogeneous firm and gravity models, for example with Chaney (2008) and Melitz and Ottaviano (2008), further helped understanding the dynamics of bilateral trade relationships and the role of firms.

Empirical studies in different countries have confirmed the theoretical predictions that international trading firms are more productive, hire more skilled workers and pay higher wages than other firms. Shortly after the introduction of firms' heterogeneity in international trade theory, Bernard et al. (2007) profiled trading firms in the United States, corroborating its results. The analysis performed in Bernard et al. (2007) was then replicated in several countries, including other small open economies like Portugal. In Muûls and Pisu (2009), the authors find that exports and imports are highly concentrated in a few firms and that the productivity advantage of exporters might be overstated because imports are typically not considered. In Castellani, Serti, and Tomasi (2010), the authors reach similar conclusions for Italy. In Andersson, Lööf, and Johansson (2008) the authors identify substantial heterogeneity among

exporting firms in the number of products and destinations exported to. In Cebeci and Fernandes (2015), the authors studied Turkey's export boom of the early 2000s, concluding that most of the growth resulted from continuous exporters in continuing markets. They also show that distance and other indicators of trade resistance determine how many firms and what type of firms trade with any given destination market.<sup>1)</sup>

Taking advantage of the recent possibility to combine a detailed transactional international trade database with an exhaustive balance sheet database of non-financial private firms, this paper has two main objectives. First, to present a detailed profile of the characteristics and performance of Portuguese firms, identifying how a set of performance indicators is associated with international trade engagement. The involvement in international trade will be measured by the volume of exports and imports, but also by the type and variety of products exported/imported and its value added. This will be the first time this analysis is performed for Portugal with the full set of non-financial private firms. Second, to analyze the interplay between the most common trade gravity indicators and firms' trade performance, taking advantage of the unique positioning of Portugal in the international trade arena to isolate the impact of each indicator. Portugal shares a common market with the EU countries, but only shares a currency with some countries in that group. Similarly, it shares a common language with several countries in the world, but has no recent colonial ties with the largest country in that group (Brazil). This unique situation <sup>2</sup> offers the opportunity to assess the effect of each specific trade enabler and its interdependence from firm's performance. The interplay between export destinations and firms' performance has already been considered in other papers. In Bastos and Silva (2010) the authors find that the destination of exports influence the price of the exported goods, and in Bastos, Silva, and Verhoogen (2018) they find that the destination of exports also affect the quality of the inputs used by the firms. In Amador, Oromolla, et al. (2017), the authors look into the contributions of intensive and extensive trade margins to the

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<sup>1</sup>For a more detailed survey of empirical studies see Wagner (2007), Wagner (2012) and Wagner (2016).

<sup>2</sup>France is the only other country that has a similar situation but, to the best of my knowledge, no similar analysis was made for that country.

changes in Portuguese exports during economic crisis.

The first part of the paper will also serve the purpose of reviewing and updating the analysis done in Silva, Afonso, and Africano (2013), which confirmed that trading-firms are bigger and have better performance than non-trading firms. This was, to the best of my knowledge, the only paper that analyzed trade propensity, trade concentration and the association between trade involvement and performance, something that has been developed for several countries [see Wagner (2007), Wagner (2012) and Wagner (2016) for a complete list of papers for different countries]. However, when that paper was developed only data for a sample of firms was available and only until 2004, so in that analysis large firms were over-represented and the effects of early century trade shocks were not incorporated. The newly available data containing the full set of non-financial private firms with detailed characteristics and balance sheet information since 2004 brought the opportunity to have a more realistic view of the Portuguese reality. As we will see in the next sections of this paper, when considering the whole universe of private non-financial firms some indicators of trade propensity, concentration and firm performance are significantly different from what was previously thought.

This paper will proceed as follows: in section 2 we will describe the data used in the rest of the paper; in section 3 we will analyze the trade propensity and the concentration of trade among Portuguese firms and compare it with that of other countries; in section 4 we will assess differences in size, productivity and capital intensity across firms with different levels of trade involvement, and in section 5 we will estimate a gravity equation at firm level.

## **1.2 Data description**

This paper relies on two main datasets provided by the Portuguese Bureau of Statistics (INE). First, a database with the entire universe of non-financial private firms in the country, including

financial results and balance sheet information. The database of firms only excludes financial firms, public administration entities and non-profit organizations. It has been maintained since 2004. This database has information from around 1 million firms per year, although a large majority are very small firms with only one employee or self-employed workers (see Table 1.1). These firms will be excluded from most of the analysis in the next sections.

This database is combined with a 'Trade database' containing customs data on firm-level international trade transactions. This second database contains all international trade transactions in the country since 1988. Transactions with EU countries are obtained via a monthly survey sent to all firms in the country. Data on transactions with non-EU countries is obtained from customs forms. The sum of the total exports and imports in this database corresponds exactly to the volume of exports and imports reported in the official statistics by the Portuguese Bureau of Statistics. Each entry details the Portuguese firm involved (including an anonymized identification number used to link to other firm-level databases), the product traded, the value traded and the destination country, among other information not relevant for the purpose of this paper. Since the database of firms does not include financial firms nor public administration entities, and there are transactions in the international trade database that are not assigned to any entity, some of the international trade transactions are lost when merging the two files. After combining the two databases, the estimation sample covers around 90% of the volume of exports and imports in each year. Table 1.2 presents the total volume of exports and imports in the merged database compared with the international trade transactional database.

As we can see the sum of exports and imports in the original international trade database is exactly the same as the reported values for the country as a whole. When merged with the firms database between 8%-12% of exports and 9%-15% of imports are lost as they are not allocated to an entity included in the firms' database.

## **1.3 Trade propensity and concentration**

### **1.3.1 Propensity to trade**

Portugal is a small open economy with a population of around 10 million people. It is also a member of one of the largest customs union in the world. Being a small country in a large customs union, we would expect a large propensity to trade among Portuguese firms [see Alesina, Spolaore, and Wacziarg (2005)], but, as we can see in Table 1.3, during the period between 2004 and 2014, only 1.8% of the firms exported and only 2.3% of firms imported. If we exclude firms with only one employee, the numbers goes up to 6.2% and 7.7% respectively. In spite of the small size of the domestic market, only a small minority of firms choose to venture into foreign markets. If we limit our analysis to firms with more than 20 employees the propensity to trade increases to 58% for exports and 54% for imports. As anticipated by international trade theories based on firm heterogeneity, the propensity to trade is higher among larger firms. These numbers are significantly lower than those of the previous paper on Portuguese firms [Silva et al. (2013)] as we can see in the last row of the table. That analysis was done on manufacturing firms with at least 2 employees, but since it had to be performed on a non-random sample of firms, it overestimated the propensity to export. The increasing number of small firms after 2004, which could have a dilution effect on trade propensity, account for some of the difference, but as we can see in tables 1.4 and 1.5 the values for 2004 were already much lower than those calculated in Silva et al. (2013).

Looking at the trend in tables 1.4 and 1.5, we find that since 2009 the propensity to trade has increased steadily. During the economic crisis, and throughout the years Portugal was under the economic and financial adjustment program, the propensity to export increased significantly, specially among larger firms. In tables 1.4 and 1.5, we also have the evolution sector by sector, according to the NACE categorization of sectors. In this table we can see that the

yearly evolution was very similar, proportionally, among sectors. Most sectors started a sharp increase in export propensity around 2009, with the only notable exception being the energy sector (which accounts for less than 1% of total trade). With some exceptions, imports also followed a similar path across all sectors: a sharp decrease in 2009 followed by a recovery in the following 2 years with a propensity in 2014 similar to that of 2008. As before, the energy sector is the exception.

### **1.3.2 Trade concentration along the firm extensive margin**

Empirical evidence from other countries show that a small minority of firms account for a large proportion of the international trade. Mayer and Ottaviano (2007) report that the top 5% of exporters account for 81% of exports in Germany, 73% in France, 69% in the United Kingdom, 59% in Italy, 91% in Hungary, 73% in Belgium and 81% in Norway. In Bernard, Jensen, and Schott (2009), the authors find that for the US that the top 5% of exporters account for 93% (which is expected given the larger internal market), and a similar level of concentration for imports, with the top 5% importers accounting for 91% of imports.

In Table 1.6, I replicate the analysis developed by Bernard et al. (2009) for Portugal, reporting the distribution of exports, imports and total trade (exports+imports) across firms percentiles for 2004 and 2014. The table also includes the value obtained in 2000 for the United States in the original paper.

We have seen before that only a small portion of firms engage in international trade, but even among those who do, international trade is highly concentrated. In Portugal, the top 1% of firms account for 59.1% of all trade and the top 5% for 81.4%. We find similar levels of concentration when looking at exports and imports separately. Specifically on exports, we can see that the top 5% of exporters (1,154 firms) account for 79.2% of all exports. This is in line with the European average in the countries covered by Mayer and Ottaviano (2007), but below

the US.

Aligned with the heterogeneous firms theory, the top 5% of international traders are also large firms. They represent only 0.16% of total firms, but account for 11.3% of employment and 35.8% of sales. Finally, the top 50% of exporters and importers account for 99.7% and 99.9% of total exports and imports, respectively. That means that half of exporters/importers (the bottom 50%) have no real weight on Portugal's international trade volume. While those firms are counted as international traders in the calculations of trade propensity, in reality they account for very little trade.

Two words of caution here. First, as stated before, firms in the United States have a much larger domestic market, which limits the comparison made above. Second, this percentile analysis for Portugal hides the concentration at the very top which is not reported in other studies. As we can see from Table 1.7, the trade concentration starts at the very top. In 2014, the top exporting firm accounted for 8.5% of all exports, while the top 10 firms accounted for 36.0%. Imports are also more concentrated at the very top, with 10 firms alone accounting for 28.1% of the country's imports. Comparing with the 2004 values, we see that trade is increasingly concentrated at the very top, with the larger firms increasing their share of international trade. In Eriksson, Smeets, Warzynski, et al. (2009) an identical analysis is done for another small EU economy, Denmark, with the 50 largest firms having a very similar share of total exports (37.7% in 2003 against 37.1% for Portugal in 2004 and 36% in 2014).

Thus, a better way to understand trade concentration is calculating the Gini index for exports and imports. When taking into account all firms, regardless of sector and number of employees, that value is extremely high: 0.999 for exports and 0.998 for imports. Even if we consider only larger firms, the Gini index is still high: for firms above 10 employees, the Gini for exports is 0.975 and for imports 0.970. In Table 1.8, we have the Gini coefficient and trade propensities for Portugal and for other countries for which studies have been made. As studies of other countries have considered different firms' populations, I use different combinations of firms characteristics to ensure comparability. Similarly, as most of previous studies focused on

the manufacturing industry, the top of the table only includes manufacturing firms in Portugal.

Independently of the measure used, Portuguese firms have lower trade propensity and higher concentration than firms in any other country. Independently of the type of firms are considered, Portugal always has lower trade propensity and higher Gini index for exports and imports. It is worth highlighting the comparison with the Italian case taken from Castellani et al. (2010). While Portuguese and Italian firms have very similar Gini coefficient for sales, the Gini coefficients for exports and imports are much higher in Portugal, indicating that differences in firms' size do not tell the whole story.

### **1.3.3 Trade concentration along the extensive margin of products and countries**

In Tables 1.9 to 1.12 we can understand the trade concentration along the product and country extensive margins (the number of products a firm trades and the number of countries traded with). Table 1.9 reports the distribution of exporting firms according to the number of exported products and export destinations, while Table 1.11 reports the same information but for importers. Table 1.10 reports the distribution of exported value according to the category of firms reported in Table 1.9. Table 1.12 does the same for the value of imports. As we can see from Table 1.9, 58% of the firms export to only one country and 30% export only one product. Most of the firms exporting only one product, export that product to one single country, thus 27% of exporting firms export a single product to a single country. At the same time, only 17% of firms export to 5 or more countries. If we look at Table 1.11, we can see that firms' distribution along the product and country extensive margin for imports is very similar to that of exports. Not only international trade is limited to a small number of firms, but within that small group, most firms have a limited reach in terms of number of countries and products. In Table 1.10 we can see the distribution of the value of exports according to the number of

products traded and countries traded with. Despite representing only a minority of trading firms (only 8%), firms that trade with more than 10 countries represent 66% of total export volume. Firms that export more than 10 products to more than 10 countries are only 5% of exporters, but account for 53% of total trade. Thus, we can conclude that exports are very concentrated in those firms able to reach several markets with many different products. Less market diversified exporters account for only a small share of total exports despite being the great majority of exporters.

A similar situation occurs with imports, where only 7% of the importing firms import from more than 10 countries and more than 10 products, but represent 56% of import value. Importers are less likely to trade with only one country than exporters, but the concentration of trade value is still very high among them.

Overall, we can conclude that trade is concentrated in a small group of well diversified firms. This is aligned with the stylized facts of international trade. It is also aligned with theories in which exporters have a sunk cost to export each product and to each country. Furthermore, it confirms that those predictions apply to imports as well, anticipating that importers might also face sunk costs to import different products from different markets and, thus, only the most productive are able to import.

## **1.4 Firm heterogeneity and international trade activities**

### **1.4.1 Characteristics of international trading firms**

Much of the empirical and theoretical work around international trade has been done around exporters. Exporters are more productive, more capital intensive and larger than non-exporters. While some papers have pointed towards the possibility of learning-by exporting [for example,

Lileeva and Trefler (2010)], most studies have concluded that exporters are more productive because the most productive firms self-select into exporting. Research on importers is more limited. Halpern, Koren, and Szeidl (2015) claim that imports are associated with productivity improvements due to higher quality of imported inputs and the fact that domestic inputs might not be good substitutes. Martins and Opromolla (2009) identify higher wages among firms that import high technology goods.

In this section, we will try to understand the differentials in size and productivity indicators between 4 types of firms: non-traders, exporters only, importers only and two-way traders.

In order to understand that, I first conduct a series of regressions aiming at understanding the differences in size, productivity and capital intensity among firms with different types of trade involvement. The general empirical model used in this section can be written as:

$$y_{it} = \alpha + \beta x_{it} + \gamma z_i + \mu L_t + \epsilon_{it}, \quad (1.1)$$

where  $y_{it}$  denotes the log of number of employees, log of annual value added, log of capital per employee, log of value added per employee and log of sales per employee;  $x_{it}$  is a vector of independent variables representing the firms' trade involvement;  $z_i$  are industry fixed effects (based on CAE 5 digit industry codes); and  $L_t$  are year-specific effects. Two sets of regressions were estimated: one set for all firms above 1 employee and one set with only those above 10 employees.

In Table 1.13 we can see the results when the vector of independent variables are dummies for firms that only export, only import and two-way traders. There is also a dummy variable for multinationals (firms with headquarters outside Portugal). When the independent variable is value added at market prices per employee, sales per employee and capital per employee, there is also a variable representing the size of the firm (the natural log of the number of employees) to control for the effects of scale in productivity and capital intensity.

The estimates in Table 1.13 indicate that two-way traders are larger, more capital inten-

sive and more productive, followed by importers only and exporters only. Multinational firms also have an advantage in these indicators, regardless of trading profile. Two way traders are 55% more productive than non-traders, while importers are 43% more productive, while the difference for exporters is 31%. The relative ranking between two-way traders, importers and exporters is similar to that found in other studies such as Castellani et al. (2010) and Muûls and Pisu (2009). Interestingly, the effects for ‘exporter only’ and ‘importer only’ added up are higher, although not much, than the total effect for a two way trader in most regressions. That means that the productivity difference between a firm that exports and a firm that does not export is higher for firms that do not trade than for firms already importing. The same occurs for the marginal impact of importing. This declining marginal difference of trade activities is an indication that, in order to start trading activity of any kind, firms incur in a sunk cost and, thus, only firms with a certain level of productivity engage in it. A firm not involved in international trade at all needs to incur in higher costs to start exporting than a firm already dealing with international suppliers in its importing activities. Similarly, it is easier (less costly) to start importing for a firm that already has the internal skill-set (language knowledge and international business network) to deal with foreign clients from its exporting activities.

The choice of specification, with three dummies including one for two-way-traders, in line with the empirical literature on firm heterogeneity, allows us to understand these marginal differences. In Table A1 in Appendix, we have a similar regression only with two dummies: a dummy for exporting firms and one for importing, and we can see that the coefficients are different from those in Table 1.13. Coefficients for export/import are larger than export only/import only when the dependent variable is linked to size and lower when the dependent variable measures productivity.

Given that most of the public policy on internationalization is focused on stimulating exports, an important take-away from this table is that the importers’ premium is higher than the exporters’ premium, something already identified in studies of other countries such as Castellani et al. (2010), Bernard et al. (2009) or Békés, Muraközy, and Harasztosi (2011). In fact,

importers are usually larger, more productive and more capital intensive than exporters. In the following tables, this is analyzed in more detail.

In Table 1.14, the dummies for exporters, importers and two-way traders are replaced by an indicator of trade intensity corresponding to the ratio of exports and imports over total sales. To avoid that the results being affected by outliers with low sales or disproportionately large exports/imports, firms with sales below 10 thousand euros or reported import/export ratios above 100% are excluded. As we can see from the table, firms that export and import more tend to be bigger, more productive and more capital intensive. The coefficient is higher for exports when we look at employment. However, the coefficient for the import ratio is larger than the one for export ratio for value added, productivity and capital intensity measures. Among firms with more than 1 employee, 1 additional percentage point of export to sales ratio is linked to an increase in 0.39% of value added per employee, while each additional percentage point of import to sales ratio is linked to an increase of 0.98% of value added per employee. Similar differences occur for firms with more than 10 employees and for other productivity measures. So, if we use a measure of intensity of exports and imports, we find a similar positive association with firm size and productivity, meaning that not only are exporters and importers larger and more productive than non-traders, but also firms that export/import more tend to be larger, more productive and more capital intensive than firms that export/import less.

Another way to look at the intensity with which a firm gets involved in international trade is to look at its extensive margin of products and countries, the number of products traded and countries traded with. In Table 1.15 we can see exactly that. Interestingly, the largest coefficient among the 4 indicators of trade intensity is, by a large distance, the one associated with the number of countries that the firm imports from. Being able to source inputs from different countries is more closely associated with firm size, capital intensity and productivity than any other indicator of trade intensity. The causality can, of course, go both ways: bigger firms are more productive and more capital intensive, and thus are more able to incur in the sunk costs to find inputs in different countries, but also being able to find the best inputs, wherever they

are in the world, might contribute towards firm productivity and size. Interestingly, as we can see in Table 1.15, when we use both measures of trade intensity in the same regression, the effect of the import and export ratio decrease significantly, even becoming negative in certain cases. On the other hand, the coefficient of number of countries imported from remains similar to the regression where the intensity ratios are not included. This is a strong indication that the association with size, capital intensity and productivity is much stronger with the ability of importing from different countries than with the ratio of imports. Firms that incur in the sunk costs of finding the right suppliers are bigger, more productive and more capital intensive.

Another finding is that the coefficients of the extensive margin of countries are much higher than the coefficients of the extensive margin of products. Trading with one additional country is more closely associated with firms' size, productivity (for firms with more than 10 employees) and capital intensity than trading an additional product. The likely reason for this is that for multi-product firms it is easier to add products to the trade portfolio than to add countries (and there are more different products in the economy than countries to trade with, which waters down the effect). This finding for the Portuguese firms confirms the vast literature on exporting sunk costs, particularly with the cost difference between the cost of country versus product expansion reported in Maurseth and Medin (2017).

Tables 1.13 to 1.16 present the results from descriptive regressions intended to characterize firms, establishing an association between their trading involvement and their size, productivity and capital intensity. It does not establish a causal relation. As far as we know, that causal relation can go both ways or does not even exist. The identified associations might be related to some unobservable characteristic of the firms that makes them more likely to trade and, at the same time, larger, more productive and more capital intensive (for example, the quality of the employees). To account for this unobservable characteristics, we can see in Appendix the same regressions but with fixed effects at firm level (tables A3 to A6). As we can see from the set of tables in Appendix, coefficients decline significantly when the firm fixed effects are added, demonstrating that most of the differences between firms are due to time-invariant char-

acteristics of the firms rather than trade involvement. Yet, in most cases the coefficients remain positive and significant for the usual confidence levels, strongly indicating that there might be a causal relation between international trade involvement and the dependent variables used. Nevertheless, caution is warranted in interpreting these results as a causal relation: a random shock at firm level might, at the same time, affect firm performance and the international trade involvement.

## **1.5 Portuguese trading firms and the gravity equation**

The gravity equation is one of the most solid relationships in International Trade. Countries tend to trade more with larger economies and those that are closer. While the size of a trade partner is easier to quantify, the definition of distance is still up for discussion. Distance can refer to physical distance, cultural proximity, existence of trade barriers, language proximity, past colonial ties or a common currency, among other indicators. Countries are expected to trade more with larger economies, those that are closer, those sharing the same language, same currency, cultural values or those with which they have colonial ties. Given that the trade barriers are lower, in a heterogeneous firms framework it is expected that the higher the productivity of a firm, the more likely the firm is to export to more distant countries. Smaller and less productive firms are theoretically more likely to trade with countries where trade barriers are lower or not to trade at all.

One of the main challenges of performing empirical work testing the gravity equations at firm level is to differentiate the impact of the different definitions of "distance". Most countries share a language with other countries with which they also share a colonial tie, or they share a currency with countries with which they also have a free trade agreement. In this scenario, Portugal is in a unique situation to understand the implications of the gravity equation on firms. Portugal is part of a free trade area (European Union), but shares a currency with only

some of its members. Simultaneously, it shares a language with some countries with which it has recent colonial ties (Angola, Mozambique, Cape Verde, São Tomé e Príncipe and Guiné-Bissau), but also with a large market with which it has no recent colonial ties (Brazil, that became independent in 1822). Analyzing firm level exporting activity for Portugal is likely to give some strong indications on the impact of the different trade barriers both on the extensive (probability of a firm exporting) and intensive (amount exported) margins. While most of this is outside the scope of this paper, we can still try to understand how the profile of firms' exports along gravity dimensions is associated with the firms' characteristics and profile.

Using pairwise country data from the CEPII database and transaction level data for international trade in Portugal, it was possible to categorize destinations according to the following gravity variables:

- Language proximity: proportion of firm's exports to countries where Portuguese is the official language
- Colonial status: proportion of firm's exports to countries with which Portugal has a recent colonial relation
- European Union: proportion of firm's exports to EU countries
- Currency union: proportion of firm's exports to Euro Zone countries
- Average distance: average physical distance of countries exported to, weighted by export value
- Average GDP: average real GDP of countries exported to, weighted by export value
- Religious proximity: average probability that two people at random, one from Portugal and one from destination country, share the same religion, weighted by export value

Table 1.17 presents a summary of these indicators for the period 2004-2014. It presents a simple average of the respective indicator for all firms (where each exporting firm is given equal weight) and an average weighted by the export volume of the firms, which corresponds to the aggregate proportion of exports or aggregate average. As we can see in that table, on average an exporting firm sells 43.6% of its exports to a former Portuguese colony and 32.1%

to an European Union country, but on aggregate only 6.8% of exports go to former colonies and 73.8% go to the European Union. This difference between the simple average among firms and the actual proportion of exports at the aggregate level indicates the existence of a large number of small firms exporting to former colonies, while Portuguese exports to the EU are likely to be concentrated in a smaller number of bigger firms. In fact, as we can see from Table 1.18, 45% of the exporting firms send more than 90% of their exports to Portuguese speaking countries, but these are firms with export volumes well below average.

Given that firm's size and productivity tend to be correlated, tables 1.17 and 1.18 already give us an indication of which export markets require more productive firms. In order to understand how the different gravity indicators are associated with the firm's size, productivity and capital intensity, the following empirical model was followed:

$$y_{it} = \alpha + \beta x_{it} + \gamma z_i + \mu L_t + \epsilon_{it} , \quad (1.2)$$

where  $y_{it}$  denotes the log of number of employees, log of annual value added, log of capital per employee, log of value added per employee and log of sales per employee;  $x_{it}$  is a vector of firms' gravity indicators, including dummies for countries with same language, recent colonial link, part of the European Union and part of the Euro Zone, average distance to export destinations, real GDP and average religious proximity;  $z_i$  are industry fixed effects (based on CAE 5 digit industry codes); and  $L_t$  are year-specific effects. As before, only firms with more than 1 employee are included, and two sets of regressions were estimated: one set for all firms above 1 employee and one set with only those above 10 employees.

According to the literature merging heterogeneous firms and gravity models [specially Chaney (2008) and Melitz and Ottaviano (2008)], the productivity threshold for a firm to export to any given country increases with distance (only the most productive firms can incur the costs of exporting to distant countries), but decreases with religious proximity, language proximity, colonial links, EU and Eurozone memberships. However, as referred in Mayer and

Ottaviano (2007), we should also expect that the productivity threshold to access the most competitive markets, such as the European Union, to be larger. Given that the threshold increases and the firm distribution after the threshold remains the same, we would expect average productivity levels of firms exporting to a given country to follow the same trend as the productivity threshold. The magnitude of these effects would also give us an indication on which gravity variable imposes a larger cost on exporters. The outcome of these regressions can be seen in Table 1.18.

We can start by looking at the value added per employee, the key indicator of productivity. The only unexpected value is the positive coefficient associated with exporting to European Union countries. Some caution is required when interpreting this. European Union countries and Portuguese-speaking countries accounted for 95% of Portuguese exports in 2014, with the United States accounting for more than 4%. The rest of the world accounts for 0.2% of Portuguese exports. So, aside from the United States, there is no real control group of destinations for this analysis. The positive coefficient associated with exporting to European Union countries should not be interpreted as higher export threshold for a country within a customs union, but that all other significant destinations (Eurozone countries within European Union, former colonies and countries with language ties) benefit from additional proximity advantages that lower the productivity threshold to export.

As expected, the coefficients of language and colonial links are negative. All else being equal, a firm exporting to Portuguese speaking countries is expected to have between 5% and 6% lower productivity than an exporting firm that does not export to those countries. Exporting to a former colony is associated with even lower productivity. On the other hand, exporting to the Eurozone is associated with lower productivity, an indication that sharing a currency decreases the costs to export (interestingly, the effects of sharing language and currency are very similar). As expected, when we look at productivity measures, the coefficient of distance is positive and the coefficient of destination GDP is negative (although only significant at 10% level for firms above 1 employee). The only unexpected result is the positive coefficient of

religion, which most likely is related with the fact that trade partners sharing the same religion might also have more competitive internal markets. Still, the coefficient is low and only significant at 10% and only when taking into account firms above 10 employees. Overall, the results for value added per employee are in line with the literature on gravity and heterogeneous firms. Having colonial and language links allows less productive firms to export to those countries. The coefficients on capital per employee are in line with those of the value added per employee, further confirming the conclusions above. Interestingly, when we take sales per employee as an indicator of productivity the coefficient for recent colonial link becomes positive. This is an indication that the lower productivity of the firms exporting to former colonies is not a result of lower sales, but a sales mix that includes products with lower value added (typically, lower quality products).

## 1.6 Conclusions

Taking advantage of newly available data on firms and international trade transactions, this paper offers a portrait of Portuguese trading firms. This is the first study of the kind done in Portugal including the full population of non-financial private firms. This paper also gives an overview of what changed in that portrait during the recent economic crisis and compares findings for Portugal with those obtained by similar studies for other countries..

First, I find that only a small portion of the Portuguese firms are involved in international trade. Trade propensity is lower than a previous study on Portugal and also lower than other countries for which similar studies were done. Even when smaller single-employee firms are not considered, Portuguese firms still have a much lower trade propensity than firms from other countries included in similar studies. During the period of the "Great Recession" (2009-2014), the trade propensity started to increase, though.

Second, even among the small number of trading firms, trade is very concentrated at the top. A very small proportion of trading firms account for most of the international trade in Portugal. Trade is particularly concentrated along product and country extensive margins: only 5% of exporting firms export more than 10 products to more than 10 countries, but those firms account for 53% of all exports. A similar situation occurs with imports: 7% of the importers trade more than 10 products in 10 countries, but they account for 56% of all imports.

Third, firms with higher exposure to international trade are bigger, more productive and more capital intensive. Firms involved in importing activities have an even larger advantage than firms engaged in exports, with two way traders having the largest positive differences against non-traders. Importing, so often neglected in international trade policy seems to be even more associated with employment and productivity than exporting. Furthermore, it was found that when we look into the extensive margin of trade engagement, the number of countries a firm imports from is the strongest indication of firms' size, productivity and capital intensity. Although it is not possible to establish the direction of causality, being able to source inputs from different countries in the world is likely to help firms improve efficiency and, thus, productivity.

Fourth, in line with theories uniting heterogeneous firm models with the gravity equation, I find that the recent colonial links between Portugal and some African countries are still a key determinant of export propensity among small and less productive exporters. Firms exporting to EU countries tend to be more productive, indicating that those markets are relatively harder to reach for Portuguese firms. The common currency partially alleviates the costs of trading with those countries.

The findings of this paper can be used to drive some shifts in international trade policy. First of all, governments should stop looking at trade diplomacy only as a tool to expand exports and support exporting firms. Reducing the sunk costs of importing might be as, or even more, important to increase employment and productivity in the country. The ability to source inputs from many countries is also a way to boost exports since it is associated with

higher productivity which makes firms more competitive. An economic diplomacy network already established to promote exports can easily do the same for imports with similar positive results. Since country diversification seems to have both direct and indirect positive effects, government trade policy should aim at promoting destination market diversity. As the number of small firms exporting almost exclusively to former colonies show, one of the most important enablers of trade is established bilateral long-term economic relations, so expanding the network of countries with which Portugal has such relations is extremely important.

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## Tables

**Table 1.1.** Profile of firms included in the database

| Sector                            | Number of employees |                |                 |               | Total            | % of total  |
|-----------------------------------|---------------------|----------------|-----------------|---------------|------------------|-------------|
|                                   | 1 employee          | 2-10 employees | 11-20 employees | >20 employees |                  |             |
| <b>Agriculture</b>                | 117,458             | 10,196         | 685             | 426           | <b>128,765</b>   | <b>11%</b>  |
| <b>Mining</b>                     | 522                 | 386            | 105             | 89            | <b>1,102</b>     | <b>0%</b>   |
| <b>Manufacturing</b>              | 33,103              | 22,268         | 4,862           | 5,968         | <b>66,201</b>    | <b>6%</b>   |
| <b>Energy</b>                     | 762                 | 130            | 17              | 32            | <b>941</b>       | <b>0%</b>   |
| <b>Water</b>                      | 539                 | 413            | 95              | 205           | <b>1,252</b>     | <b>0%</b>   |
| <b>Construction</b>               | 49,853              | 24,024         | 2,338           | 1,629         | <b>77,844</b>    | <b>7%</b>   |
| <b>Transportation and storage</b> | 162,415             | 71,907         | 5,387           | 4,013         | <b>243,722</b>   | <b>22%</b>  |
| <b>Tourism</b>                    | 53,407              | 27,471         | 1,947           | 1,297         | <b>84,122</b>    | <b>7%</b>   |
| <b>ICT</b>                        | 10,202              | 3,769          | 403             | 460           | <b>14,834</b>    | <b>1%</b>   |
| <b>Real estate activities</b>     | 24,267              | 5,042          | 166             | 86            | <b>29,561</b>    | <b>3%</b>   |
| <b>Consulting</b>                 | 93,367              | 18,309         | 1,012           | 670           | <b>113,358</b>   | <b>10%</b>  |
| <b>Administrative</b>             | 137,371             | 6,061          | 657             | 898           | <b>144,987</b>   | <b>13%</b>  |
| <b>Education</b>                  | 51,720              | 2,886          | 327             | 391           | <b>55,324</b>    | <b>5%</b>   |
| <b>Health</b>                     | 72,727              | 9,832          | 666             | 478           | <b>83,703</b>    | <b>7%</b>   |
| <b>Entertainment</b>              | 26,704              | 1,882          | 116             | 142           | <b>28,844</b>    | <b>3%</b>   |
| <b>Other services</b>             | 45,010              | 8,298          | 235             | 155           | <b>53,698</b>    | <b>5%</b>   |
| <b>Total</b>                      | <b>879,427</b>      | <b>212,874</b> | <b>19,018</b>   | <b>16,939</b> | <b>1,128,258</b> | <b>100%</b> |
| <b>% of total</b>                 | <b>78%</b>          | <b>19%</b>     | <b>2%</b>       | <b>2%</b>     | <b>100%</b>      |             |

Source: Statistics Portugal (INE), own calculations.

**Table 1.2.** Volume of Exports and Imports contained in databases (millions of Euros)

|             | Exports ('000 €) |                |               |                 | Imports ('000 €) |                |               |                 |
|-------------|------------------|----------------|---------------|-----------------|------------------|----------------|---------------|-----------------|
| Year        | Published data   | Trade Database | After merging | After merging % | Published data   | Trade Database | After merging | After merging % |
| <b>2004</b> | 30,920           | 30,920         | 28,007        | <b>91%</b>      | 49,260           | 49,259         | 43,959        | <b>89%</b>      |
| <b>2005</b> | 31,137           | 31,137         | 28,505        | <b>92%</b>      | 51,379           | 51,379         | 47,514        | <b>92%</b>      |
| <b>2006</b> | 35,641           | 35,640         | 32,258        | <b>91%</b>      | 56,295           | 56,294         | 50,993        | <b>91%</b>      |
| <b>2007</b> | 38,294           | 38,294         | 34,997        | <b>91%</b>      | 59,927           | 59,926         | 54,715        | <b>91%</b>      |
| <b>2008</b> | 38,847           | 38,847         | 34,880        | <b>90%</b>      | 64,194           | 64,193         | 57,723        | <b>90%</b>      |
| <b>2009</b> | 31,697           | 31,696         | 27,960        | <b>88%</b>      | 51,379           | 51,378         | 43,880        | <b>85%</b>      |
| <b>2010</b> | 37,268           | 37,267         | 33,572        | <b>90%</b>      | 58,647           | 58,647         | 50,742        | <b>87%</b>      |
| <b>2011</b> | 42,828           | 42,828         | 38,996        | <b>91%</b>      | 59,551           | 59,551         | 53,205        | <b>89%</b>      |
| <b>2012</b> | 45,213           | 45,213         | 40,993        | <b>91%</b>      | 56,374           | 56,374         | 50,458        | <b>90%</b>      |
| <b>2013</b> | 47,303           | 47,302         | 43,031        | <b>91%</b>      | 57,013           | 57,012         | 50,700        | <b>89%</b>      |
| <b>2014</b> | 48,054           | 48,053         | 43,218        | <b>90%</b>      | 59,032           | 59,032         | 51,902        | <b>88%</b>      |

Source: Statistics Portugal (INE), own calculations.

Notes: The column 'Published data' refers to the the official aggregate export and import values published by the Statistics Portugal (INE) and Eurostat; 'Trade database' refers to the sum of the individual import and export transactions in the transactional database; 'After merging' refers to the sum of the individuals import and export transactions performed by firms that also have an entry in the firms' database with financial and balance sheet information; 'After merging %' reflects the percentage of transaction volume captured in the previous column.

**Table 1.3.** Trade propensity according to size and type of firm

|                          |                    | > 20 workers | >10 workers | > 1 worker | All firms |
|--------------------------|--------------------|--------------|-------------|------------|-----------|
| <b>Export propensity</b> | All                | 32.5%        | 22.3%       | 6.2%       | 1.8%      |
|                          | Only manufacturing | 58.0%        | 42.0%       | 18.3%      | 9.7%      |
|                          | Silva et al (2013) |              |             | 63.0%      |           |
| <b>Import propensity</b> | All                | 37.1%        | 25.7%       | 7.7%       | 2.3%      |
|                          | Only manufacturing | 53.8%        | 36.9%       | 15.1%      | 8.0%      |
|                          | Silva et al (2013) |              |             | 69.0%      |           |

Source: Statistics Portugal (INE), own calculations.

Notes: This table contains the export propensity (% of firms in Portugal that export) and import propensity (% of firms in Portugal that import) for all firms and only manufacturing firms according to firm size defined as number of employees. Below manufacturing firms, we can see the export and import propensities calculated in Silva et al. (2013) based on a sample of firms from 1996 to 2004.

**Table 1.4.** Evolution of export propensity of firms with more than 1 employee, by sector

| Sectors                           | 2004        | 2005        | 2006        | 2007        | 2008        | 2009        | 2010        | 2011        | 2012        | 2013        | 2014        |
|-----------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Agriculture</b>                | 3.0%        | 3.0%        | 3.5%        | 3.5%        | 3.2%        | 2.9%        | 3.5%        | 3.7%        | 4.2%        | 4.0%        | 4.0%        |
| <b>Mining</b>                     | 13.5%       | 15.0%       | 17.1%       | 18.0%       | 16.3%       | 15.7%       | 17.8%       | 18.7%       | 20.2%       | 23.0%       | 23.4%       |
| <b>Manufacturing</b>              | 16.1%       | 15.9%       | 17.0%       | 17.2%       | 16.8%       | 16.3%       | 18.4%       | 19.4%       | 21.2%       | 22.8%       | 23.2%       |
| <b>Energy</b>                     | 6.0%        | 6.7%        | 6.9%        | 4.4%        | 5.4%        | 6.3%        | 5.5%        | 9.0%        | 5.8%        | 5.3%        | 5.6%        |
| <b>Water</b>                      | 14.1%       | 13.4%       | 14.9%       | 14.5%       | 12.4%       | 12.8%       | 14.6%       | 16.6%       | 19.2%       | 19.8%       | 18.1%       |
| <b>Construction</b>               | 0.9%        | 0.9%        | 1.2%        | 1.4%        | 1.4%        | 1.7%        | 1.7%        | 1.8%        | 2.5%        | 2.9%        | 2.9%        |
| <b>Transportation and storage</b> | 6.7%        | 6.6%        | 7.4%        | 7.7%        | 8.0%        | 8.0%        | 8.3%        | 8.8%        | 9.7%        | 10.4%       | 10.5%       |
| <b>Tourism</b>                    | 0.2%        | 0.3%        | 0.2%        | 0.2%        | 0.2%        | 0.2%        | 0.2%        | 0.2%        | 0.2%        | 0.2%        | 0.2%        |
| <b>ICT</b>                        | 8.0%        | 7.2%        | 7.5%        | 7.3%        | 8.1%        | 7.6%        | 8.3%        | 8.0%        | 8.5%        | 9.0%        | 8.5%        |
| <b>Real estate activities</b>     | 1.3%        | 1.1%        | 0.9%        | 0.6%        | 1.2%        | 1.0%        | 0.8%        | 1.0%        | 0.9%        | 1.0%        | 1.0%        |
| <b>Consulting</b>                 | 1.6%        | 1.6%        | 1.6%        | 1.8%        | 1.9%        | 2.3%        | 2.5%        | 2.6%        | 3.0%        | 3.2%        | 3.4%        |
| <b>Administrative</b>             | 2.3%        | 2.2%        | 2.4%        | 2.7%        | 2.7%        | 2.5%        | 2.8%        | 2.9%        | 3.3%        | 3.8%        | 3.5%        |
| <b>Education</b>                  | 0.7%        | 0.6%        | 0.5%        | 0.6%        | 0.6%        | 0.6%        | 0.6%        | 0.6%        | 0.8%        | 0.8%        | 0.8%        |
| <b>Health</b>                     | 0.2%        | 0.1%        | 0.1%        | 0.2%        | 0.2%        | 0.1%        | 0.1%        | 0.2%        | 0.2%        | 0.2%        | 0.3%        |
| <b>Entertainment</b>              | 2.2%        | 1.7%        | 2.0%        | 2.0%        | 1.9%        | 1.6%        | 2.2%        | 2.2%        | 2.0%        | 2.5%        | 3.2%        |
| <b>Other services</b>             | 0.5%        | 0.6%        | 0.7%        | 0.7%        | 0.7%        | 0.6%        | 0.6%        | 0.7%        | 0.7%        | 0.9%        | 1.0%        |
| <b>Total</b>                      | <b>5.5%</b> | <b>5.3%</b> | <b>5.8%</b> | <b>5.8%</b> | <b>5.8%</b> | <b>5.7%</b> | <b>6.1%</b> | <b>6.4%</b> | <b>7.2%</b> | <b>7.7%</b> | <b>7.8%</b> |

Source: Statistics Portugal (INE), own calculations.

**Table 1.5.** Evolution of import propensity of firms with more than 1 employee, by sector

| Sectors                           | 2004        | 2005        | 2006        | 2007        | 2008        | 2009        | 2010        | 2011        | 2012        | 2013        | 2014        |
|-----------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Agriculture</b>                | 2.6%        | 3.0%        | 3.7%        | 3.3%        | 3.6%        | 1.9%        | 2.1%        | 2.8%        | 3.1%        | 2.9%        | 2.4%        |
| <b>Mining</b>                     | 7.7%        | 7.2%        | 8.5%        | 8.0%        | 7.0%        | 3.7%        | 4.8%        | 5.8%        | 5.8%        | 4.7%        | 4.1%        |
| <b>Manufacturing</b>              | 15.2%       | 15.2%       | 16.3%       | 16.1%       | 15.8%       | 12.2%       | 13.6%       | 14.9%       | 15.7%       | 15.8%       | 15.4%       |
| <b>Energy</b>                     | 19.5%       | 19.3%       | 24.6%       | 21.4%       | 25.1%       | 17.2%       | 20.8%       | 20.1%       | 17.9%       | 14.4%       | 10.6%       |
| <b>Water</b>                      | 18.0%       | 18.0%       | 19.4%       | 18.7%       | 17.3%       | 12.2%       | 13.2%       | 14.2%       | 15.5%       | 15.1%       | 11.9%       |
| <b>Construction</b>               | 1.4%        | 1.5%        | 1.8%        | 1.7%        | 1.9%        | 1.2%        | 1.5%        | 1.7%        | 1.7%        | 1.8%        | 1.6%        |
| <b>Transportation and storage</b> | 12.9%       | 13.1%       | 14.8%       | 14.3%       | 14.9%       | 10.7%       | 11.4%       | 12.1%       | 12.1%       | 11.6%       | 10.8%       |
| <b>Tourism</b>                    | 0.8%        | 0.9%        | 1.0%        | 0.9%        | 1.0%        | 0.8%        | 0.8%        | 0.9%        | 0.9%        | 0.8%        | 0.8%        |
| <b>ICT</b>                        | 16.8%       | 14.6%       | 16.0%       | 15.6%       | 15.7%       | 13.6%       | 13.8%       | 13.6%       | 12.7%       | 12.0%       | 11.7%       |
| <b>Real estate activities</b>     | 2.4%        | 2.2%        | 2.0%        | 1.6%        | 2.2%        | 1.5%        | 1.3%        | 1.3%        | 1.2%        | 1.0%        | 0.9%        |
| <b>Consulting</b>                 | 4.3%        | 4.1%        | 4.3%        | 4.2%        | 4.2%        | 3.4%        | 3.7%        | 3.7%        | 3.7%        | 3.8%        | 3.8%        |
| <b>Administrative</b>             | 5.3%        | 5.7%        | 5.8%        | 5.5%        | 6.1%        | 4.1%        | 4.9%        | 4.7%        | 5.0%        | 4.8%        | 4.3%        |
| <b>Education</b>                  | 2.0%        | 2.1%        | 2.3%        | 2.2%        | 2.7%        | 1.8%        | 2.1%        | 2.4%        | 1.9%        | 2.1%        | 2.1%        |
| <b>Health</b>                     | 2.1%        | 2.5%        | 2.3%        | 2.1%        | 2.2%        | 2.1%        | 2.1%        | 2.1%        | 1.8%        | 1.8%        | 1.8%        |
| <b>Entertainment</b>              | 7.2%        | 8.1%        | 8.5%        | 8.7%        | 9.5%        | 6.7%        | 7.5%        | 7.5%        | 7.6%        | 6.6%        | 8.0%        |
| <b>Other services</b>             | 1.2%        | 1.5%        | 1.7%        | 1.8%        | 1.8%        | 1.6%        | 1.9%        | 2.0%        | 2.2%        | 2.1%        | 1.9%        |
| <b>Total</b>                      | <b>8.1%</b> | <b>8.1%</b> | <b>8.8%</b> | <b>8.5%</b> | <b>8.6%</b> | <b>6.3%</b> | <b>6.8%</b> | <b>7.4%</b> | <b>7.5%</b> | <b>7.3%</b> | <b>6.9%</b> |

Source: Statistics Portugal (INE), own calculations.

**Table 1.6.** Export and Import concentration across firms

| Firm rank      | Number of firms |         | % of all firms |        | % of employment    |        | % of trade |        | % of sales |        |
|----------------|-----------------|---------|----------------|--------|--------------------|--------|------------|--------|------------|--------|
|                | PT2014          | US2000  | PT2014         | US2000 | PT2014             | US2000 | PT2014     | US2000 | PT2014     | PT2004 |
| Top 1 percent  | 363             | 2,245   | 0.032          | 0.033  | <i>Total trade</i> |        | 59.1       | 55.9   | 80.9       | 20.9   |
| Top 5 percent  | 1,814           | 11,223  | 0.161          | 0.164  | 6.1                | 14.0   | 81.4       | 78.6   | 92.7       | 32.7   |
| Top 10 percent | 3,627           | 22,445  | 0.321          | 0.328  | 11.3               | 21.2   | 89.5       | 87.3   | 96.1       | 38.2   |
| Top 25 percent | 9,067           | 56,111  | 0.804          | 0.820  | 14.7               | 23.9   | 97.3       | 96.0   | 99.0       | 45.4   |
| Top 50 percent | 18,134          | 112,221 | 1.607          | 1.640  | 19.7               | 28.7   | 99.9       | 99.5   | 99.8       | 51.7   |
|                |                 |         |                |        | 24.8               | 34.2   |            |        |            |        |
| Top 1 percent  | 231             | 1,673   | 0.020          | 0.016  | <i>Exports</i>     |        | 55.6       | 53.0   | 80.9       | 9.4    |
| Top 5 percent  | 1,154           | 8,361   | 0.102          | 0.080  | 3.2                | 11.0   | 79.2       | 77.5   | 93.0       | 16.0   |
| Top 10 percent | 2,308           | 16,722  | 0.205          | 0.160  | 7.0                | 17.6   | 88.4       | 87.4   | 96.3       | 19.8   |
| Top 25 percent | 5,769           | 41,805  | 0.511          | 0.400  | 9.5                | 20.8   | 97.0       | 96.7   | 98.9       | 25.8   |
| Top 50 percent | 11,538          | 83,609  | 1.023          | 0.801  | 14.0               | 27.0   | 99.7       | 99.7   | 99.8       | 32.6   |
|                |                 |         |                |        | 18.6               | 32.7   |            |        |            |        |
| Top 1 percent  | 227             | 1,179   | 0.020          | 0.025  | <i>Imports</i>     |        | 57.1       | 54.5   | 77.6       | 19.8   |
| Top 5 percent  | 1,131           | 5,891   | 0.100          | 0.126  | 4.8                | 11.0   | 79.3       | 76.9   | 90.8       | 30.2   |
| Top 10 percent | 2,261           | 11,782  | 0.200          | 0.252  | 8.7                | 16.3   | 87.6       | 85.6   | 95.0       | 35.5   |
| Top 25 percent | 5,653           | 29,453  | 0.501          | 0.630  | 11.7               | 18.5   | 96.2       | 95.0   | 98.6       | 42.3   |
| Top 50 percent | 11,305          | 58,906  | 1.002          | 1.261  | 16.2               | 21.7   | 99.9       | 99.2   | 99.8       | 48.4   |
|                |                 |         |                |        | 21.1               | 25.5   |            |        |            |        |

Notes: Table reports the number of firms, percent of all firms, percent of employment, percent of sales and percent trade for firms that are responsible for the top 1, 5, 10, 25, and 50 percentiles of the total trade, export and import distributions, respectively. Data for US is taken from similar analysis in Bernard et al. (2009). It includes all firms in the database.

**Table 1.7.** Export and Import concentration at the very top

|                     | <b>2004</b>    |                | <b>2014</b>    |                |
|---------------------|----------------|----------------|----------------|----------------|
|                     | <b>Exports</b> | <b>Imports</b> | <b>Exports</b> | <b>Imports</b> |
| <b>Top 1 firm</b>   | 5.3            | 12.0           | 8.5            | 16.7           |
| <b>Top 2 firms</b>  | 8.5            | 15.0           | 11.5           | 19.4           |
| <b>Top 5 firms</b>  | 14.6           | 20.9           | 17.4           | 23.7           |
| <b>Top 10 firms</b> | 21.1           | 28.6           | 21.8           | 28.1           |
| <b>Top 50 firms</b> | 37.1           | 52.8           | 36.0           | 44.6           |

Source: Statistics Portugal (INE), own calculations.

Notes: This table reports the concentration of total exports and imports in the top 1, 2, 5, 10 and 50 firms in 2004 and 2014. The values represent the % of total exports/imports concentrated in each group of firms.

**Table 1.8.** Cross-country comparison of trade participation and concentration

| Country              | Sector | # employees        | % exp | % imp | Gini Exports | Gini Imports | Gini Sales | Comments              | Source                   |
|----------------------|--------|--------------------|-------|-------|--------------|--------------|------------|-----------------------|--------------------------|
| <b>United States</b> | Man    | All                | 27.0% | 14.0% | 0.972        | 0.965        | 0.916      | Plant level, 2002     | Bernard et al.(2007)     |
| <b>Belgium</b>       | Man    | All                | 41.2% | 43.2% | 0.959        | 0.956        | 0.873      | Firm-level, 1996      | Muuls and Pisu (2007)    |
| <b>Hungary</b>       | Man    | All (large sample) | 27.7% | 33.2% | 0.936        | 0.945        | 0.922      | Firm-level, 1992-2003 | Békés et al. (2011)      |
| <b>Portugal</b>      | Man    | All                | 10.0% | 8.0%  | 0.990        | 0.993        | 0.935      | Firm-level, 2004-14   | This paper               |
| <b>Sweden</b>        | Man    | >1 employee        | 36.0% | 27.0% | -            | -            | -          | Firm level, 2004      | Andersson et al (2008)   |
| <b>Denmark</b>       | Man    | >1 employee        | 38.0% | -     | -            | -            | -          | Firm level, 2003      | Eriksson et al. (2009)   |
| <b>Portugal</b>      | Man    | >1 employee        | 18.0% | 15.0% | 0.980        | 0.986        | 0.892      | Firm-level 2004-14    | This paper               |
| <b>Sweden</b>        | Man    | >10 employees      | 71.0% | 60.0% | -            | -            | -          | Firm level, 2004      | Andersson et al (2008)   |
| <b>Denmark</b>       | Man    | >10 employees      | 66.6% | -     | -            | -            | -          | Firm level, 2003      | Eriksson et al. (2009)   |
| <b>Portugal</b>      | Man    | >10 employees      | 42.0% | 37.0% | 0.943        | 0.962        | 0.831      | Firm-level, 2004-14   | This paper               |
| <b>Italy</b>         | Man    | >20 employees      | 70.6% | 69.3% | 0.825        | 0.899        | 0.807      | Firm level, 1997      | Castellani et al. (2010) |
| <b>Portugal</b>      | Man    | >20 employees      | 58.0% | 54.0% | 0.908        | 0.940        | 0.799      | Firm-level, 2004-14   | This paper               |
| <b>United States</b> | All    | All                | 3.1%  | 2.2%  | -            | -            | -          | Firm level, 2000      | Bernard et al.(2009)     |
| <b>Portugal</b>      | All    | All                | 1.8%  | 2.3%  | 0.999        | 0.998        | 0.908      | Firm-level, 2004-14   | This paper               |
| <b>Denmark</b>       | All    | >1 employee        | 14.9% | -     | -            | -            | -          | Firm level, 2003      | Eriksson et al. (2009)   |
| <b>Portugal</b>      | All    | >1 employee        | 6.2%  | 7.7%  | 0.995        | 0.992        | 0.878      | Firm-level, 2004-14   | This paper               |
| <b>Denmark</b>       | All    | >10 employees      | 29.0% | -     | -            | -            | -          | Firm level, 2003      | Eriksson et al. (2009)   |
| <b>Portugal</b>      | All    | >10 emp            | 22.3% | 25.7% | 0.975        | 0.970        | 0.825      | Firm-level, 2004-14   | This paper               |
| <b>Portugal</b>      | All    | >20 employees      | 32.5% | 37.1% | 0.957        | 0.955        | 0.801      | Firm-level, 2004-14   | This paper               |

Notes: Table includes measures of concentration for firms of all sectors and only manufacturing. It only compares with papers that also used the entire population of firms in the analysis.

**Table 1.9.** Country and product extensive margins - Exporting firms distribution, 2004-14

| <b>Products</b> | <b>Countries</b> |            |            |            |            | <b>Total</b> |
|-----------------|------------------|------------|------------|------------|------------|--------------|
|                 | <b>1</b>         | <b>2</b>   | <b>3-4</b> | <b>5-9</b> | <b>10+</b> |              |
| <b>1</b>        | 27%              | 2%         | 1%         | 1%         | 0%         | <b>30%</b>   |
| <b>2</b>        | 8%               | 3%         | 1%         | 1%         | 0%         | <b>13%</b>   |
| <b>3-4</b>      | 7%               | 3%         | 2%         | 1%         | 1%         | <b>15%</b>   |
| <b>5-9</b>      | 7%               | 3%         | 3%         | 2%         | 2%         | <b>16%</b>   |
| <b>10+</b>      | 9%               | 4%         | 4%         | 4%         | 5%         | <b>25%</b>   |
| <b>Total</b>    | <b>58%</b>       | <b>14%</b> | <b>11%</b> | <b>9%</b>  | <b>8%</b>  | <b>100%</b>  |

Source: Statistics Portugal (INE), own calculations.

Notes: This table reports the distribution of exporting firms according to the number of products they export and number of countries they export to.

**Table 1.10.** Country and product extensive margins - Export value distribution, 2004-14

| <b># products</b> | <b>Countries</b> |           |            |            |            | <b>Total</b> |
|-------------------|------------------|-----------|------------|------------|------------|--------------|
|                   | <b>1</b>         | <b>2</b>  | <b>3-4</b> | <b>5-9</b> | <b>10+</b> |              |
| <b>1</b>          | 2%               | 1%        | 1%         | 1%         | 1%         | <b>4%</b>    |
| <b>2</b>          | 1%               | 1%        | 1%         | 1%         | 1%         | <b>4%</b>    |
| <b>3-4</b>        | 1%               | 1%        | 1%         | 2%         | 2%         | <b>8%</b>    |
| <b>5-9</b>        | 1%               | 1%        | 2%         | 4%         | 9%         | <b>17%</b>   |
| <b>10+</b>        | 3%               | 2%        | 3%         | 7%         | 53%        | <b>67%</b>   |
|                   | <b>7%</b>        | <b>5%</b> | <b>8%</b>  | <b>14%</b> | <b>66%</b> | <b>100%</b>  |

Source: Statistics Portugal (INE), own calculations.

Notes: This table reports the distribution of total value exported in Portugal by firms distributed according to the number of products they export and number of countries they export to.

**Table 1.11.** Country and product extensive margins - Importing firms distribution, 2004-14

| <b>Products</b> | <b>Countries</b> |            |            |            |            | <b>Total</b> |
|-----------------|------------------|------------|------------|------------|------------|--------------|
|                 | <b>1</b>         | <b>2</b>   | <b>3-4</b> | <b>5-9</b> | <b>10+</b> |              |
| <b>1</b>        | 26%              | 1%         | 1%         | 0%         | 0%         | <b>28%</b>   |
| <b>2</b>        | 7%               | 3%         | 1%         | 0%         | 0%         | <b>11%</b>   |
| <b>3-4</b>      | 5%               | 3%         | 2%         | 1%         | 0%         | <b>11%</b>   |
| <b>5-9</b>      | 4%               | 3%         | 4%         | 2%         | 0%         | <b>14%</b>   |
| <b>10+</b>      | 5%               | 4%         | 7%         | 12%        | 7%         | <b>36%</b>   |
|                 | <b>47%</b>       | <b>15%</b> | <b>15%</b> | <b>16%</b> | <b>7%</b>  | <b>100%</b>  |

Source: Statistics Portugal (INE), own calculations.

Notes: This table reports the distribution of importing firms according to the number of products they import and number of countries they import from.

**Table 1.12.** Country and product extensive margins - Import value distribution, 2004-14

| <b>Products</b> | <b>Countries</b> |           |            |            |            | <b>Total</b> |
|-----------------|------------------|-----------|------------|------------|------------|--------------|
|                 | <b>1</b>         | <b>2</b>  | <b>3-4</b> | <b>5-9</b> | <b>10+</b> |              |
| <b>1</b>        | 1%               | 0%        | 0%         | 0%         | 0%         | <b>2%</b>    |
| <b>2</b>        | 1%               | 1%        | 1%         | 1%         | 0%         | <b>3%</b>    |
| <b>3-4</b>      | 1%               | 1%        | 1%         | 1%         | 0%         | <b>3%</b>    |
| <b>5-9</b>      | 1%               | 1%        | 2%         | 2%         | 1%         | <b>6%</b>    |
| <b>10+</b>      | 3%               | 3%        | 7%         | 17%        | 56%        | <b>86%</b>   |
|                 | <b>6%</b>        | <b>6%</b> | <b>10%</b> | <b>21%</b> | <b>56%</b> | <b>100%</b>  |

Source: Statistics Portugal (INE), own calculations.

Notes: This table reports the distribution of total value imported in Portugal by firms distributed according to the number of products they import and number of countries they import from.

**Table 1.13.** Descriptive regressions, 2004-2014, All firms

| Dependent variable            | Log employment |                | Log Value added |                | Log Value added per employee |                | Log sales per employee |                | Log capital per employee |                |
|-------------------------------|----------------|----------------|-----------------|----------------|------------------------------|----------------|------------------------|----------------|--------------------------|----------------|
| Firms included                | ≥ 1 employee   | ≥ 10 employees | ≥ 1 employee    | ≥ 10 employees | ≥ 1 employee                 | ≥ 10 employees | ≥ 1 employee           | ≥ 10 employees | ≥ 1 employee             | ≥ 10 employees |
| <b>Intercept</b>              | 1.31           | 2.90           | 10.80           | 12.18          | 8.96                         | 9.13           | 10.16                  | 10.14          | 9.83                     | 9.37           |
| <b>Exporter only</b>          | 0.63 ***       | 0.26 ***       | 0.99 ***        | 0.48 ***       | 0.31 ***                     | 0.21 ***       | 0.58 ***               | 0.42 ***       | 0.49 ***                 | 0.48 ***       |
| <b>Importer only</b>          | 0.78 ***       | 0.46 ***       | 1.31 ***        | 0.84 ***       | 0.43 ***                     | 0.36 ***       | 0.65 ***               | 0.58 ***       | 0.66 ***                 | 0.70 ***       |
| <b>Two-way trader</b>         | 1.62 ***       | 0.94 ***       | 2.34 ***        | 1.51 ***       | 0.55 ***                     | 0.52 ***       | 0.98 ***               | 0.93 ***       | 1.13 ***                 | 1.11 ***       |
| <b>Multinational</b>          | 0.84 ***       | 0.43 ***       | 1.45 ***        | 0.74 ***       | 0.47 ***                     | 0.28 ***       | 0.52 ***               | 0.35 ***       | 0.51 **                  | 0.23 **        |
| <b>Year dummies</b>           | Yes            | Yes            | Yes             | Yes            | Yes                          | Yes            | Yes                    | Yes            | Yes                      | Yes            |
| <b>Industry dummies</b>       | Yes            | Yes            | Yes             | Yes            | Yes                          | Yes            | Yes                    | Yes            | Yes                      | Yes            |
| <b>Control for size</b>       | No             | No             | No              | No             | Yes                          | Yes            | Yes                    | Yes            | Yes                      | Yes            |
| <b>Number of observations</b> | 3,012,944      | 458,813        | 2,217,007       | 434,299        | 2,217,007                    | 434,299        | 2,952,371              | 456,806        | 1,892,785                | 396,179        |
| <b>R<sup>2</sup></b>          | 0.30           | 0.22           | 0.29            | 0.37           | 0.20                         | 0.33           | 0.33                   | 0.52           | 0.23                     | 0.34           |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Notes: Exporter only: firm exporting but not importing in a given year; Importer only: firm importing, but not exporting in a given year; Two-way trader: firm exporting and importing in a given year; Multinational: firm categorized as a subsidiary of a multinational corporation.

**Table 1.14.** Descriptive regressions, 2004-2014, All firms

| Dependent variable<br>Firms included | Log employment |               | Log Value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|--------------------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
|                                      | ≥ 1 employee   | ≥10 employees | ≥ 1 employee    | ≥10 employees | ≥ 1 employee                 | ≥10 employees | ≥ 1 employee           | ≥10 employees | ≥ 1 employee             | ≥10 employees |
| Intercept                            | 1.35           | 2.97          | 10.91           | 12.34         | 9.00                         | 9.06          | 10.32                  | 10.05         | 9.76                     | 9.21          |
| Export ratio                         | 1.39 ***       | 0.86 ***      | 1.89 ***        | 1.25 **       | 0.39 ***                     | 0.30 ***      | 1.00 ***               | 0.77 ***      | 0.93 ***                 | 0.82 **       |
| Import ratio                         | 1.51 ***       | 0.74 ***      | 2.67 ***        | 1.66 **       | 0.98 ***                     | 0.85 ***      | 1.63 ***               | 1.44 ***      | 1.53 **                  | 1.51 **       |
| Multinational                        | 0.98 ***       | 0.48 ***      | 1.56 ***        | 0.78 **       | 0.44 ***                     | 0.25 ***      | 0.49 ***               | 0.30 ***      | 0.46 **                  | 0.18 **       |
| Year dummies                         | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies                     | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size                     | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations               | 2,862,369      | 452,515       | 2,173,030       | 429,822       | 2,173,030                    | 429,822       | 2,862,369              | 452,515       | 1,827,396                | 391,309       |
| R <sup>2</sup>                       | 0.24           | 0.23          | 0.24            | 0.32          | 0.21                         | 0.33          | 0.37                   | 0.52          | 0.22                     | 0.32          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Notes: Export ratio: proportion of total exports over total sales in any given year; Import ratio: proportion of total imports over total sales in any given year; Multinational: firm categorized as a subsidiary of a multinational corporation.

**Table 1.15.** Descriptive regressions, 2004-2014, All firms

| Dependent variable     | Log employment |                | Log Value added |                | Log Value added per employee |                | Log sales per employee |                | Log capital per employee |                |
|------------------------|----------------|----------------|-----------------|----------------|------------------------------|----------------|------------------------|----------------|--------------------------|----------------|
| Firms included         | > 1 employee   | ≥ 10 employees | > 1 employee    | ≥ 10 employees | > 1 employee                 | ≥ 10 employees | > 1 employee           | ≥ 10 employees | > 1 employee             | ≥ 10 employees |
| Intercept              | 1.344          | 3.018          | 10.902          | 12.408         | 8.960                        | 9.213          | 10.149                 | 10.273         | 9.845                    | 9.558          |
| # products exp         | 0.003          | 0.002          | 0.005           | 0.003          | 0.002                        | 0.001          | 0.004                  | 0.002          | 0.002                    | 0.002          |
| # countries exp        | 0.055          | 0.031          | 0.058           | 0.037          | -                            | 0.005          | 0.010                  | 0.014          | 0.019                    | 0.017          |
| # products imp         | -              | 0.001          | 0.002           | 0.000          | -                            | 0.001          | 0.001                  | 0.001          | 0.002                    | 0.001          |
| # countries imp        | 0.159          | 0.078          | 0.234           | 0.126          | 0.056                        | 0.045          | 0.088                  | 0.070          | 0.112                    | 0.087          |
| Multinational          | 0.830          | 0.388          | 1.473           | 0.709          | 0.489                        | 0.291          | 0.554                  | 0.374          | 0.525                    | 0.252          |
| Year dummies           | Yes            | Yes            | Yes             | Yes            | Yes                          | Yes            | Yes                    | Yes            | Yes                      | Yes            |
| Industry dummies       | Yes            | Yes            | Yes             | Yes            | Yes                          | Yes            | Yes                    | Yes            | Yes                      | Yes            |
| Control for size       | No             | No             | No              | No             | Yes                          | Yes            | Yes                    | Yes            | Yes                      | Yes            |
| Number of observations | 3,012,944      | 458,813        | 2,217,007       | 434,299        | 2,217,007                    | 434,299        | 2,952,371              | 456,806        | 1,892,785                | 396,179        |
| R <sup>2</sup>         | 0.29           | 0.33           | 0.27            | 0.38           | 0.19                         | 0.32           | 0.32                   | 0.50           | 0.22                     | 0.33           |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Notes: # products exp: number of different product categories exported in a given year; # countries exp: number of countries a firms exported to in a given year;  
# products imp: number of different product categories imported in a given year; # countries imp: number of countries a firm imported from in a given year;  
Multinational: firm categorized as a subsidiary of a multinational corporation.

**Table 1.16.** Descriptive regressions, 2004-2014, All firms

| Dependent variable     | Log employment |               | Log Value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
| Firms included         | ≥ 1 employee   | >10 employees | ≥ 1 employee    | >10 employees | ≥ 1 employee                 | >10 employees | ≥ 1 employee           | >10 employees | ≥ 1 employee             | >10 employees |
| Intercept              | 1.358          | 3.016         | 10.925          | 12.384        | 9.019                        | 9.181         | 10.349                 | 10.227        | 9.822                    | 9.472         |
| Export ratio           | 0.424 ***      | 0.167 ***     | 0.691 **        | 0.345 **      | 0.314 ***                    | 0.168 ***     | 0.822 ***              | 0.561 ***     | 0.563 **                 | 0.501 **      |
| Import ratio           | 0.089 ***      | - 0.400 ***   | 0.797 **        | 0.118 **      | 0.778 ***                    | 0.550 ***     | 1.321 ***              | 1.018 **      | 0.934 **                 | 0.878 **      |
| # products exp         | 0.002 ***      | 0.002 ***     | 0.004 ***       | 0.003 ***     | 0.001 ***                    | 0.001 ***     | 0.003 ***              | 0.002 ***     | 0.002 ***                | 0.002 ***     |
| # products imp         | 0.044 ***      | 0.026 ***     | 0.045 ***       | 0.030 ***     | 0.004 ***                    | 0.003 ***     | - 0.001 ***            | 0.005 ***     | 0.011 ***                | 0.010 ***     |
| # countries exp        | - 0.001 ***    | 0.000 ***     | - 0.002 ***     | 0.000 ***     | - 0.001 ***                  | 0.001 ***     | - 0.001 ***            | - 0.001 ***   | - 0.001 ***              | - 0.001 ***   |
| # countries imp        | 0.153 ***      | 0.087 ***     | 0.202 ***       | 0.123 ***     | 0.029 ***                    | 0.031 ***     | 0.041 ***              | 0.043 ***     | 0.077 ***                | 0.064 ***     |
| Multinational          | 0.837 ***      | 0.413 ***     | 1.400 ***       | 0.704 ***     | 0.438 ***                    | 0.260 ***     | 0.482 ***              | 0.309 ***     | 0.444 **                 | 0.195 **      |
| Year dummies           | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies       | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size       | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations | 2,862,369      | 452,515       | 2,173,030       | 429,822       | 2,173,030                    | 429,822       | 2,862,369              | 452,515       | 1,827,396                | 391,309       |
| R <sup>2</sup>         | 0.29           | 0.34          | 0.28            | 0.39          | 0.21                         | 0.34          | 0.37                   | 0.53          | 0.23                     | 0.34          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Notes: Export ratio: proportion of total exports over total sales in any given year; Import ratio: proportion of total imports over total sales in any given year; # products exp: number of different product categories exported in a given year; # countries exp: number of countries a firms exported to in a given year; # products imp: number of different product categories imported in a given year; # countries imp: number of countries a firm imported from in a given year; Multinational: firm categorized as a subsidiary of a multinational corporation.

**Table 1.17.** Average of gravity variables by firm and aggregate

|                           | <b>Average by firm</b> | <b>Aggregate average</b> |
|---------------------------|------------------------|--------------------------|
| <b>Same language</b>      | 45.9%                  | 7.9%                     |
| <b>Colonial link</b>      | 43.6%                  | 6.8%                     |
| <b>European Union</b>     | 32.1%                  | 73.8%                    |
| <b>Euro Zone</b>          | 28.5%                  | 63.5%                    |
| <b>Distance ('000 km)</b> | 4.1                    | 2.5                      |
| <b>GDP (trillion USD)</b> | 1.4                    | 2.2                      |
| <b>Religion</b>           | 58.0%                  | 55.2%                    |

Notes: the second column is a simple average across all observations of the variable representing the proportion of a firm's exports going to that category of countries, while the third column is the same average weighted by the volume of exports of the firm in that year.

**Table 1.18.** Distribution of firms according to proportion of exports to Portuguese speaking countries

| <b>% of exports to portuguese speaking countries</b> | <b>% of total exporting firms</b> | <b>Average volume</b> |
|------------------------------------------------------|-----------------------------------|-----------------------|
| < 10% to portuguese speaking countries               | 48%                               | 3,505,710             |
| Between 10% and 90%                                  | 7%                                | 2,023,536             |
| > 90% to Portuguese speaking countries               | 45%                               | 231,374               |

Notes: This table reports the distribution of exporting firms according to export exposure to Portuguese speaking countries and the average export volume of those firms. For example, in the second row we can see that 48% of total exporting firms have less than 10% of total exports to Portuguese speaking countries and have an average export volume of 3,505,710 euros.

**Table 1.19.** Descriptive regressions - Gravity, 2004-2014, All firms

| Dependent variable     | Log employment |               | Log value added |               | Log Value added per employee |               | Log capital per employee |               | Log sales per employee |               |
|------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|--------------------------|---------------|------------------------|---------------|
|                        | > 1 employee   | >10 employees | > 1 employee    | >10 employees | > 1 employee                 | >10 employees | > 1 employee             | >10 employees | > 1 employee           | >10 employees |
| Language               | 0.04           | -             | 0.01            | 0.00          | -                            | 0.05          | ***                      | -             | 0.10                   | ***           |
| Colonial link          | 0.05           | **            | 0.01            | 0.13          | ***                          | 0.06          | ***                      | -             | 0.06                   | ***           |
| European Union         | 0.98           | ***           | 0.70            | 1.27          | ***                          | 0.03          | **                       | -             | 0.01                   | ***           |
| Euro Zone              | 0.28           | ***           | 0.26            | 0.32          | ***                          | 0.23          | ***                      | -             | 0.62                   | ***           |
| Distance ('000 km)     | 0.01           | ***           | 0.01            | 0.02          | ***                          | 0.06          | ***                      | -             | 0.08                   | ***           |
| GDP (trillion USD)     | 0.00           | **            | 0.00            | 0.02          | ***                          | 0.01          | ***                      | -             | 0.01                   | ***           |
| Religion               | 0.03           | **            | 0.11            | 0.00          | **                           | 0.00          | *                        | -             | 0.00                   | ***           |
| Year dummies           | Yes            | Yes           | Yes             | 0.00          | *                            | 0.02          | *                        | -             | 0.00                   | *             |
| Industry dummies       | Yes            | Yes           | Yes             | 0.02          | *                            | 0.02          | *                        | -             | 0.00                   | *             |
| Number of observations | 188,295        | 102,303       | 175,056         | 99,682        | 175,056                      | 99,682        | 165,057                  | 95,540        | 187,958                | 102,224       |
| R <sup>2</sup>         | 0.31           | 0.25          | 0.26            | 0.26          | 0.20                         | 0.33          | 0.21                     | 0.30          | 0.35                   | 0.46          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

## **Appendix: Additional Tables**

Table A1: Descriptive regressions with fixed effects, 2004-2014, All firms

| Dependent variable<br>Firms included | Log employment |               | Log value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|--------------------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
|                                      | ≥ 1 employee   | >10 employees | ≥ 1 employee    | >10 employees | ≥ 1 employee                 | >10 employees | ≥ 1 employee           | >10 employees | ≥ 1 employee             | >10 employees |
| Intercept                            | 1.23           | 2.90          | 10.67           | 12.12         | 8.94                         | 9.05          | 10.13                  | 10.07         | 9.91                     | 9.68          |
| Exporter                             | 0.71 ***       | 0.35 ***      | 1.00 ***        | 0.55 ***      | 0.23 ***                     | 0.18 ***      | 0.45 ***               | 0.36 ***      | 0.50 ***                 | 0.46 ***      |
| Importer                             | 0.84 ***       | 0.53 ***      | 1.33 ***        | 0.91 ***      | 0.38 ***                     | 0.36 ***      | 0.55 ***               | 0.54 ***      | 0.68 ***                 | 0.73 ***      |
| Multinational                        | 0.96 ***       | 0.53 ***      | 1.64 ***        | 0.89 ***      | 0.50 ***                     | 0.32 ***      | 0.55 ***               | 0.40 ***      | 0.57 ***                 | 0.25 ***      |
| Year dummies                         | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies                     | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size                     | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations               | 3,012,944      | 458,813       | 2,217,007       | 434,299       | 2,217,007                    | 434,299       | 2,952,371              | 456,806       | 1,892,785                | 396,179       |
| R <sup>2</sup>                       | 0.25           | 0.22          | 0.23            | 0.31          | 0.16                         | 0.28          | 0.25                   | 0.43          | 0.16                     | 0.28          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Table A2: Descriptive regressions with fixed effects, 2004-2014, All firms

| Dependent variable<br>Firms included | Log employment |               | Log value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|--------------------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
|                                      | ≥ 1 employee   | >10 employees | ≥ 1 employee    | >10 employees | ≥ 1 employee                 | >10 employees | ≥ 1 employee           | >10 employees | ≥ 1 employee             | >10 employees |
| Intercept                            | 1.49           | 3.07          | 11.03           | 13.00         | 9.73                         | 10.25         | 10.87                  | 11.40         | 9.91                     | 10.39         |
| Exporter                             | 0.11 ***       | 0.06 ***      | 0.20 ***        | 0.10 ***      | 0.11 ***                     | 0.05 ***      | 0.19 ***               | 0.10 ***      | 0.10 ***                 | 0.06 ***      |
| Importer                             | 0.16 ***       | 0.10 ***      | 0.26 ***        | 0.18 ***      | 0.13 ***                     | 0.09 ***      | 0.23 ***               | 0.15 ***      | 0.14 ***                 | 0.10 ***      |
| Multinational                        | 0.04 ***       | 0.02 ***      | 0.13 ***        | 0.04 ***      | 0.10 ***                     | 0.02 ***      | 0.13 ***               | 0.06 ***      | 0.09 ***                 | 0.10 ***      |
| Year dummies                         | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies                     | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size                     | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations               | 3,012,944      | 458,813       | 2,217,007       | 434,299       | 2,217,007                    | 434,299       | 2,952,371              | 456,806       | 1,892,785                | 396,179       |
| R <sup>2</sup>                       | 0.91           | 0.93          | 0.85            | 0.89          | 0.70                         | 0.80          | 0.82                   | 0.90          | 0.85                     | 0.89          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Table A3: Descriptive regressions with fixed effects, 2004-2014, All firms

| Dependent variable<br>Firms included | Log employment |               | Log Value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|--------------------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
|                                      | ≥ 1 employee   | ≥10 employees | ≥ 1 employee    | ≥10 employees | ≥ 1 employee                 | ≥10 employees | ≥ 1 employee           | ≥10 employees | ≥ 1 employee             | ≥10 employees |
| Intercept                            | 1.49           | 3.08          | 11.03           | 13.00         | 9.73                         | 10.25         | 10.87                  | 11.40         | 9.91                     | 10.39         |
| Exporter only                        | 0.10 ***       | 0.05 ***      | 0.20 ***        | 0.09 ***      | 0.11 ***                     | 0.04 ***      | 0.19 ***               | 0.10 ***      | 0.09 ***                 | 0.05 ***      |
| Importer only                        | 0.15 ***       | 0.09 ***      | 0.26 ***        | 0.17 ***      | 0.14 ***                     | 0.09 ***      | 0.24 ***               | 0.15 ***      | 0.14 ***                 | 0.10 ***      |
| Two-way trader                       | 0.29 ***       | 0.17 ***      | 0.46 ***        | 0.28 ***      | 0.23 ***                     | 0.13 ***      | 0.41 ***               | 0.24 ***      | 0.24 ***                 | 0.16 ***      |
| Multinational                        | 0.04 ***       | 0.02 ***      | 0.13 ***        | 0.04 ***      | 0.10 ***                     | 0.02 ***      | 0.13 ***               | 0.06 ***      | 0.09 ***                 | 0.10 ***      |
| Year dummies                         | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies                     | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size                     | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations               | 3,012,944      | 458,813       | 2,217,007       | 434,299       | 2,217,007                    | 434,299       | 2,952,371              | 456,806       | 1,892,785                | 396,179       |
| R <sup>2</sup>                       | 0.91           | 0.93          | 0.85            | 0.89          | 0.70                         | 0.80          | 0.82                   | 0.90          | 0.85                     | 0.89          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Table A4: Descriptive regressions with fixed effects, 2004-2014, All firms

| Dependent variable     | Log employment |               | Log Value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
| Firms included         | ≥ 1 employee   | >10 employees | ≥ 1 employee    | >10 employees | ≥ 1 employee                 | >10 employees | ≥ 1 employee           | >10 employees | ≥ 1 employee             | >10 employees |
| Intercept              | 1.52           | 3.09          | 11.11           | 12.98         | 9.81                         | 10.22         | 11.08                  | 11.48         | 9.94                     | 10.40         |
| Export ratio           | 0.27 ***       | 0.20 ***      | 0.60 ***        | 0.43 **       | 0.38 ***                     | 0.26 ***      | 0.69 ***               | 0.50 ***      | 0.32 **                  | 0.23 **       |
| Import ratio           | 0.32 ***       | 0.23 ***      | 0.59 ***        | 0.43 **       | 0.34 ***                     | 0.22 **       | 0.72 ***               | 0.54 **       | 0.39 **                  | 0.32 **       |
| Multinational          | 0.04 ***       | 0.01 ***      | 0.11 ***        | 0.03 ***      | 0.08 ***                     | 0.01 ***      | 0.10 ***               | 0.04 ***      | 0.09 ***                 | 0.10 ***      |
| Year dummies           | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies       | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size       | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations | 2,862,369      | 452,515       | 2,173,030       | 429,822       | 2,173,030                    | 429,822       | 2,862,369              | 452,515       | 1,827,396                | 391,309       |
| R <sup>2</sup>         | 0.91           | 0.93          | 0.85            | 0.89          | 0.70                         | 0.80          | 0.86                   | 0.92          | 0.85                     | 0.89          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Table A5: Descriptive regressions with fixed effects, 2004-2014, All firms

| Dependent variable     | Log employment |               | Log Value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
|                        | ≥ 1 employee   | >10 employees | ≥ 1 employee    | >10 employees | ≥ 1 employee                 | >10 employees | ≥ 1 employee           | >10 employees | ≥ 1 employee             | >10 employees |
| <b>Intercept</b>       | 1.488          | 3.073         | 11.030          | 12.996        | 9.731                        | 10.272        | 10.878                 | 11.442        | 9.911                    | 10.418        |
| # products exp         | 0.000          | ***           | 0.001           | ***           | 0.001                        | 0.000         | 0.001                  | ***           | 0.001                    | ***           |
| # countries exp        | 0.023          | ***           | 0.030           | ***           | 0.012                        | 0.007         | 0.025                  | ***           | 0.010                    | ***           |
| # products imp         | 0.001          | ***           | 0.001           | ***           | 0.000                        | ***           | 0.001                  | ***           | 0.001                    | ***           |
| # countries imp        | 0.045          | ***           | 0.069           | ***           | 0.034                        | 0.021         | 0.056                  | ***           | 0.039                    | ***           |
| Multinational          | 0.029          | ***           | 0.110           | ***           | 0.085                        | 0.017         | 0.106                  | ***           | 0.106                    | ***           |
| Year dummies           | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies       | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size       | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations | 3,012,944      | 458,813       | 2,217,007       | 434,299       | 2,217,007                    | 434,299       | 2,952,371              | 456,806       | 1,892,785                | 396,179       |
| R <sup>2</sup>         | 0.91           | 0.93          | 0.85            | 0.89          | 0.70                         | 0.80          | 0.82                   | 0.90          | 0.85                     | 0.89          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

Table A6: Descriptive regressions with fixed effects, 2004-2014, All firms

| Dependent variable     | Log employment |               | Log Value added |               | Log Value added per employee |               | Log sales per employee |               | Log capital per employee |               |
|------------------------|----------------|---------------|-----------------|---------------|------------------------------|---------------|------------------------|---------------|--------------------------|---------------|
|                        | > 1 employee   | >10 employees | > 1 employee    | >10 employees | > 1 employee                 | >10 employees | > 1 employee           | >10 employees | > 1 employee             | >10 employees |
| Intercept              | 1.512          | 3.063         | 11.095          | 12.942        | 9.816                        | 10.242        | 11.090                 | 11.510        | 9.941                    | 10.423        |
| Export ratio           | 0.112          | 0.075         | 0.384           | 0.268         | 0.291                        | 0.200         | 0.549                  | 0.406         | 0.244                    | 0.177         |
| Import ratio           | 0.107          | 0.044         | 0.254           | 0.132         | 0.176                        | 0.094         | 0.516                  | 0.374         | 0.215                    | 0.176         |
| # products exp         | 0.000          | 0.000         | 0.001           | 0.000         | 0.001                        | 0.000         | 0.001                  | 0.000         | 0.001                    | 0.000         |
| # countries exp        | 0.020          | 0.011         | 0.024           | 0.014         | 0.008                        | 0.004         | 0.014                  | 0.008         | 0.006                    | 0.003         |
| # products imp         | -0.001         | 0.000         | 0.001           | 0.001         | 0.000                        | 0.000         | 0.001                  | 0.000         | 0.001                    | 0.000         |
| # countries imp        | 0.040          | 0.026         | 0.061           | 0.042         | 0.029                        | 0.020         | 0.038                  | 0.025         | 0.033                    | 0.022         |
| Multinational          | 0.025          | 0.008         | 0.099           | 0.020         | 0.076                        | 0.013         | 0.089                  | 0.042         | 0.101                    | 0.102         |
| Year dummies           | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Industry dummies       | Yes            | Yes           | Yes             | Yes           | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Control for size       | No             | No            | No              | No            | Yes                          | Yes           | Yes                    | Yes           | Yes                      | Yes           |
| Number of observations | 2,862,369      | 452,515       | 2,173,030       | 429,822       | 2,173,030                    | 429,822       | 2,862,369              | 452,515       | 1,827,396                | 391,309       |
| R <sup>2</sup>         | 0.91           | 0.93          | 0.85            | 0.89          | 0.70                         | 0.80          | 0.86                   | 0.92          | 0.85                     | 0.89          |

\*\*\* significant at 1% confidence level

\*\* significant at 5% confidence level

\* significant at 10% confidence level

## Chapter 2

# Looking out: trading during a domestic demand crisis

**Abstract:** Lower domestic demand had a relevant role in triggering the Portuguese export miracle between 2009 and 2014. Using Portuguese firm-level data on exports and firm characteristics, this paper examines the evolution of exports and the profile of exporting firms during the crisis years in Portugal. During that period, the propensity to export increased among Portuguese firms, with several new firms starting to export. Those firms already exporting increased their portfolio of products and destinations, being the ones that contributed the most to the export growth. The results suggest that this expansion was, at least in part, a response to the reduction in domestic demand, and that lower wages did not have a relevant effect in the Portuguese export miracle.

**JEL codes:** F12, F13, F14, F43

**Key words:** firm heterogeneity, economic crisis, international trade

## 2.1 Introduction

Firms that trade internationally (both importers and exporters) are larger and more productive than non-trading firms [Bernard, Jensen, and Schott (2009), Castellani, Serti, and Tomasi (2010), Halpern, Koren, and Szeidl (2015), Mayer and Ottaviano (2007), Andersson, Lööf, and Johansson (2008) and Muûls and Pisu (2009)]. Among trading firms, importers are larger and more productive than exporters, and firms that both export and import are larger and more productive than those that only export or import.<sup>1</sup> The empirical findings in the literature that exporters are larger and more productive than non-trading firms are fully aligned with the international trade model presented in Melitz (2003). Yet, the direction of the causal relationship is still unclear. Are larger and more productive firms more likely to export or do they become larger and more productive because they are exposed to external competition? Or is it a vicious cycle with effects going both ways?

Internal demand crisis are good opportunities to understand the dynamics of trading firms. A decrease in internal demand should decrease firms' size, everything else remaining constant, as domestic sales decrease, making them less productive. If firms are smaller and less productive, they should also export less. If the causal relation was only one way (firms export because they are bigger and more productive), then a drastic decrease in firms' domestic market would also decrease exporting capacity among those firms. If the causal relation was only one way, a domestic crisis would always result in a lower number of exporting firms and lower exports for firms still exporting.

During the Great Recession, the exact opposite happened in Portugal. The Great Recession was characterized by a sharp drop in domestic demand, but exports increased significantly, turning a long-standing current account deficit into a small surplus. Portugal faced a similar situation to that reported in Almunia, Antràs, Lopez Rodriguez, and Morales (2018) regard-

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<sup>1</sup>See Wagner (2007), Wagner (2012) and Wagner (2016) for more literature around this topic.

ing "Spain's export miracle". The increase in exports happened for two reasons: more firms started exporting, including smaller firms, while firms already exporting increased their exports. Many firms previously selling only for the domestic market started exporting during that period. Others already involved in international trade increased their exposure, extending their trade to new countries, selling new products, and increasing sales to existing foreign clients. Simultaneously, the relative size of exporters decreased, while productivity increased. Differences in productivity between importers and exporters decreased. In some years they became statistically insignificant. Exporters were able to adapt to the crisis quicker, increasing labor productivity faster than firms relying on the domestic market. Exporting was extended towards smaller, yet more productive, firms. Still, most of the increase in exports came from firms that were already exporting before the crisis.

Two potential explanations arise when explaining this increase in exports. The first is some gain in competitiveness resulting from lower labor costs as a result of austerity measures and higher unemployment. This argument, internal devaluation, was advocated by international institutions, including the IMF. The second possible mechanism is the "vent for surplus" theory first proposed by Adam Smith in *The Wealth of Nations* (1776) Book II, Chapter V. International trade models rarely contemplate the possibility that a drop in domestic demand might lead to an increase in exports. The current leading model in international trade, Melitz (2003), does not include any mechanism for this shift from domestic to foreign markets to happen. On the other hand, models with short-term capacity constraints, such as Blum, Claro, and Horstmann (2013) assume that increasing marginal costs in the short-term due to higher domestic demand decrease exports, and vice-versa. In Almunia et al. (2018) and also in de Lucco, Mínguez, Minondo, and Requena (2017) the authors conclude that the "vent for surplus" mechanism was the most relevant in the case of Spain. This paper tests this hypothesis for Portugal, concluding that drops in domestic demand were associated with export growth at firm level, but wage variation was not. We also find indications that the "vent for surplus" effect was stronger among firms that had a balanced split between domestic and foreign clients when

the crisis started. For firms heavily reliant on domestic markets (with littler export exposure) or heavily reliant on foreign markets (with little exposure to domestic markets) the "vent for surplus" effect was less visible.

The objective of this paper is two-fold. First, to analyze the evolution of the profile of exporters during the Great Recession in Portugal using a specification with a time-variant coefficient. Second, to understand whether the increase in exports was driven by decreases in domestic demand at firm level.

The remainder of the paper is organized as follows. In section 2 we provide a detailed description of the data employed. In section 3 we present the empirical methodology. In section 4 we look into the main results of the analysis performed. In section 5 we conclude.

## **2.2 Data description**

### **2.2.1 Data sources**

The analysis in this paper draws on three main firm and worker-level databases, compiled by Statistics Portugal (INE), the Portuguese national statistical agency. First, a "Trade database" with customs data on firm-level international trade transaction, which are collected separately for European Union (EU) partner countries (Estatísticas Correntes do Comércio Intracomunitário, Current Statistics on Intra-Community Trade) and non-EU partners (Estatísticas Correntes do Comércio Extracomunitário, Current Statistics on Extra-Community Trade).<sup>2</sup> These data include information on firm-level exports and imports in each year over 2004-2014, in-

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<sup>2</sup>Transactions intra-EU are obtained via a monthly survey sent to all firms in the country, capturing the universe of external trade transactions. Data on transactions extra-EU is obtained from customs forms, capturing shipments from firms registered in the value-added tax system whose value of annual shipments exceed a cut-off that has changed over time. In 2013, for instance, the cut-off was 250,000 euros.

cluding the identifier of the firm, the product traded, the value traded and the destination/source country of each export/import flow. Using the unique firm identifiers, we combine these data with firm-level financial results from the "Sistema de Contas Integradas de Empresas" (SCIE, Enterprise Integrated Accounts System), a census of all private non-financial firms over the 2004-2016 period. We utilize the firm-level information including size, value added, sector and location. For sole proprietor firms there is no info on value added since they have different reporting requirements. Third, we use "Quadros de Pessoal", a mandatory annual employment survey collected by the Portuguese Ministry of Labor and Social Solidarity. Quadros de Pessoal covers all public and private firms with at least one employee. Due to the mandatory nature of Quadros de Pessoal, this dataset virtually covers all the population of firms with at least one employee. Household services sectors are not covered. Since 2002, the Central, Regional and Local Administration and Public Institutes with at least one employee are also required to report. This database contains detailed data at firm-level (location, industry, employment, sales, ownership, and legal setting), and also at worker-level (gender, age, education, skill, occupational category, admission date, earnings, and tenure).

### **2.2.2 Summary statistics**

Portugal is a small open economy and, thus, highly dependent on international trade for its economic development. Yet, it has also seen the other side of trade liberalization, having been affected by two episodes of trade liberalization that brought competitive challenges to Portuguese exporters: the entry of China in the World Trade Organization (2001-02) and the enlargement of the European Union to East in 2004-2007. The impact of these trade shocks lasted for years and the 2000s were often described as the Portuguese lost decade. During that period the average real GDP grow rate was below 0.4%. The lost decade culminated in a large recession, a public debt crisis and subsequent Financial Assistance Program led

by the European Central Bank, European Commission, and the International Monetary Fund (Troika).

We can divide this economic crisis in two stages: the first stage was mostly driven by a decrease in exports due to the global crisis, while the second stage was driven by lower domestic demand as a result of austerity measures. Portugal withstood relatively well the first stage of the financial crisis (see Figure 2.1). Between 2008 and 2010, Portugal's share of the GDP of the first 12 countries of the European Monetary Union (EMU12) actually increased (see Figure 2.2). In 2010, despite the global crisis, Portugal's GDP grew more than in 6 of the previous 10 years, partly due to a fiscal stimulus that increased domestic demand (see Figure 2.3). Late in 2010, the first austerity measures were implemented following political pressure from EU institutions and the debilitating situation of the country's public finances and its banks. In 2011, a full scale austerity package was implemented following the official start of the Financial Assistance Programme negotiated with the Troika. Cuts in public spending, especially focused on public investment and public servants' wages, and general tax increases were the most visible effects of the Programme. Those public spending cuts had a significant effect on domestic demand and GDP. Between 2010 and the end of the Financial Assistance Programme in 2014, public consumption decreased by 14%, private consumption by 3.4%, and public investment by 66%. In total, domestic demand decreased by 5.6% in 2011, 7.1% in 2012 and 1.9% in 2013, increasing by 2.1% in 2014. The unemployment rate reached a peak of 18% in 2013.<sup>3</sup>

Some of the most important trading partners (including Spain and Italy) were facing similar squeezes in domestic demand, but Portuguese exports still increased significantly both in absolute terms and, as we can see in Figure 2.2, as a percentage of total EMU12. Between 2009 and 2014, Portugal increased its exports to all its main trading partners, including those facing a similar domestic slump. By 2013, Portugal achieved a current account surplus for the

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<sup>3</sup>Source: These data are provided by Statistics Portugal and compiled by PORDATA. Can be consulted in (<https://www.pordata.pt/en/Theme/Portugal/Macroeconomics-11>).

first time in 30 years. Merchandise exports went up by an accumulated 28.1% between 2010 and 2014 after a small decline of 4.2% between 2008 and 2010.

As a result of this increase, Portugal's share of EMU12's exports increased, even though Portugal's share of EMU12's GDP went down during the same period. Portugal's economy was shrinking in relative terms, but its exporting sector was becoming larger, even when compared with other countries of the Eurozone (excluding the possibility of an exchange rate effect).

### **2.2.2.1 Trade propensity**

The increase in exports was associated with an increase in the number of exporting firms. As we can see in Figure 2.4, 2009 was a year of upwards inflection in the propensity to export among Portuguese firms. Until 2009, the propensity to export among Portuguese firms remained stable, but that year marked the beginning of an upwards trend that lasted until 2014. Since 2009 the propensity to export increased steadily. During the economic crisis, and throughout the years Portugal was under the economic and financial adjustment program, the propensity to export increased significantly, especially among larger firms. As we can see from Figure 2.4, among firms with more than 10 employees the propensity jumped from 20% to 27% between 2009 and 2014. Among those with more than 20 employees it went from 30% to 37% in the same period. Import propensity tells a different story, though. Ignoring the large drop in 2009, it has mostly remained stable over the last 10 years (see Figure 2.5). <sup>4</sup>

This increase in trade propensity could have happened for two reasons. First, due to an effective increase in the number of firms exporting. Second, due to a composition effect, caused by the exit of smaller non-trading firms during the crisis, increasing the ratio of exporting

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<sup>4</sup>Since many similar studies focus only on the manufacturing sector, and the sector represents 81% of total exports and 46% of total imports, it is worth analyzing the evolution of this sector specifically. In the Appendix we can see a similar analysis as in Figures 2.4 and 2.5, but this time only with manufacturing firms (Figures A1 and A2). The trade propensity is indeed higher among manufacturing firms, but it follows a similar trend. There was also an increase in export propensity after 2009, specifically among larger firms. Import propensity among manufacturing firms also follows a similar pattern as other firms.

firms. The latter hypothesis is aligned with the conclusions of Melitz (2003). According to his model, a drop in domestic demand would lead to the exit of less productive (non-exporting) firms, thus raising the share of firms in the market that export, without increasing the number of exporting firms. In Table 2.1, we can see that this is not the case.

Table 2.1 decomposes the evolution in the number of trading firms between 2009 and 2014. This table follows closely a similar analysis performed in Bernard et al. (2009). Each row of the table focus on a non mutually exclusive subset of trading firms. The second column reports the number of firms in that subset in 2009. The third column reports the number of firms in that subset that exited the market by 2014 and the fourth column the number of firms that entered the market after 2009 and joined that subset of firms. The fifth, sixth and seventh columns report the trading status of firms existing in both years, and the eighth column reports the total number of firms in the subset in 2014. The final two rows show a similar breakdown for all firms and only for those with more than one employee. The lower panel of the table shows the same information but as a percentage of the 2009 values.

In Table 2.1 it is clear that during this time period, while the total number of firms in the country decreased (6% drop between 2009 and 2014), the number of exporting firms increased substantially (23% increase between 2009 and 2014). This was due to a higher survival rate among exporters, but mostly due to firms that did not export in 2009, but were exporting by 2014. Out of the 23,075 firms exporting in 2014, 13,477 were not exporters in 2009. Nearly two thirds of these new exporters were firms that already existed in 2009 and started exporting during that period. This increase was unique to exporters: the number of importers actually declined slightly during the same period, indicating that the increase in the number of exporters was not due to a general increase in trade propensity in the country. In conclusion, the number of exporting firms increased thanks to three concurrent factors: existing exporting firms had lower mortality rate, new firms had higher propensity to export and many existing non-exporting firms started to export. There was a clear shift towards foreign markets among Portuguese firms.

### 2.2.2.2 Trading firms dynamics during the crisis

According to Table 2.1, the uptake on export propensity was mostly a result of an increase in the number of exporting firms. As we saw earlier, the number of exporting firms increased by 23% between 2009 and 2014, while the total number of firms decreased by 6% in the same period. A large share of the contribution came from firms that already existed in 2009 but were not yet exporting and started exporting in the 2010-14 period, clearly surpassing the number of firms going in the opposite direction. On the other hand, the number of new entrants that started exporting closely matched the number of exporters exiting the market. Overall, 59% of firms exporting in 2014 were not doing so 5 years earlier. The number of firms importing remained almost the same, while the number of firms that both export and import showed a similar behavior to the number of exporting firms. Interestingly, firms that both import and export had a lower mortality rate in the period than the subsets of exporting and importing firms. The firm mortality rate was also higher among firms that only exported or only imported. Another interesting insight from Table 2.1 is that while the subset "firms that import" almost did not change, the subset "firms that only import" decreased substantially, indicating that many importing-only firms became exporters during this period (thus leaving the subset of importing-only firms). In fact, 14.3% of the firms that only imported in 2009 made the transition into exporting by 2014. That compares with only 2.6% of all the firms with more than 1 employee that were neither exporting nor importing in 2009. Importing firms are more likely to become exporters, probably because they are usually already larger and more productive, and have the internal skill-set to export (like knowledge of languages and international trading processes).

What this table does not tell us is how did this affect the evolution of total exports. Was the rise of new exporting firms the main factor leading to the increase in export volume? Table 2.2 answers that question. Table 2.2 decomposes the evolution of exports and imports assigning them to the different categories of firms used in Table 2.1. For example, the 4,156 firms that

exported in 2009 and exited the market before 2014 accounted for a drop of 1.60 billion euros in exports, while the 4,286 new exporters entering the market accounted for an increase of 2.01 billion euros.

In the population of firms for which there is data available (covering 88% of total exports in 2009 and 90% in 2014), exports increased by 55% between 2009 and 2014 (it was 52% in total for the country). Despite the significant increase in the number of exporting firms, most of the increase in export volume came from firms that were already exporting in 2009. From Table 2.1 we can see that only 41% of the firms exporting in 2014 were already exporting in 2009 (9,598 out of 23,075). The majority of the firms exporting in 2014, 59%, were new exporters, but these new exporters accounted for less than one fifth of the increase in exports between 2009 and 2014.

As expected since the number of importing firms remained similar between 2009 and 2014, the increase in imports was mostly driven by the firms that remained importers between 2009 and 2014.

### **2.2.2.3 Export evolution and the extensive margin of products and countries**

It is clear now from the previous tables that the growth in exports came from firms that exported both in 2009 and 2014. Yet, this growth could still have several sources. Firms could be selling more of the same products to the same markets, they could be selling different products to the same markets, the same products to different markets or different products to different markets. In Table 2.3 we start to understand the drivers of the growth in exports during the crisis. In that table, the firms that exported in 2009 and 2014 are sub-segmented into 9 categories according to the evolution of their extensive margins of products exported and countries of destination. For example, firms that exported less products to more countries (third row, first column) accounted for an increase in exports of 3.93 billion euros. Similarly, firms that sold less products to less countries in 2014 than 2009 accounted for a decrease in exports of 0.95

billion euros. In the lower panel, we have the same analysis but as a % of the total evolution.

Overall, exports by continuing exporters increased by 11.97 billion euros, of which 7.13 euros (60%) came from firms that increased both the number of products exported and the number of countries exported to. When we look only at the variation in the number of export destinations, the numbers are even more revealing: 11.47 out of the 11.97 (96%) increase in exports came from firms that exported to more markets in 2014 than in 2009. Firms that took the effort of expanding to new markets accounted for almost all the increase in exports during the period. This finding is in line with the theory stating that only the most productive firms are able to incur the fixed costs of exporting to new markets. This does not mean, necessarily, that the increase in export volume came from these new markets. The exporting firms that expanded the number of markets might still have derived most of their export growth from existing markets. In reality, as we can see from Table 2.4, a vast majority of the positive variation in exports was effectively derived from sales to the same countries. Most likely, the efficiency improvements required to expand to new markets had positive spillover effects towards existing markets, driving firms to increase efficiency which had positive effects in their existing markets. Another interesting finding from Table 2.4 is that despite of the fact that most of the positive export evolution came from firms that expanded both the number of products exported and the number of countries exported to, no positive variation came from selling a different product to a different market. On the contrary, the contribution was even slightly negative (resulting from some firms dropping unique country/product combinations that were not compensated by new country/product combinations). Firms prefer to go to new markets with existing products and sell new products in existing markets (most likely to existing clients).

In this section we analyzed two trends: the increase in the number of exporters during the crisis and the large increase in exports by previously existing exporters. In the rest of this paper, we will try to answer two questions. The first question is whether the surge in the number of exporters changed the profile of exporters in terms of size and productivity. The second question is whether the expansion of exports was a response by firms to the reduction

in domestic demand.

## 2.3 Empirical methodology

### 2.3.1 The correlation between trading and performance during the crisis

The literature on international trade has shown that exporting and importing activities are highly correlated with firms' size and productivity. International trade is more likely among larger and more productive firms. Firms that both import and export rank higher in these criteria followed by importers and exporters. In Portugal, these stylized facts also existed in 2009. But did the large shift in number of exporting firms changed this in any way? Did the relation between trading and size/productivity change during the crisis? In order to understand that, the following set of regressions are specified:

$$y_{it} = \alpha + \beta_t x_{it} + \gamma z_i + \mu L_t + \epsilon_{it}, \quad (2.1)$$

where  $y_{it}$  denotes the log of number of employees, log of annual value added, log of value added per employee, and log of sales per employee;  $x_{it}$  is comprised of two dummy variables, one for exports and another for imports, that take value 1 if the firm exports/imports and 0 if not,  $\beta_t$  is a year specific coefficient assigned to an export and import dummy,  $z_i$  are industry fixed effects (based on CAE 5 digit industry codes); and  $L_t$  are year-specific effects. Having year-specific coefficients for the trade dummies will allow us to understand if the correlation between the trading status of the firm and its size and productivity changed during the crisis and how. The coefficient of interest here is  $\beta_t$ . If  $\beta_t$  remained constant through the years, it would mean that size and productivity differences between traders and no traders remained the

same through the crisis. Any change in  $\beta_t$  would mean that the profile of trading firms has changed during the crisis. The fixed effects for year and sector control for general trends in the dependent variables unrelated to the trading profile of the firm.

### 2.3.2 Domestic demand and the shift to exports

It is clear from the previous section that the Portuguese export miracle was mostly a result of existing exporting firms exporting more of the same products to the same destinations. There are three possible reasons for this to have happened during the economic crisis. The first would be competitiveness gains through changes in exchange rate, but we can rule this one out since as seen in Figure 2.2, Portuguese exports outperformed those of countries with the same currency. The second reason would be internal devaluation as austerity measures led to higher unemployment and lower salaries. This argument was used at the time by international organizations [see Armingeon and Baccaro (2012)]. The third reason would be the "vent-for-surplus" effect, according to which a decrease in domestic demand encourages firms to look to foreign markets to compensate in order to use installed capacity. According to this argument, originally posed by Adam Smith in *The Wealth of Nations* [Smith (2010)], when firms have a reduction in domestic demand the short-run marginal costs of exporting decrease making them more competitive in foreign markets, allowing them to export more.

In order to test these last two possibilities, we estimate the following specification:

$$\Delta Exp_i = \alpha + \beta \Delta DD_i + \gamma \Delta P_i + \mu \Delta W_i + \nu M_{i,09} + \psi L_{i,09} + \phi S_{i,09} + \epsilon_i, \quad (2.2)$$

where  $\Delta Exp_i$  is the growth in exports of firm  $i$  between 2009 and 2014,  $\Delta DD_i$  is the growth in domestic demand of firm  $i$  between 2009 and 2014,  $\Delta P_i$  is the growth in productivity of firm  $i$  between 2009 and 2014,  $\Delta W_i$  is the growth in average wage between 2009 and 2014,

$M_{i,09}$  is a dummy variable that takes value 1 if firm  $i$  is a multinational and 0 otherwise,  $L_{i,09}$  is the region of firm  $i$  in 2009 and  $S_{i,09}$  is the sector of firm  $i$  in 2009. Growth rates are calculated as the log differences of the variables between 2009 and 2014.

There are some reasons to believe that the OLS estimates of  $\beta$  for regression (2) might be biased. Firms can have clients that have both domestic and foreign branches so the same order might serve domestic demand and export markets. In this case, a decline in domestic demand might result in decline of exports as well, even if that demand shock led the firm to export more to other clients. Another potential source of bias are firms that use intermediaries to export. The sales to those intermediaries count as domestic demand, and if they decide to stop using the intermediary there will be a statistical transfer from domestic sales to exports resulting in an artificial negative correlation between the exports and domestic demand. Similarly, a firm-specific shock not captured by productivity measures (new product launch, bankruptcy of a competitor,...), might simultaneously generate more domestic sales and exports. Finally, we have the potential for measurement errors. Domestic sales are calculated as the difference between total sales and exports. If a firm makes an error in the declaration of exports, it will also affect the calculation of domestic demand. A positive error in the declaration of exports will decrease domestic demand and a negative error will increase it.

To address the endogeneity concerns, we supplement the OLS results with an instrumental-variables strategy. A key challenge in constructing the instruments is to identify a source of variation at the firm level that is exogenous to the firm. Our IV strategy relies on the assumption that demand addressed to a specific sector could be addressed by any firm in that sector, so our baseline instrument will be the domestic demand in sector  $s$  excluding that of the firm, which is defined as the sum of domestic sales of firms with the same 5-digit industry code minus own firm's domestic sales:

$$DD_{i,s} = \sum_j DS_{j,s} - DS_i, \quad (2.3)$$

where  $DD_{i,s}$  is the domestic demand in sector  $s$  excluding the own firm  $i$ ,  $\sum_j DS_{j,s}$  is the sum of domestic sales of all firms of sector  $s$ , and  $DS_i$  is the domestic sales of firm  $i$ .

## 2.4 Main results

### 2.4.1 Trade, performance and firms' characteristics

Figure 2.6 reports the evolution of the coefficient associated with export and import dummies for each dependent variable.

Starting with employment, we can see that since the crisis the coefficient associated with the export dummy decreased after 2009, which is an indication that smaller firms started exporting during the crisis, since existing exporters actually increased in size after 2009. The average number of employees of an exporting firm went from 43.1 in 2009 to 34.9. The average size of new exporters in 2014 (firms that were not exporting in 2009) was 14.5. Interestingly, the export dummy coefficient in the regression with total value added as dependent variable remained relatively stable during the crisis. Exporting was extended towards smaller firms (when measured by number of employees), but not towards firms with lower value added. This is an important finding, since it is usually stated in the literature that larger firms have higher propensity to export, with number of employees being the usual criteria to define firm's size. However, as we can see from this evolution following a domestic demand shock, the only stable correlation is with total value added, not with number of employees. The two measures are, obviously, correlated, but it is value added and not number of employees that is more strongly linked with propensity to export. The threshold to export seems to be more strongly correlated with value added not with number of employees. Unsurprisingly then, exporting became increasingly more correlated with productivity during the crisis, extending a trend that

was already in place since 2004. If we assume that the export productivity threshold goes up with average productivity (which it does in the Melitz model when the number of firms remain constant) then we have a paradoxical situation: the number of exporters going up while the productivity threshold also goes up.

The coefficient for the import dummy is in every regression and every year always above the coefficient for the export dummy, with only one notable exception: the year 2014 in the regression with sales per employee as dependent variable. In 2014, the confidence intervals overlap when taking firms above one employee. The difference between importers and exporters in value added per employee also narrows, although not as strongly. During the crisis, exporters increased their productivity in relative terms, both with respect to non-traders and importers. The decrease in domestic demand, as expected, had a stronger negative impact on non-exporters. The ability to diversify into foreign markets helped exporters keeping higher margins.

## **2.4.2 Domestic demand and the shift to exports**

The analysis in this section will use the set of 9,598 firms that exported both in 2009 and 2014 (see Table 2.1). Those firms accounted for 11.97 out of the 15.26 thousands of million of euros increase in exports between 2009 and 2014. As expected, these firms are larger and more productive than the average firm in the country and more than the average exporter, as we can see in Table 2.5.

We can see the results of running specification 2.2 in Table 2.6. In regressions 1 and 3 productivity is measured as sales per employee and in regressions 2 and 4 as gross value added (GVA) per employee. Regressions 1 and 2 do not include controls for region and sector, while 3 and 4 include those controls. Two productivity measures are used since GVA per employee can be disproportionately affected by sudden shifts in sales for firms with large fixed costs. In

these cases, sales per employee are a better indicator of productivity.

As expected, export growth is positively correlated with gains in productivity. Firms increasing labor productivity were more likely to increase exports. Most importantly, the coefficient associated with the variation in domestic sales is always negative regardless of specification. A reduction of 1 percentage point in the variation of domestic demand led to a 0.07 to 0.19 percentage point increase in the variation of exports for that period. The coefficient is statistically significant at 1% level for all specifications. On the contrary, the coefficient associated with average wage takes positive and negative values depending on the specification and is never significant at the usual levels. This is a strong indication that it was the drop in domestic sales, and not wage devaluation, that had a positive contribution to the Portuguese export boom between 2009 and 2014. Also interesting to notice is that, everything else remaining constant, being a multinational firm was negatively correlated with an increase in exports. While multinational firms tend to export more, they are also less likely to have their management decisions affected by local demand conditions.

To check the robustness of these estimates, we excluded those firms that did not increase exports during this period, to ensure we do not have firms that decrease exports while increasing domestic demand affecting the estimates. In Table 2.7, only firms that increased exports between 2009 and 2014 are considered in the regression. The results are similar to those in Table 2.6.

The question that remains is whether the impact of domestic demand is the same for firms with different exposure to exports. Were firms already highly dependent on foreign markets the ones that managed to better replace domestic demand? To understand that, in the next table we present the results of running Regression 3 of Table 2.6 for different levels of export dependence in 2009. In the first level, we have firms where exports represented between 0% and 25% of all sales, the second level between 25% and 50%, the third level between 50% and 75% and the fourth level between 75% and 100%. The results are in Table 2.8. There is an interesting pattern when looking into the regression estimates by level of export

exposure: variation in domestic demand seems to have a small effect in the two extremes of export dependency. Firms with very low exposure to exports do not seem to increase exports following a decrease in domestic demand. Similarly, firms highly exposed to exports (>75%) also do not show a great reaction to drops in domestic demand. Those firms in the second and third levels, which have a more balanced split between domestic demand and exports, seem to be more reactive to drops in domestic demand. Firms with low exposure probably do not have solid export links to react suddenly to drops in domestic demand (this subset of firms includes firms with very low exposure, having an average of 4.6%), while firms which are highly exposed to exports to start with are less affected by domestic shocks. Firms that are both exposed to domestic demand and have strong export links are more likely to react to sudden drops in domestic demand and start exporting more.

We also investigated other sources of heterogeneity among firms, specifically the level of education of firms' managers, the age of the firms, the size of the firm represented by the number of employees, and the productivity of the firm represented by the gross value added per employee. The level of education of firms' managers is measured in two ways: the percentage of firm's managers with at least a bachelor degree and the average value of a variable reporting the education of the manager.<sup>5</sup>

To understand if these firm characteristics had any impact on how exports reacted to domestic demand, we ran 5 regressions for each characteristic. First, we divide the set of firms in four quartiles of the variables in question and ran the regression on each subset. Second, we ran regression 3 of Table 2.7 adding one interaction variable between the variable in question and the variation in domestic demand.

In Table 2.9 we can see the results of this analysis. The table contains the coefficient associated with domestic demand in Equation 2.2 for each quartile of firms. Quartile 1 representing the firms with the lowest percentage of managers with high education, lowest average edu-

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<sup>5</sup>The variable in the database goes from 1 (does not know how to read or write) to 8 (has a PhD). The rest of the values are: 2 for up to 4 years of education, 3 for 4 to 9 years of education, 4 for high school education, 5 for lower superior education, 6 for Bachelor degree and 7 for Masters degree.

cation of managers, lowest age, lowest number of employees and lowest GVA per employee. Quartile 4 contains the firms with the highest value in each of these heterogeneity variables. In the last column we can see the coefficient of the interaction variable between domestic demand and the variable defined in the row.

None of the interaction variables are statistically significant for the usual significance levels, except for the number of employees which is positive, indicating that larger firms had a lower reaction to domestic demand drops, potentially because they had less space to grow their exports as large firms exported more to start with. The interaction variables for the education of managers are not statistically significant, but the quartile analysis shows that firms with less qualified managers reacted more to variations in domestic demand than firms with more qualified managers. One possible explanation for this is that firms with more qualified managers were taking more advantage of the potential of export markets when the crisis started. It was those firms with less qualified managers that were taking less advantage of international markets when the crisis started, that had a stronger push towards exports.

#### **2.4.2.1 Instrumental variable approach**

The results using an IV approach are presented in Tables 2.10, 2.11 and 2.12, which replicate tables 2.6, 2.7 and 2.8 using the selected instrument. For the first stage, we report the Cragg-Donald Wald F-statistic. The common practice is to compare this statistic to the Stock-Yogo critical values. This comparison suggests that we can reject the null hypothesis of weak instruments. We also report the heteroskedasticity-robust Kleibergen and Paap (2006) Wald rk F-statistic. The appropriate critical values in the heteroskedastic case have not been tabulated in the literature [Anna (2013)], but following the common practice to compare this statistic to the Stock-Yogo critical values, we also conclude that we can reject the null of weak instruments.

The coefficients associated with domestic demand are even larger with this approach as we

can see in Tables 2.10 and 2.11. When we take into account only firms that increased their exports, the coefficient is always below -1, indicating that a 1% decrease in domestic sales led to an increase in exports above 1%. The analysis at export exposure level (seen in Table 2.12) does not provide statistically significant results with the IV approach.

Overall, in all major specifications considered, both estimated with OLS and IV, we find that the  $\beta$  coefficient is negative: exogenous changes in firm-level domestic demand are negatively related to variations of firms' exports between 2009 and 2014.

## 2.5 Conclusions

Using a large firm-level database of Portuguese firms combining balance-sheet and destination-specific export information over the period of 2009-2014, this paper investigates the dynamics of the exporting sector during that period. We find that the profile of exporting firms changed during that period thanks to an inflow of new exporters, but it was those already exporting that contributed most to the increase. The decrease in domestic demand triggered a firm-level response that led to higher exports.

During the recent financial crisis in Portugal, the propensity to export increased among Portuguese firms. The number of firms exporting increased by 23% between 2009 and 2014, despite the fact that the total number of firms in the economy decreased during the same period. Despite the increase in the number of exporting firms and a reduction of their average size, the relative productivity of those firms also increased, both when comparing with non-traders and importing firms.

While the number of exporters increased, it was those firms already exporting that contributed most to the increase in exports in the years of the crisis. Among continuing exporters, the increase was driven by exports to same countries and products they were already selling

before the crisis, indicating gains in market share. Expansion in intensive and extensive margins of trade is correlated with export growth, but most of the growth was driven by existing exporters selling existing products to existing markets, and not by the expansion in markets and products. First time exporters represented less than one fourth of the total increase in exports.

Domestic demand drops was a driver behind the increase in exports among continuing exporters, especially among those firms that were exposed both to domestic demand and export markets before the crisis. Under pressure from lower domestic demand, firms looked into foreign markets to make up for the lost business. Those firms with established commercial relationships were more prone to replace lost domestic sales with exports.

The "vent-for-surplus" effect originally mentioned in Smith (2010) played an important role in the increase in exports during the economic crisis in Portugal. Internal wage devaluation does not seem to have had a significant impact on export growth. The vent-out effect prevailed over internal devaluation. In future domestic demand crisis, having firms prepared to take advantage of foreign markets, replacing domestic demand with foreign demand, should be taken as a priority for public policy as opposed to wage devaluation.

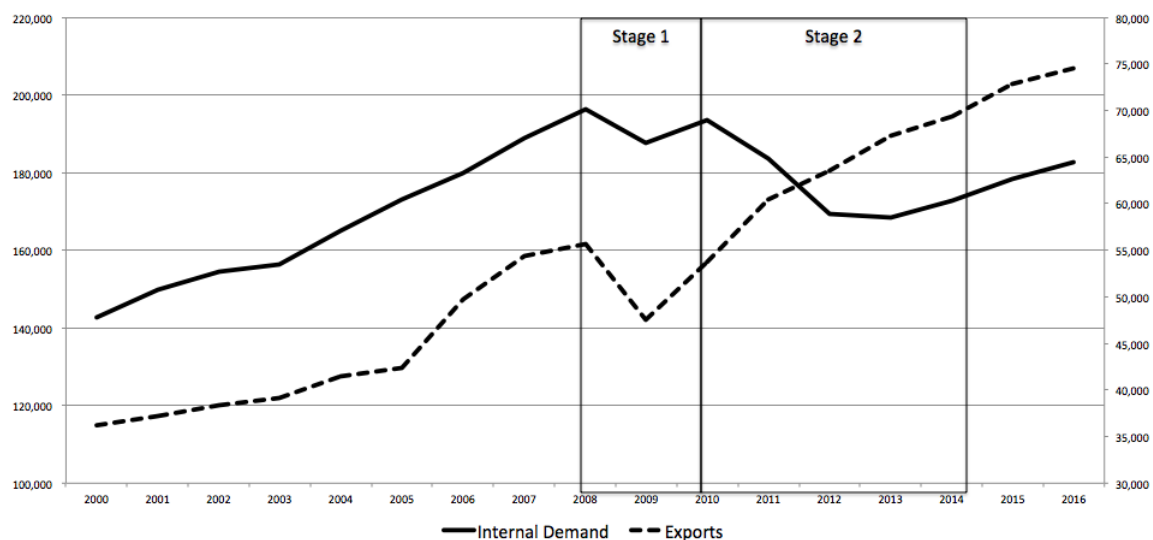
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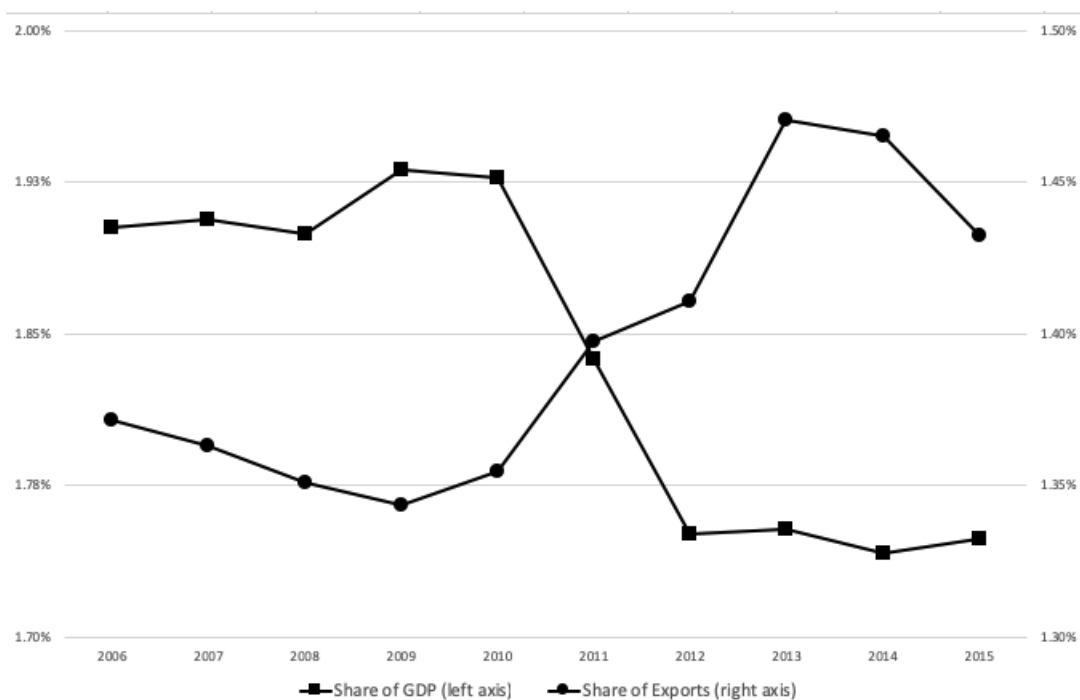
## Tables and figures

**Figure 2.1.** Internal demand and exports evolution (Billions of Euros, 2000-2016, constant prices base=2011)



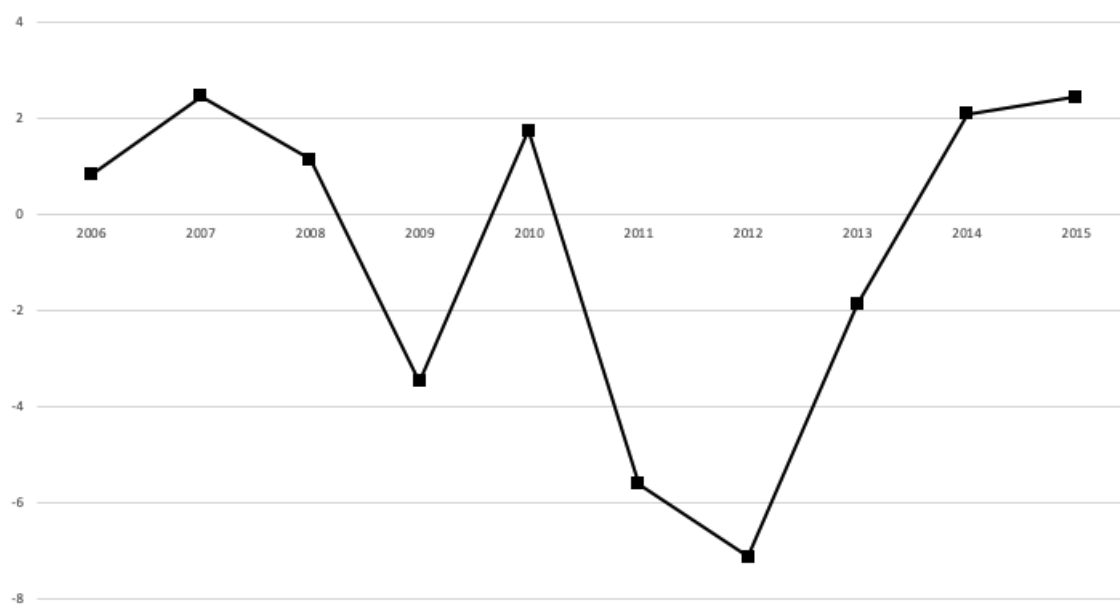
Source: Statistics Portugal (INE), own calculations.

**Figure 2.2.** Evolution of Portugal's share of EMU12 GDP and Exports



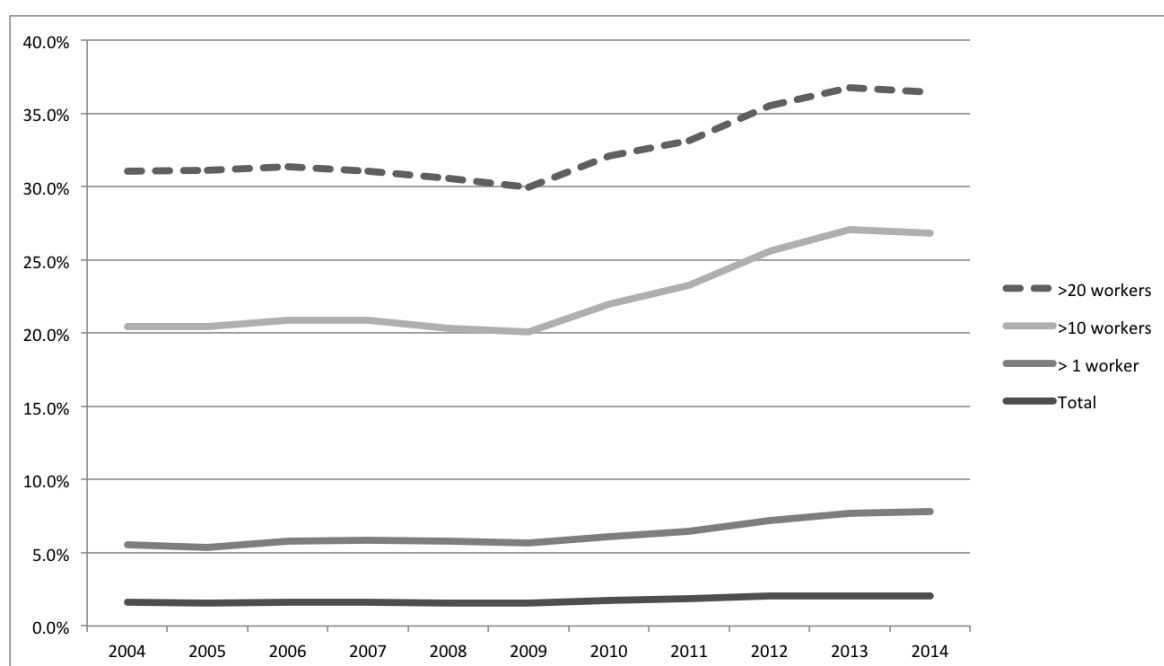
Source: Statistics Portugal (INE), Eurostat, own calculations.

**Figure 2.3.** Domestic demand growth rate



Source: Statistics Portugal (INE), own calculations.

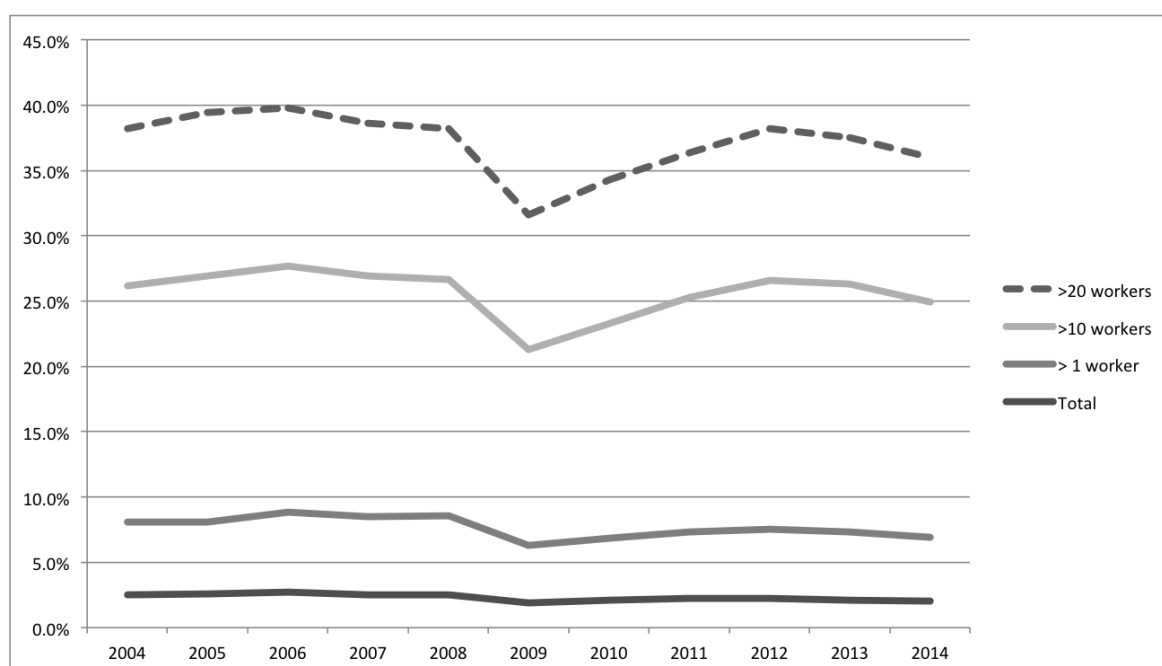
**Figure 2.4.** Evolution of export propensity - (All firms)



Source: Statistics Portugal (INE), own calculations.

Notes: this figure represents the evolution of the propensity to export, defined as the percentage of firms with at least one export activity during the year, for all firms, those above 1 worker, above 10 workers and above 20 workers.

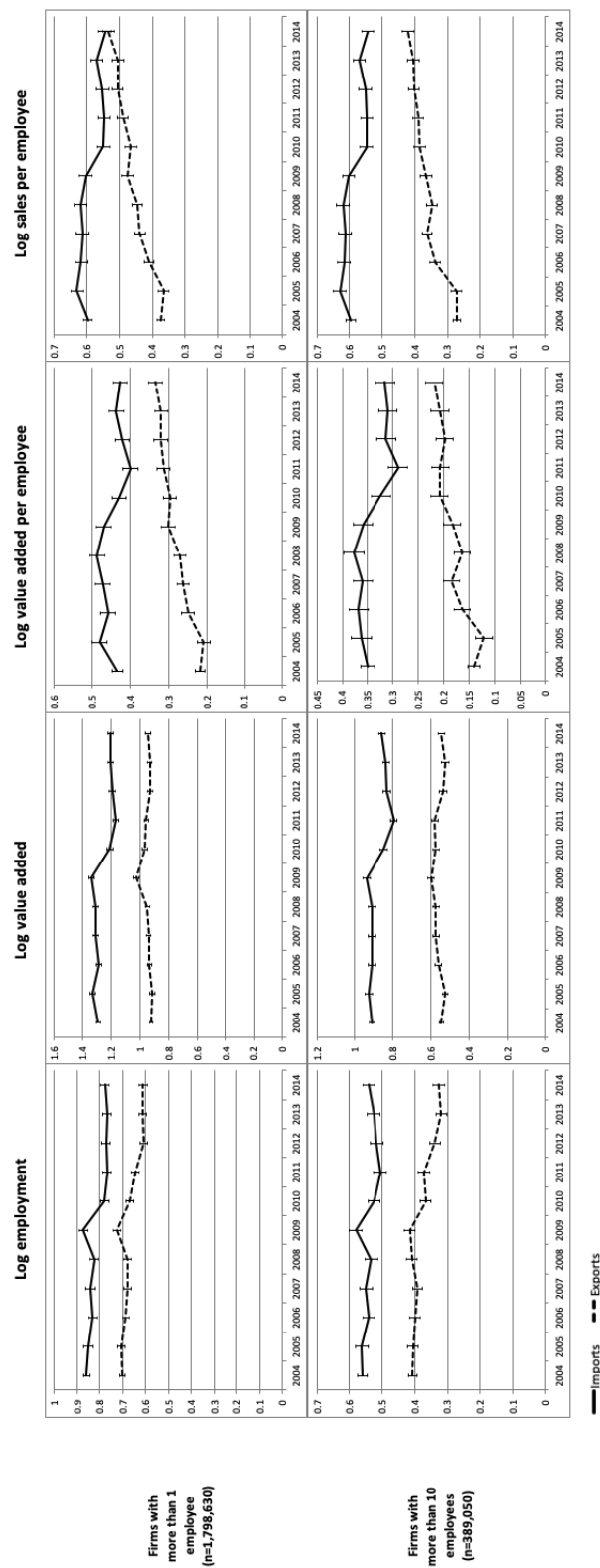
**Figure 2.5.** Evolution of import propensity - (All firms)



Source: Statistics Portugal (INE), own calculations.

Notes: this figure represents the evolution of the propensity to import, defined as the percentage of firms with at least one import activity during the year, for all firms, those above 1 worker, above 10 workers and above 20 workers.

**Figure 2.6.** Evolution of coefficients for export and import dummies, 2004-2014



Notes: Charts represent the evolution of the year specific coefficient assigned to an export and import dummy, with the vertical bars representing confidence bars for a 95% confidence interval.

**Table 2.1.** Decomposition of number of trading firms - 2009 to 2014

| Subset of firms                   | (1) 2009  | (2) Exiting firms | (3) New entrants | Continuing firms                                 |                                           |                                          |           |
|-----------------------------------|-----------|-------------------|------------------|--------------------------------------------------|-------------------------------------------|------------------------------------------|-----------|
|                                   |           |                   |                  | (4) Same subset in both years                    | (5) Entered sub-set between 2009 and 2014 | (6) Exited sub-set between 2009 and 2014 | (7) 2014  |
|                                   |           |                   |                  | <i>Number of firms</i>                           |                                           |                                          |           |
| Firms that Export                 | 18,777    | 4,156             | 4,286            | 9,598                                            | 9,191                                     | 5,023                                    | 23,075    |
| Firms that Import                 | 22,771    | 5,107             | 5,283            | 10,541                                           | 6,786                                     | 7,123                                    | 22,610    |
| Firms that both export and import | 7,810     | 1,090             | 1,074            | 6,258                                            | 3,719                                     | 2,096                                    | 9,417     |
| Firms that only export            | 10,967    | 3,066             | 3,212            | 3,340                                            | 7,106                                     | 4,561                                    | 13,658    |
| Firms that only import            | 14,961    | 4,017             | 4,209            | 4,283                                            | 5,455                                     | 7,415                                    | 13,193    |
| All firms                         | 1,199,843 | 557,652           | 486,067          | -                                                | -                                         | -                                        | 1,128,258 |
| All firms above 1 employee        | 312,394   | 82,599            | 62,417           | -                                                | -                                         | -                                        | 292,212   |
|                                   |           |                   |                  | <i>Share of firms relative to 2009 level (%)</i> |                                           |                                          |           |
| Firms that Export                 | 100       | 22                | 23               | 51                                               | 49                                        | 27                                       | 123       |
| Firms that Import                 | 100       | 22                | 23               | 46                                               | 30                                        | 31                                       | 99        |
| Firms that both export and import | 100       | 14                | 14               | 80                                               | 48                                        | 27                                       | 121       |
| Firms that only export            | 100       | 28                | 29               | 30                                               | 65                                        | 42                                       | 125       |
| Firms that only import            | 100       | 27                | 28               | 29                                               | 36                                        | 50                                       | 88        |
| All firms                         | 100       | 46                | 41               | na                                               | na                                        | na                                       | 94        |
| All firms above 1 employee        | 100       | 26                | 20               | na                                               | na                                        | na                                       | 94        |

Source: Statistics Portugal (INE), own calculations, table based on similar analysis in Bernard et al. (2009).

Notes: Table summarizes dynamics across different subsets of firms between 2009 and 2014. The overall growth in the number of firms of each type is decomposed across columns. Upper panel displays firm counts while lower panel displays the share of each count relative to the 2009 total. Columns 1 and 7 report the number of firms of each type in 2009 and 2014, respectively. The subsets of firms reported in each row are not mutually exclusive (i.e., some of the firms that export also import, and vice versa). Columns 2, 3, and 4 report the number of 2009 firms that exit, the number of new firms entering between 2009 and 2014, and the number of 2009 firms present in both years, respectively. Column 5 and 6 report the number of firms that switch their trading status between 2009 and 2014. Column 5 indicates the number of continuing firms that did not engage in the noted activity in 2009 but start doing so by 2014. Column 6 reports the opposite.

**Table 2.2.** Breakdown of export and import evolution in volume according to the different categories of firms

| Type of transaction | 2009  | Exiting firms | New entrants | Continuing firms                               |                                           |                                          |       |
|---------------------|-------|---------------|--------------|------------------------------------------------|-------------------------------------------|------------------------------------------|-------|
|                     |       |               |              | Same subset in both years                      | Entered the sub-set between 2009 and 2014 | Exited the sub-set between 2009 and 2014 | 2014  |
| Exports             | 27.96 | -1.60         | 2.01         | 11.97                                          | 3.77                                      | -0.89                                    | 43.22 |
| Imports             | 43.88 | -2.84         | 2.28         | 8.40                                           | 1.81                                      | -1.62                                    | 51.90 |
|                     |       |               |              | <i>Transactions relative to 2009 level (%)</i> |                                           |                                          |       |
| Exports             | 100   | -6            | 7            | 43                                             | 13                                        | -3                                       | 155   |
| Imports             | 100   | -6            | 5            | 19                                             | 4                                         | -4                                       | 118   |

Notes: This table summarizes the evolution of total export volume in Portugal. The column 2009 refers to total exports/imports in that year, "Exiting firms" reports exports/imports lost due to firms that existed in 2009 but not in 2014, "New entrants" reports exports/imports gained due to firms that existed in 2014 but not in 2009, "Same subset in both years" reports the export/import evolution from firms that exported/imported in both years, "Entered the subset between 2009 and 2014" refers to firms that were not exporters/importers in 2009 but joined that subset before or during 2014, and "Exited the subset between 2009 and 2014" refers to firms that were exporters/importers in 2009 but no longer exported/imported in 2014.

**Table 2.3.** Change in exports by category of variation in number of products exported and countries exported to (Billion Euro and as a % of total)

|                                    |              | Variation of products exported |             |             |              |
|------------------------------------|--------------|--------------------------------|-------------|-------------|--------------|
|                                    |              | Less                           | Same        | More        | Total        |
| Variation of countries exported to | Less         | -0.95                          | 0.16        | 0.48        | <b>-0.31</b> |
|                                    | Same         | 0.09                           | 0.05        | 0.68        | <b>0.82</b>  |
|                                    | More         | 3.93                           | 0.41        | 7.13        | <b>11.47</b> |
|                                    | <b>Total</b> | <b>3.07</b>                    | <b>0.62</b> | <b>8.28</b> | <b>11.97</b> |

|                                    |              | Variation of products exported (%) |           |            |             |
|------------------------------------|--------------|------------------------------------|-----------|------------|-------------|
|                                    |              | Less                               | Same      | More       | Total       |
| Variation of countries exported to | Less         | -8%                                | 1%        | 4%         | <b>-3%</b>  |
|                                    | Same         | 1%                                 | 0%        | 6%         | <b>7%</b>   |
|                                    | More         | 33%                                | 3%        | 60%        | <b>96%</b>  |
|                                    | <b>Total</b> | <b>26%</b>                         | <b>5%</b> | <b>69%</b> | <b>100%</b> |

Notes: This table represents the difference in exports between 2009 and 2014 according to the evolution in the number of countries and products exported. In the upper side, the differences are in absolute terms (billion of Euros) and in the lower side as a proportion of total export evolution within the sample. For example, the number 3.93 in the upper side of the table means that firms that exported a lower variety of products in 2014 than in 2009, but to more countries, added 3.93 billion euro to the national exports. In the lower side, we can see that 3.93 represents 33% of the total difference in exports between the two years.

**Table 2.4.** Breakdown of export variation according the category of country and product

| Type of export                       | Difference between 2009-14 | Difference between 2009-14 (%) |
|--------------------------------------|----------------------------|--------------------------------|
| Same country, same product           | 5.25                       | 44%                            |
| Same country, different product      | 4.58                       | 38%                            |
| Same product, different country      | 2.24                       | 19%                            |
| Different product, different country | -0.10                      | -1%                            |
| <b>Total</b>                         | <b>11.97</b>               | <b>100%</b>                    |

Notes: This table represents the difference in exports between 2009 and 2014 according to the destination and type of product. In the first line we have the difference in exports between 2009 and 2014 originated from firms selling to the same combination of country/product. In the second line, the difference in exports from firms selling to the same country, but different products. In the third line, the same products they were selling in 2009 but to new countries. In the fourth row, the difference in exports from exporting to different combinations of country/product. The negative value in this last row means that there was a larger volume of lost exports by dropping combinations of country/product than gains by adding new combinations.

**Table 2.5.** Summary statistics: total number of firms and exports (thousands euros); average number of employees, sales (thousand euros), value added per employee (thousand euros), exports (thousand euros)

|                                 |      | <b>All firms</b> | <b>All exporters</b> | <b>Continuing exporters</b> |
|---------------------------------|------|------------------|----------------------|-----------------------------|
|                                 |      | <b>(2014)</b>    |                      |                             |
| <b>Total number of firms</b>    |      | 1,712,459        | 23,075               | 9,598                       |
| <b>Total exports (2014)</b>     |      | 42,113           | 42,113               | 36,482                      |
| <b>Average employees</b>        | 2009 | 3                | 41                   | 65                          |
|                                 | 2014 | 3                | 35                   | 63                          |
| <b>Average sales</b>            | 2009 | 280              | 7,519                | 12,503                      |
|                                 | 2014 | 279              | 6,919                | 13,308                      |
| <b>Average Value Added p.e.</b> | 2009 | 30               | 54                   | 65                          |
|                                 | 2014 | 30               | 56                   | 80                          |
| <b>Average exports</b>          | 2009 | 16               | 1,108                | 2,663                       |
|                                 | 2014 | 25               | 1,825                | 3,801                       |

Notes: This table reports the number of firms, total exports, number of employees, average sales, average value added per employee and average exports of each group of firms. There are three sets of firms. First all the firms in the database in 2009 or 2014. Second a subset of the first group, containing only firms exporting in 2014. Third, a subset of the second group, containing firms that exported both in 2009 and 2014. All values are in thousands of euros, except number of firms and number of employees.

**Table 2.6.** Export growth: All firms

| Regression                  | 1                    | 2                    | 3                    | 4                    |
|-----------------------------|----------------------|----------------------|----------------------|----------------------|
| $\Delta$ Domestic sales     | -0.186***<br>(0.028) | -0.071**<br>(0.030)  | -0.188***<br>(0.028) | -0.073**<br>(0.029)  |
| $\Delta$ Sales per employee | 0.919***<br>(0.057)  |                      | 0.926***<br>(0.057)  |                      |
| $\Delta$ GVA per employee   |                      | 0.397***<br>(0.049)  |                      | 0.395***<br>(0.049)  |
| $\Delta$ Average wage       | -0.025<br>(0.084)    | 0.018<br>(0.087)     | -0.049<br>(0.084)    | 0.005<br>(0.087)     |
| Multinational               | -0.264***<br>(0.082) | -0.289***<br>(0.083) | -0.220***<br>(0.086) | -0.237***<br>(0.086) |
| Observations                | 7,739                | 7,374                | 7,731                | 7,366                |
| $R^2$                       | 0.048                | 0.015                | 0.057                | 0.024                |
| Sector FE                   | No                   | No                   | Yes                  | Yes                  |
| Region FE                   | No                   | No                   | Yes                  | Yes                  |

Notes: \*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance. Standard errors appear in parenthesis, clustered at firm level. For any X,  $\Delta X$  is the log difference between 2009 and 2014.

Difference in the number of observations is a result of some firms having no values for variation of value added (either because information is not available or is negative in one of the years).

**Table 2.7.** Export growth: Only firms with positive export growth

| Regression                  | 1                    | 2                    | 3                    | 4                    |
|-----------------------------|----------------------|----------------------|----------------------|----------------------|
| $\Delta$ Domestic sales     | -0.145***<br>(0.028) | -0.125***<br>(0.028) | -0.149***<br>(0.028) | -0.120***<br>(0.028) |
| $\Delta$ Sales per employee | 0.201***<br>(0.057)  |                      | 0.307***<br>(0.057)  |                      |
| $\Delta$ GVA per employee   |                      | 0.055<br>(0.046)     |                      | 0.106**<br>(0.047)   |
| $\Delta$ Average wage       | 0.026<br>(0.076)     | 0.058<br>(0.080)     | -0.086<br>(0.077)    | -0.046<br>(0.080)    |
| Multinational               | -0.221***<br>(0.079) | -0.243***<br>(0.080) | -0.201**<br>(0.081)  | -0.217***<br>(0.082) |
| Observations                | 4,963                | 4,785                | ,                    | 4,779                |
| Adjusted $R^2$              | 0.007                | 0.005                | 0.040                | 0.035                |
| Sector FE                   | No                   | No                   | Yes                  | Yes                  |
| Region FE                   | No                   | No                   | Yes                  | Yes                  |

Notes: \*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance. Standard errors appear in parenthesis, clustered at firm level. For any X,  $\Delta X$  is the log difference between 2009 and 2014.

**Table 2.8.** Export growth and domestic demand by quartile of export exposure

| Export exposure             | Less than 25%       | 25% to 50%           | 50% to 75%           | More than 75%        |
|-----------------------------|---------------------|----------------------|----------------------|----------------------|
| $\Delta$ Domestic sales     | -0.077<br>(0.064)   | -0.227***<br>(0.069) | -0.183***<br>(0.063) | -0.073***<br>(0.026) |
| $\Delta$ Sales per employee | 0.799***<br>(0.085) | 1.210***<br>(0.143)  | 1.145***<br>(0.117)  | 0.717***<br>(0.105)  |
| $\Delta$ Average wage       | -0.015<br>(0.111)   | -0.010<br>(0.213)    | 0.204<br>(0.164)     | -0.099<br>(0.139)    |
| Multinational               | -0.275**<br>(0.125) | 0.135<br>(0.195)     | 0.050<br>(0.170)     | 0.177<br>(0.114)     |
| Observations                | 5,041               | 893                  | 760                  | 1,014                |
| Adjusted $R^2$              | 0.058               | 0.258                | 0.246                | 0.21                 |
| Sector FE                   | Yes                 | Yes                  | Yes                  | Yes                  |
| Region FE                   | Yes                 | Yes                  | Yes                  | Yes                  |
| Average export exposure     | 4.6%                | 36.5%                | 62.0%                | 89.2%                |

Notes: In quartile 1 we have firms with 0 to 25% export exposure, in Quartile 2 only firms with 25% to 50% export exposure, in Quartile 3 only firms with 50% to 75% export exposure, and in quartile 4 only firms with more than 75% export exposure.

\*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance. Standard errors appear in parenthesis, clustered at firm level. For any X,  $\Delta X$  is the log difference between 2009 and 2014.

**Table 2.9.** Heterogeneity analysis - Quartile and Interaction variable

| Regression                           | Quartile 1 | Quartile 2 | Quartile 3 | Quartile 4 | Interaction variable |
|--------------------------------------|------------|------------|------------|------------|----------------------|
| <b>Managers with high education</b>  | -0.284***  | -0.103     | -0.090     | -0.220***  | 0.0097               |
| <b>Average education of managers</b> | -0.340***  | -0.126**   | -0.177**   | -0.166**   | 0.0104               |
| <b>Firm's age</b>                    | -0.205***  | -0.171***  | -0.274***  | -0.215***  | 0.0032               |
| <b>Number of employees</b>           | -0.184***  | -0.254***  | -0.281***  | -0.113*    | 0.0002*              |
| <b>GVA per employee</b>              | -0.231***  | -0.231***  | -0.214***  | -0.093     | -0.0000              |

Notes: This table contains the OLS estimates of the coefficients for the variable of interest in each of the 25 regressions used to assess the impact of firm heterogeneity on the effect of domestic demand growth on export growth. The first four columns reports the coefficients from running regression 3 of Table 6 on a subset of firms defined by the quartiles of the source of heterogeneity. Quartile 1 of each regression contains the firms with the lowest values for each variable representing a source of heterogeneity and Quartile 4 contains the firms with the highest values. The fifth column reports the coefficient associated with an interaction variable between growth of domestic demand and the variable representing the source of heterogeneity.

There are five variables associated with heterogeneity. In the first row we have the % of managers in the firm with at least a bachelor degree. In the second row, we have the average of a variable representing the level of education of the firm's managers. This variable can go from 1 (manager can not read or write) to 8 (manager has a PhD). In the third row we have the average of firm's age. In the fourth row, we have the number of employees. In the fifth row we have the gross value added per employee.

\*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance.

**Table 2.10.** Export growth: All firms exporting in both years - IV approach

| Regression                          | 1                    | 2                    | 3                    | 4                   |
|-------------------------------------|----------------------|----------------------|----------------------|---------------------|
| Domestic sales                      | -0.878***<br>(0.328) | -0.386*<br>(0.265)   | -2.066***<br>(0.780) | -1.092**<br>(0.550) |
| Sales per employee                  | 1.389***<br>(0.224)  |                      | 2.146***<br>(0.512)  |                     |
| GVA per employee                    |                      | 0.500***<br>(0.096)  |                      | 0.702***<br>(0.171) |
| Average wage                        | -0.014<br>(0.091)    | 0.034<br>(0.090)     | -0.005<br>(0.118)    | 0.080<br>(0.107)    |
| Multinational                       | -0.267***<br>(0.085) | -0.289***<br>(0.083) | -0.184*<br>(0.108)   | -0.208**<br>(0.095) |
| Observations                        | 7,739                | 7,374                | 7,731                | 7,366               |
| Cragg-Donald Wald F-Statistic       | 109.6                | 152.9                | 22.3                 | 36.5                |
| P-value                             | 0.0000               | 0.0000               | 0.0000               | 0.0000              |
| Kleibergen-Paap Wald rk F-statistic | 55.8                 | 65.7                 | 17.2                 | 24.1                |
| Sector FE                           | No                   | No                   | Yes                  | Yes                 |
| Region FE                           | No                   | No                   | Yes                  | Yes                 |

Notes: \*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance. Standard errors appear in parenthesis, clustered at firm level. For any X,  $\Delta X$  is the log difference between 2009 and 2014.

**Table 2.11.** Export growth: firms exporting in both years with positive export growth - IV approach

| Regression                          | 1                    | 2                    | 3                    | 4                    |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|
| Domestic sales                      | -1.778***<br>(0.362) | -1.255***<br>(0.254) | -2.038***<br>(0.686) | -1.213***<br>(0.414) |
| Sales per employee                  | 1.284***<br>(0.261)  |                      | 1.537***<br>(0.463)  |                      |
| GVA per employee                    |                      | 0.449***<br>(0.108)  |                      | 0.475***<br>(0.153)  |
| Average wage                        | -0.015<br>(0.117)    | 0.067<br>(0.098)     | -0.134<br>(0.129)    | -0.022<br>(0.097)    |
| Multinational                       | -0.134<br>(0.104)    | -0.209**<br>(0.092)  | -0.114<br>(0.116)    | -0.185**<br>(0.094)  |
| Observations                        | 4,963                | 4,785                | 4,958                | 4,779                |
| Cragg-Donald Wald F-Statistic       | 48.0                 | 73.5                 | 12.8                 | 26.3                 |
| P-value                             | 0.0000               | 0.0000               | 0.0020               | 0.0042               |
| Kleibergen-Paap Wald rk F-statistic | 25.7                 | 33.2                 | 15.0                 | 14.0                 |
| Sector FE                           | No                   | No                   | Yes                  | Yes                  |
| Region FE                           | No                   | No                   | Yes                  | Yes                  |

Notes: \*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance. Standard errors appear in parenthesis, clustered at firm level. For any X,  $\Delta X$  is the log difference between 2009 and 2014.

**Table 2.12.** Export growth and domestic demand by level of export exposure: IV approach

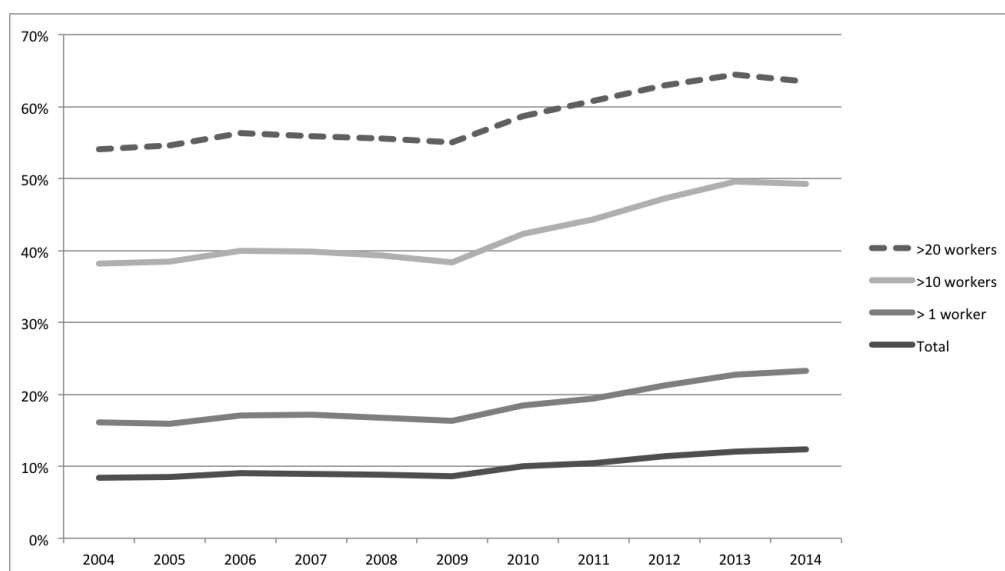
| Export exposure                     | Less than 25%       | 25% to 50%        | 50% to 75%       | More than 75%      |
|-------------------------------------|---------------------|-------------------|------------------|--------------------|
| Domestic sales                      | -1.309<br>(1.120)   | 0.588<br>(2.106)  | 0.811<br>(1.147) | -4.850<br>(10.622) |
| Sales per employee                  | 1.675**<br>(0.803)  | 0.631<br>(1.478)  | 0.386<br>(0.880) | 1.779<br>(2.471)   |
| Average wage                        | -0.093<br>(0.139)   | -0.008<br>(0.234) | 0.078<br>(0.231) | 1.278<br>(3.165)   |
| Multinational                       | -0.335**<br>(0.139) | 0.133<br>(0.205)  | 0.185<br>(0.243) | 0.790<br>(1.523)   |
| Observations                        | 5,041               | 893               | 760              | 1,014              |
| Cragg-Donald                        | 14.36               | 0.49              | 2.06             | 0.20               |
| Wald F-Statistic                    |                     |                   |                  |                    |
| P-value                             | 0.0000              | 0.0000            | 0.0000           | 0.8263             |
| Kleibergen-Paap Wald rk F-statistic | 13.8                | 0.7               | 2.0              | 0.2                |
| Average exposure                    | 4.6%                | 36.5%             | 62.0%            | 89.2%              |

Notes: In quartile 1 we have firms with 0 to 25% export exposure, in Quartile 2 only firms with 25% to 50% export exposure, in Quartile 3 only firms with 50% to 75% export exposure, and in quartile 4 only firms with more than 75% export exposure.

\*\*\* denotes 1% significance, \*\* denotes 5% significance, \* denotes 10% significance. Standard errors appear in parenthesis. For any X,  $\Delta X$  is the log difference between 2009 and 2014.

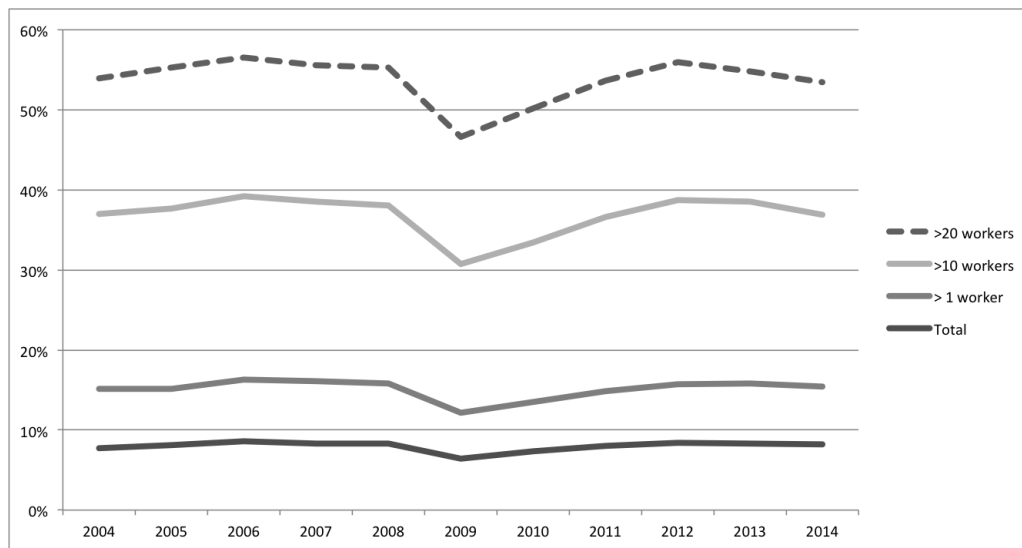
## Appendix - Additional figures and tables

Figure A1: Evolution of export propensity - (Manufacturing)



Notes: this figure represents the evolution of the propensity to export, defined as the % of firms with at least one export activity during the year, for manufacturing firms, those above 1 worker, above 10 workers and above 20 workers.

Figure A2: Evolution of import propensity - (Manufacturing)



Notes: this figure represents the evolution of the propensity to import, defined as the % of firms with at least one import activity during the year, for manufacturing firms, those above 1 worker, above 10 workers and above 20 workers.

Table A1: Profile of firms included in the database

| Sector                            | Number of employees |                |                 |               | Total            | % of total  |
|-----------------------------------|---------------------|----------------|-----------------|---------------|------------------|-------------|
|                                   | 1 employee          | 2-10 employees | 11-20 employees | >20 employees |                  |             |
| <b>Agriculture</b>                | 117,458             | 10,196         | 685             | 426           | <b>128,765</b>   | <b>11%</b>  |
| <b>Mining</b>                     | 522                 | 386            | 105             | 89            | <b>1,102</b>     | <b>0%</b>   |
| <b>Manufacturing</b>              | 33,103              | 22,268         | 4,862           | 5,968         | <b>66,201</b>    | <b>6%</b>   |
| <b>Energy</b>                     | 762                 | 130            | 17              | 32            | <b>941</b>       | <b>0%</b>   |
| <b>Water</b>                      | 539                 | 413            | 95              | 205           | <b>1,252</b>     | <b>0%</b>   |
| <b>Construction</b>               | 49,853              | 24,024         | 2,338           | 1,629         | <b>77,844</b>    | <b>7%</b>   |
| <b>Transportation and storage</b> | 162,415             | 71,907         | 5,387           | 4,013         | <b>243,722</b>   | <b>22%</b>  |
| <b>Tourism</b>                    | 53,407              | 27,471         | 1,947           | 1,297         | <b>84,122</b>    | <b>7%</b>   |
| <b>ICT</b>                        | 10,202              | 3,769          | 403             | 460           | <b>14,834</b>    | <b>1%</b>   |
| <b>Real estate activities</b>     | 24,267              | 5,042          | 166             | 86            | <b>29,561</b>    | <b>3%</b>   |
| <b>Consulting</b>                 | 93,367              | 18,309         | 1,012           | 670           | <b>113,358</b>   | <b>10%</b>  |
| <b>Administrative</b>             | 137,371             | 6,061          | 657             | 898           | <b>144,987</b>   | <b>13%</b>  |
| <b>Education</b>                  | 51,720              | 2,886          | 327             | 391           | <b>55,324</b>    | <b>5%</b>   |
| <b>Health</b>                     | 72,727              | 9,832          | 666             | 478           | <b>83,703</b>    | <b>7%</b>   |
| <b>Entertainment</b>              | 26,704              | 1,882          | 116             | 142           | <b>28,844</b>    | <b>3%</b>   |
| <b>Other services</b>             | 45,010              | 8,298          | 235             | 155           | <b>53,698</b>    | <b>5%</b>   |
| <b>Total</b>                      | <b>879,427</b>      | <b>212,874</b> | <b>19,018</b>   | <b>16,939</b> | <b>1,128,258</b> | <b>100%</b> |
| <b>% of total</b>                 | <b>78%</b>          | <b>19%</b>     | <b>2%</b>       | <b>2%</b>     | <b>100%</b>      |             |

Source: Statistics Portugal (INE), own calculations.

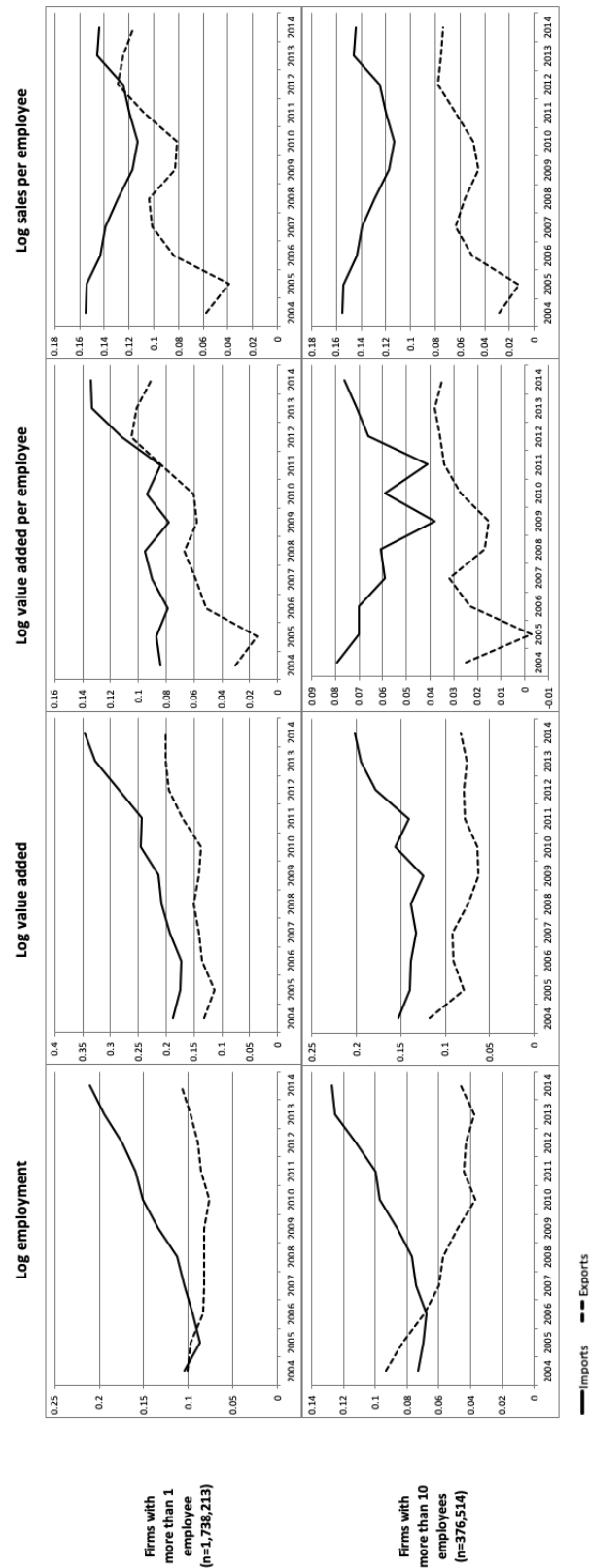
Table A2: Volume of Exports and Imports contained in databases (thousands of Euros)

|             | Exports ('000 Euro) |          |               |                 | Imports ('000 Euro) |          |               |                 |
|-------------|---------------------|----------|---------------|-----------------|---------------------|----------|---------------|-----------------|
| Year        | Published data      | Trade DB | After merging | % after merging | Published data      | Trade DB | After merging | % after merging |
| <b>2004</b> | 30,920              | 30,920   | 28,007        | <b>91%</b>      | 49,260              | 49,259   | 43,959        | <b>89%</b>      |
| <b>2005</b> | 31,137              | 31,137   | 28,505        | <b>92%</b>      | 51,379              | 51,379   | 47,514        | <b>92%</b>      |
| <b>2006</b> | 35,641              | 35,640   | 32,258        | <b>91%</b>      | 56,295              | 56,294   | 50,993        | <b>91%</b>      |
| <b>2007</b> | 38,294              | 38,294   | 34,997        | <b>91%</b>      | 59,927              | 59,926   | 54,715        | <b>91%</b>      |
| <b>2008</b> | 38,847              | 38,847   | 34,880        | <b>90%</b>      | 64,194              | 64,193   | 57,723        | <b>90%</b>      |
| <b>2009</b> | 31,697              | 31,696   | 27,960        | <b>88%</b>      | 51,379              | 51,378   | 43,880        | <b>85%</b>      |
| <b>2010</b> | 37,268              | 37,267   | 33,572        | <b>90%</b>      | 58,647              | 58,647   | 50,742        | <b>87%</b>      |
| <b>2011</b> | 42,828              | 42,828   | 38,996        | <b>91%</b>      | 59,551              | 59,551   | 53,205        | <b>89%</b>      |
| <b>2012</b> | 45,213              | 45,213   | 40,993        | <b>91%</b>      | 56,374              | 56,374   | 50,458        | <b>90%</b>      |
| <b>2013</b> | 47,303              | 47,302   | 43,031        | <b>91%</b>      | 57,013              | 57,012   | 50,700        | <b>89%</b>      |
| <b>2014</b> | 48,054              | 48,053   | 43,218        | <b>90%</b>      | 59,032              | 59,032   | 51,902        | <b>88%</b>      |

Source: Statistics Portugal (INE), own calculations.

Notes: The column 'Published data' refers to the the official aggregate export and import values published by the Statistics Portugal (INE) and Eurostat; 'Trade DB' refers to the sum of the individual import and export transactions in the transactional database; 'After merging' refers to the sum of the individuals import and export transactions performed by firms that also have an entry in the firms' database with financial and balance sheet information; '% After merging' reflects the % of transaction volume captured in the previous column.

Figure A3: Evolution of coefficients for export and import dummies with fixed effects, 2004-2014



Notes: Charts represent the evolution of the year specific coefficient assigned to an export and import dummy.

## **Chapter 3**

# **The distinct role of imports and exports linkages in business cycle comovement**

**Abstract:** We find empirical support for a different role of imports and exports in the business cycle comovement using a firm-level data analysis. The strength of the interdependence between a firm and a country of destination is associated with the intensity of the exports to that country, but with imports the interdependence is not associated with intensity. Imported inputs have a high degree of complementarity to domestically purchased inputs, so even a small import intensity can bring interdependence. Since exports are substitutes of domestic sales, the level of interdependence between a firm and an export destination depends on the weight of that destination in total sales.

**JEL codes:** F14, F43, F44

**Keywords:** International trade, Business cycle, Comovement

### 3.1 Introduction

A growing body of research suggests that business cycles are transmitted across-countries through trade linkages [Frankel and Rose (1998); di Giovanni, Levchenko, and Mejean (2018b); Kleinert, Martin, and Toubal (2015); di Giovanni, Levchenko, and Mejean (2018a); di Giovanni, Levchenko, and Mejean (2014)]. In “The linkage of interest rates within the EMS, author=Artis, Michael J and Zhang, Wenda, journal=Weltwirtschaftliches Archiv, volume=134, number=1, pages=117–132, year=1998, publisher=Springer” (n.d.), the authors find that the income of European countries was more correlated with that of the United States in the 60s and 70s, but became more correlated with Germany’s after the Exchange Rate Mechanism (ERM) increased trade links between European countries. In a study that included more than 100 countries, Calderon, Chong, and Stein (2007) concluded that bilateral trade intensity is robustly related to business cycle synchronization. Along the same line, Inklaar, Jong-A-Pin, and De Haan (2008) find that trade intensity affects synchronization but also that specialization and convergence in monetary and fiscal policies have similar impacts.

While business cycle transmission across countries through trade linkages has been widely studied, the exact transmission mechanism remains controversial. One strand of the literature emphasizes structural factors such as the role of similarity in specialization patterns across countries [Imbs (n.d.); Clark and Van Wincoop (2001)], the level of vertical specialization Kose and Yi (2001) or the existence of low elasticity of substitution between domestic and foreign intermediate goods [Drozd and Nosal (2008)]. A more recent strand has emphasized the role of individual firms [di Giovanni and Levchenko (2009); di Giovanni et al. (2018b)]. Other papers had already concluded that idiosyncratic shocks in destination markets affected firms’ sales and total employment growth volatility pointing towards the same possibility [Berman, Berthou, and Héricourt (2015); Vannoorenberghe (2012); Kurz and Senses (2016)].

The empirical literature has shown that the mere presence of export flows matters, but there

is very little empirical work on how trade intensity and import flows affect business cycle comovement. If the firm exports to a country, it is intuitive to anticipate that an economic slowdown in that country will affect the potential demand of the firm and, thus, its performance. These effects are likely to be larger if a large share of the firm's revenues come from exports to that market [Kurz and Senses (2016)]. For imports, the relationship is more complex. If a supplier produces a more sophisticated input, the firm can benefit greatly from it even if the input only represents a small share of the costs. Similarly, if a supplier stops producing, the firm might see its production capabilities constrained. For example, some software or cloud services can represent a small share of a firm's costs, but its improvement or service failures might have a drastic impact on productivity. In the case of exports it seems clear that the more exposed the firm is to a certain market, the more it will be affected by a slowdown (or a more positive economic performance), while in the case of imports that is not so clear. Using the natural experiment of the great east Japan earthquake, Carvalho, Nirei, Saito, and Tahbaz-Salehi (2016) identify signs of downstream shock propagation, indicating that downstream players can be harmed by productivity shocks upstream. Yet, the impact of such shock is not strictly dependent on the weight of imports from that supplier in the total costs of the firm. Even the absence of an input that represents only a small share of total costs can have significant productivity effects (for example, e-mail services are cheap, but lack of access to them can halt decision processes even in the largest firms). Trade links at firm level impact business cycle comovement, but import and export linkages are likely to work differently.

We fill this gap in the literature by analyzing specifically the effect of firms' trade intensity in the business cycle comovement and how it differs between imports and exports. In this paper, we use a rich combination of customs and matched employer-employee longitudinal data from Portugal to further examine the micro underpinnings of the trade-comovement relationship. To organize our thinking about the empirical work, we develop a model of GDP growth correlation, extending the framework of di Giovanni et al. (2018b). By assuming a production function with domestic and imported inputs, and a demand function with domestic

and foreign demand, the model provides a deeper view on how export and import trade links affect growth co-movement. This also allows us to understand the impact of trade intensity thus overcoming the limitations imposed by the use of binary variables to measure trade involvement. The model predicts that the effect of trade intensity in the correlation between a firm's performance and the economy of its trade partners will depend on the elasticity of substitution in the production function in the case of imports, and the elasticity of substitution in the demand function in the case of exports. When the elasticity of substitution in the production function is close to zero, we would expect firms with a small share of imported goods from a given country to have a similar correlation as firms with a higher share of imports from the same country. Conversely, if we have a high degree of substitution in the demand function (if sources of demand are independent) then we would expect a firm to be more exposed to a destination country the more it exports to that country.

In the empirical section, we relate the intensity of trade relations and growth comovement. Simple correlations indicate that trade relationships at a micro level are one important source of business cycle comovement and that export intensity has a positive effect on correlation between firm and destination country. However, import intensity does not, indicating that the micro level mechanisms through which business cycles are transmitted are different between imports and exports.

Our paper proceeds as follows. Section 2 presents the theoretical framework. Section 3 describes the database sources, empirical methodology, and models used to achieve the three objectives outlined before. Section 4 presents our main results and a wide array of robustness tests. Section 5 concludes.

## 3.2 Conceptual framework

Our conceptual framework starts with the correlation model developed by di Giovanni et al. (2018b). Crucially, we extend it to include a mechanism through which firms' exposure to trade and elasticity of substitution can affect the transmission of foreign shocks in countries with which the firm trades. The second part of the model features a production function with domestic and foreign inputs, as well as a demand function with domestic and foreign demand. This allows us to understand how trade intensity affects the impact of a foreign shock on firm's profit growth.

### 3.2.1 Correlation

The growth rate of the world's GDP (excluding the home country) is a weighted average of the growth rate of each country and can be written as:

$$\gamma_t^w = \sum_c \psi_{c,t-1} \gamma_{c,t} , \quad (3.1)$$

where  $\gamma_t^w$  is the growth rate of the world economy at time  $t$ ,  $\gamma_{c,t}$  is the GDP growth rate of country  $c$  at time  $t$  and  $\psi_{c,t-1}$  is the share of  $c$ 's value added in the world economy at time  $t - 1$ . Similarly the growth rate of the home country's GDP is the weighted sum of all its individual firms growth rates:

$$\gamma_t^P = \sum_f \omega_{f,t-1} \gamma_{f,t} , \quad (3.2)$$

where  $\gamma_t^P$  is the GDP growth rate of Portugal,  $\gamma_{f,t}$  is the value added growth of firm  $f$  and  $\omega_{f,t-1}$  is the share of  $f$ 's value added in the Portuguese total GDP. Thus, the correlation between the

GDP of the home country and the rest of the world will be:

$$\rho(\gamma_t^P, \gamma_t^w) = \frac{Cov(\gamma_t^P, \gamma_t^w)}{\sigma^P \sigma^w} . \quad (3.3)$$

Combining (3.1), (3.2), and (3.3), the correlation between home country's GDP and the rest of the world is a weighted sum of the correlations between each firm's value added with each individual country's GDP and is given by:

$$\begin{aligned} \rho(\gamma_t^P, \gamma_t^w) &= \frac{Cov(\sum_f \omega_{f,t-1} \gamma_{f,t}, \sum_c \psi_{c,t-1} \gamma_{c,t})}{\sigma^P \sigma^w} \\ &= \sum_f \sum_c \omega_{f,t-1} \psi_{c,t-1} \frac{\sigma_f \sigma_c}{\sigma^P \sigma^w} \rho(\gamma_{f,t}, \gamma_{c,t}) . \end{aligned} \quad (3.4)$$

Given that the correlation between a country's GDP and the world GDP is the weighted sum of individual firms' value added correlation with each country, the question that remains is what affects these individual correlations. The remaining of this section will extend the theoretical model to understand potential mechanisms and the empirical section will test those mechanisms.

### 3.2.2 Firm's trade intensity

In order to understand how firm's trade intensity with one country affects the correlation between that country's GDP growth and the firm's profit, we develop a model with domestic and foreign inputs in the production function and domestic and foreign demand.

Suppose the firms have a production technology that includes two inputs, one imported and the other locally sourced, such that the production functions follows a CES production function with technological progress as in Klump, McAdam, and Willman (2007) in the calibrated form as defined in Böhringer, Rutherford, and Wiegard (2003). Instead of Labor and Capital, our

factors of production are imported ( $M$ ) and locally sourced inputs ( $L$ ):

$$Y_t = Y \left[ \theta \left( \frac{A_t^M M_t}{A^M M} \right)^{\frac{\sigma-1}{\sigma}} + (1 - \theta) \left( \frac{A_t^L L_t}{A^L L} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} . \quad (3.5)$$

$A^L$  is the local productivity associated with the inputs purchased in the base year,  $A^M$  is the blended productivity of the countries where the input is imported from (and thus reflects the level of foreign technology) in the base year <sup>1</sup> and  $\sigma$  is the elasticity of substitution between imported and domestic inputs. The variables with subscript  $t$  refer to the year in question. The parameter  $\theta$  is the value share of imported goods over total inputs purchases at the base year.

If firms are price takers both in the final goods market and in the input market, they will maximize the following profit function:

$$\Pi_t = Y_t P_t - L_t P_t^L - M_t P_t^M , \quad (3.6)$$

where  $P_t$  is the market price of the final good at time  $t$ ,  $P_t^L$  is the market price of domestic input at time  $t$ , and  $P_t^M$  is the market price of foreign input at time  $t$ . The optimization is subject to the restriction that output equals demand. While the firms are price takers, they are unable to sell any quantity at a given price. Instead, they have to rely on established commercial relationships. We assume they have two sets of clients (national and foreign) to whom they sell at the market price. The demand is modelled in a similar way as the production function, with constant elasticity of substitution between the two destinations. Intuitively, we would expect demand sources to be perfect substitutes, although that need not be the case if local and foreign clients are closely related or the firm sells two related subproducts (think about an oil refinery producing petrol for domestic markets and diesel for foreign markets in the same oil

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<sup>1</sup>To save on notation, the variables from the base year appear without subscript.

refining process). Demand is defined by:

$$D_t = D \left[ \phi \left( \frac{A_t^X X_t}{A^X X} \right)^{\frac{\epsilon-1}{\epsilon}} + (1-\phi) \left( \frac{A_t^C C_t}{A^C C} \right)^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}}, \quad (3.7)$$

where  $A^X$  is the blended productivity of the export destination countries,  $A^L$  is the domestic productivity term associated with changes in consumption,  $C$  is the domestic demand ignoring productivity shifts,  $X$  is the foreign demand ignoring productivity shifts,  $\epsilon$  is the elasticity of substitution between domestic and foreign demand for the firm and  $\phi$  is the value share of exports in demand for the base year. As before, values without time subscript refer to the base year. In each period firms optimize the amount of domestic ( $L_t$ ) and foreign ( $M_t$ ) inputs. From the optimization, we obtain that the optimal choice of  $L_t$  and  $M_t$  is:

$$L_t = \frac{D_t}{Y} \left( \frac{A^L L}{A_t^L} \right) \left[ (1-\theta) + \theta^\sigma (1-\theta)^{1-\sigma} \left( \frac{A_t^M A^L L P_t^L}{A_t^L A^M M P_t^M} \right)^{\sigma-1} \right]^{\frac{\sigma}{1-\sigma}}, \quad (3.8)$$

and,

$$M_t = \frac{D_t}{Y} \left( \frac{A^M M}{A_t^M} \right) \left[ \theta + (1-\theta)^\sigma \theta^{1-\sigma} \left( \frac{A_t^M A^L L P_t^L}{A_t^L A^M M P_t^M} \right)^{1-\sigma} \right]^{\frac{\sigma}{1-\sigma}}. \quad (3.9)$$

Plugging the above expressions back into the profit function and simplifying we get:

$$\begin{aligned} \Pi_t = D_t \left\{ P_t \left[ (1 + \delta^\sigma \zeta^{1-\sigma})^{-1} + (1 + \delta^{-\sigma} \zeta^{\sigma-1})^{-1} \right]^{\frac{\sigma}{\sigma-1}} \right. \\ \left. - \frac{P_t^M}{Y} \frac{A^M M}{A_t^M} \theta^{\frac{\sigma}{1-\sigma}} (1 + \delta^\sigma \zeta^{(1-\sigma)})^{\frac{\sigma}{1-\sigma}} \right. \\ \left. - \frac{P_t^L}{Y} \frac{A^L L}{A_t^L} (1-\theta)^{\frac{\sigma}{1-\sigma}} (1 + \delta^{-\sigma} \zeta^{(\sigma-1)})^{\frac{\sigma}{1-\sigma}} \right\} \end{aligned}$$

with  $\delta \equiv \theta^{-1}(1-\theta)$ ,  $\zeta \equiv A_t^M \iota$ , where in turn  $\iota \equiv \frac{P_t^L A^L L}{A_t^L P_t^M A^M M}$ .

To save on notation, we didn't include a firm identifier, but profit, imported inputs, locally sourced inputs, as well as technology factors for both local and imported inputs are firm specific. In order to understand how a productivity shock in a foreign country affects the profit of

a firm, we differentiate the above equation for profit with respect to foreign technology:

$$\begin{aligned} \frac{\partial \Pi_t}{\partial A_t^M} &= D_t P_t \frac{\sigma}{\sigma - 1} \left[ (1 + \delta^\sigma \zeta^{1-\sigma})^{-1} + (1 + \delta^{-\sigma} \zeta^{\sigma-1})^{-1} \right]^{\frac{1}{\sigma-1}} \\ &\quad \left[ (1 + \delta^\sigma \zeta^{1-\sigma})^{-2} \delta^\sigma (\sigma - 1) \zeta^{-\sigma} \iota - (1 + \delta^{-\sigma} \zeta^{\sigma-1})^{-2} \delta^{-\sigma} (\sigma - 1) \zeta^{\sigma-2} \iota \right] \\ &\quad + \frac{P_t^M}{Y} \frac{A_t^M M}{A_t^M} \theta^{\frac{\sigma}{1-\sigma}} \left[ \frac{(1 + \delta^\sigma \zeta^{1-\sigma})^{\frac{\sigma}{1-\sigma}}}{A_t^M} - \frac{\sigma}{1 - \sigma} (1 + \delta^\sigma \zeta^{1-\sigma})^{\frac{2\sigma-1}{1-\sigma}} \delta^\sigma (1 - \sigma) \zeta^{-\sigma} \iota \right] \\ &\quad - \frac{P_t^L}{Y} \frac{A_t^L L}{A_t^L} (1 - \theta)^{\frac{\sigma}{1-\sigma}} \frac{\sigma}{1 - \sigma} (1 + \delta^{-\sigma} \zeta^{\sigma-1})^{\frac{2\sigma-1}{1-\sigma}} \delta^{-\sigma} (\sigma - 1) \zeta^{\sigma-2} \iota . \end{aligned}$$

The impact of a foreign shock in a firm's profit is a function of the share of foreign inputs in the production (import intensity) in the base year ( $\theta$ ). Import intensity can be a factor influencing how the value added of a firm responds to foreign shocks. However, that impact is dependent on the elasticity of substitution. When inputs are perfectly complementary ( $\sigma = 0$ ), import intensity becomes irrelevant to determine the effect of a foreign shock as all the terms with  $\theta$  or  $\delta$  disappear from the equation.<sup>2</sup>

Import intensity is only a factor to determine the impact of a shock in a foreign country if there is some level of substitution between inputs. If inputs are perfectly complementary, then the impact will be similar, regardless of the initial share of those inputs in the total cost. In an extreme situation, if complementary imported inputs become unavailable due to a severe crisis, a firm might actually need to stop producing, even if those inputs are only a small share of total cost. The case of the tsunami in Japan and its effect on American subsidiaries is a good example of that, as described in Carvalho et al. (2016). Similarly, the effect of a positive productivity shock can be large for complementary inputs even if its share in the total cost is low. A good example is the impact of innovation on information and communication technologies, such as online platforms, in sectors where they don't represent a large share of the costs, such as traditional manufacturing.

We can do a similar exercise for demand. If we differentiate profit with respect to foreign

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<sup>2</sup>With  $\sigma = 0$  then  $\frac{\partial \Pi_t}{\partial A_t^M} = \frac{P_t^M}{Y} \frac{A_t^M M}{A_t^M}$ , so  $\theta$  (import intensity) becomes irrelevant in the calculation

technology of buyers we get:

$$\frac{\partial \Pi_t}{\partial A_t^X} = D \left[ \phi \left( \frac{A_t^X X_t}{A^X X} \right)^{\frac{\epsilon-1}{\epsilon}} + (1 - \phi) \left( \frac{A_t^C C_t}{A^C C} \right)^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{1}{\epsilon-1}} \phi \left( \frac{A_t^X X_t}{A^X X} \right)^{\frac{-1}{\epsilon}} \frac{X_t}{A^X X} P_t \left[ (1 + \delta^\sigma \zeta^{1-\sigma})^{-1} + (1 + \delta^{-\sigma} \zeta^{\sigma-1})^{-1} \right]^{\frac{\sigma}{\sigma-1}} .$$

The effect of a foreign shock in the firm's profit is a function of the share of demand from foreign markets. Similarly to the case of imported inputs, that impact becomes zero when the two sources of demand are perfectly complementary (when  $\epsilon = 0$ ). As the elasticity of substitution approaches infinity, the impact of a foreign shock in the company's profits becomes directly proportional to the share of demand coming from exports.

In summary, the effect of trade intensity in the correlation between a firm's performance and the economy of its trade partners will depend on the elasticity of substitution in the production function in the case of imports and the elasticity of substitution in the demand function in the case of exports. When the elasticity of substitution in the production function is close to zero, we would expect firms with a small share of imported goods from a given country to have a similar correlation as firms with a higher share of imports from the same country. Conversely, if we have a high degree of substitution in the demand function (if sources of demand are independent) then we would expect a firm to be more exposed to a destination country the more it exports to that country.

In the empirical section of this paper we will test whether import and export intensity have a significant effect on the correlation between a foreign market growth and firms' growth. By doing so, we can infer the magnitude of the elasticity of substitution between domestic and foreign inputs (in case of imports) and elasticity of substitution between demand sources (in case of exports).

## 3.3 Data and Empirical Approach

### 3.3.1 Data

The analysis in this paper draws on three main firm-level databases, collected by *8Statistics Portugal* (INE), the Portuguese national statistical agency. First, a "Trade database" with customs data on firm-level international trade transactions, which are collected separately for European Union (EU) partner countries (*Estatísticas Correntes do Comércio Intracomunitário* – Current Statistics on Intra-Community Trade) and non-EU partners (*Estatísticas Correntes do Comércio Extracomunitário* – Current Statistics on Extra-Community Trade).<sup>3</sup> This database has recently been used by Amador and Opromolla (2013); Bastos and Silva (2010); Bastos, Silva, and Verhoogen (2018), although these papers utilize shorter panels. Besides information on firm-level exports and imports in each year from 1996 through 2016, the data includes an identifier of the firm, the product traded, the value traded, and the destination/source country of each export/import flow.

Using the unique firm identifier we combine the "Trade database" with two firm level datasets that cover different time periods. For the most recent period of 2004-2016 we use the *Sistema de Contas Integradas de Empresas* (SCIE, Enterprise Integrated Accounts System), a census of all private non-financial firms. This dataset includes economic and financial firm-level variables such as size, sales, sector of activity, and location for all firms. However, for sole proprietor firms information for some variables such as value added is missing. For the 1996 to 2004 period the firm-level information comes from the *Inquérito Anual às Empresas* – the Annual Firm Survey. This last dataset contains balance sheet information for a sample

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<sup>3</sup>Intra-EU transactions are obtained via a monthly survey sent to all firms in the country, capturing the universe of external trade transactions. Data on transactions extra-EU are obtained from customs forms, capturing shipments from firms registered in the value-added tax system whose value of annual shipments exceeds a cut-off that has changed over time. In 2013, for instance, the cut-off was 250,000 euros.

of private non-financial firms in Portugal and covers the universe of firms with more than 50 employees and a sample of smaller firms. The survey makes available data on sales and value added for all firms.<sup>4</sup> We supplement these data with information on country level real GDP growth rates from the World Bank's World Development indicators.

Table 3.1 reports summary statistics for the full sample period in our dataset. Although trading firms are only a small minority of the firms, they account for most of the aggregate value added. This is especially true for manufacturing value added where importing firms account for 88% of total value added and exporting firms for 89%. Affiliates of foreign firms also have a disproportional share of the value added, accounting for 25%, despite representing only 0.24% of the total number of manufacturing firms. There are more firms importing than exporting and the latter are also, on average, bigger than exporters, although not by a large difference. In terms of value added affiliates of foreign multinationals are larger than the average firm by an order of magnitude and also larger than importers and exporters.<sup>5</sup>

The leading source and destination countries are Angola, Belgium, China, France, Germany, Italy, Netherlands, Spain, United Kingdom and the United States. Most of the analysis will be made using value added growth rates from 1997 to 2016 (1996 data is only used to calculate growth rates). Table A1 in the Appendix presents descriptive statistics for the number of firms, their share of value added, and correlation between firm growth rates and foreign country GDP for the 1996-2016 period. Table A2 presents the same value but for each type of connection. We exclude petroleum trade, as we will do throughout the paper.

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<sup>4</sup>Throughout the analysis, the firm level data on value added and sales is deflated with the Portuguese GDP deflator. Moreover, the firm level growth rates are winsorized to be bounded by +100% and -50% to reduce the impact of outliers and potential errors in the database. As the international trade database and the firm-level accounting information are obtained separately, in some cases we can find mismatches in the data, namely firms with higher exports than total sales or higher imports than total purchases. These data mismatch affects particularly the high exporters and importers, so eliminating these entries would bias the final sample. Thus, instead of eliminating these entries, we simply normalized the export and import ratios to 1.

<sup>5</sup>For a detailed overview of performance differences by firm type and the importance of trading firms in the Portuguese economy see Pinto (2018).

### 3.3.2 Empirical Methodology

Following the literature on the micro origins of international comovements, we start our empirical analysis by establishing that trade and multinational linkages, direct and indirect, at the firm level, to a particular foreign country are associated with higher correlation between the firm value added and that foreign country GDP. The estimating equation is:

$$\rho(\gamma_{ft}, \gamma_{ct}) = \alpha + \beta_1 EX_{fc} + \beta_2 IM_{fc} + \beta_3 AFF_{fc} + \beta_4 DS_{fjc} + \beta_5 US_{fjc} + \delta_f + \delta_c + \eta_{fc} \quad (3.10)$$

where  $EX_{fc}$ ,  $IM_{fc}$  and  $AFF_{fc}$  are binary indicators of whether the firm  $f$  exports to country  $c$ , imports from that country or is an affiliate of a multinational of that country, respectively. These variables measure the effect of direct linkages.<sup>6</sup> To account for the fact that even firms that are not directly connected with a particular foreign country might be affected by shocks in that country if they buy inputs from importers or sell to firms that export to that country (i.e. if they are connected through the supply chain), we also control for the firm-specific indices of indirect linkages,  $DS_{fjc}$  and  $US_{fjc}$ , measuring the exposure of each firm to other national firms that export to or import from the foreign country, respectively. The downstream effect,  $DS_{fjc}$ , will be higher the larger the share of intermediate inputs in firm's costs, or if the sectors from which the firm's sector buys inputs import from that country. Similarly, the upstream effect,  $US_{fjc}$ , will be larger the more a firm sells domestically, or if the sectors to

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<sup>6</sup>Our specification follows di Giovanni et al. (2018b) with two exceptions. First, we do not consider linkages established through Portuguese multinationals with foreign affiliates as we do not have this information. Second, we just have information on the location of the headquarters of a foreign firm operating in Portugal from 2010 onwards, and therefore we assume that the firms' headquarters were in the same country in the previous years. Yet, results in di Giovanni et al. (2018b) suggest that the effect of this type of linkages is relatively small in the case of France with export and/or import linkages accounting for more than 90% of the correlation identified.

which firms in the same sector sell more export from that country.<sup>7</sup> Finally, we use firm fixed effects to control for firm specific shocks, and country fixed effects to control for common shocks between Portugal and trade partners that affect all the firms equally.

We now consider the effects of the intensity of trade linkages between a firm and a foreign country on the correlation between a firm's value added growth and a foreign market's GDP growth. While theory tends to focus on import/export intensity to establish linkages between countries (for example, to examine how exchange rate movements affect firms), di Giovanni et al. (2018b) measure direct trade linkages as a binary variable equal to one if there was at least one export/import flow over the period under analysis. In this context, a French firm that exported once a merchandise worth 0.1% of its sales to Portugal and did not have any additional linkages, would have the same direct linkage as a French firm that exported every year 90% of its sales to Portugal. Table 3.2 presents the average exposure of Portuguese importers and exporters to each country. Among firms importing from Spain, an average of 17% of their total costs come from imports from that country, and for 9% those imports represent more than 50% of their total costs, indicating a strong input-dependence from Spanish firms. On the contrary, among those importing from China, on average only 2% of their costs are a result of imports from China, showing a much lower average dependence. Similar differences exist for exports. Among those firms exporting to France, 12% are highly dependent on that country (exports represent more than 50% of sales), but among those exporting to Belgium only 2%

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<sup>7</sup>The indexes measuring indirect linkages are given by

$$DS_{fjc} = INPUTINT_f \sum_i IO_{ij} \frac{NIM_{ic}}{N_i},$$

and

$$US_{fjc} = DOMINT_f \sum_i IO_{ji} \frac{NEX_{ic}}{N_i},$$

where  $j$  and  $i$  index sectors with firm  $f$  belonging to sector  $j$ ;  $IO$  is the domestic direct requirement coefficient of the 2013 Input-Output matrix, defined as the share of spending on domestically produced sector;  $i$  inputs in production in sector  $j$ ;  $NIM_{ic}$  is the number of firms in sector  $i$  importing from country  $c$ ;  $NEX_{ic}$  is the number of firms in sector  $i$  exporting to country  $c$ ;  $INPUTINT$  is the total input usage intensity of the firm, defined as the total material inputs spending of the firm divided by material inputs spending plus wage bill, averaged across years; and  $DOMINT$  is the total input usage intensity of the firm, defined as the share of firm  $f$ 's sales that goes to the domestic market, averaged across years. Following di Giovanni et al. (2018b), the indices are constructed using 2-digit sector-level information as there is no firm-level input-output matrix available for Portugal.

are in the same situation. Within the same country, we also see differences between having an import and export relationship. For the average importer from Angola, imports from that country account for only 2% of total costs, but for those exporting the exports account for 11% of their total sales. A simple binary variable fails to reflect fully the dimension of the links between firms and countries. If we do not take into account the export and import intensity, we might be underestimating the impact of having a trade relationship since the empirical analysis would take into account many firms with very weak links to each country. For example, in the case of Angola we would be taking into consideration many firms whose export intensity is less than 5% and by doing so underestimate the impact of business cycle transmission from that country to firms with a dependence above 50%.

Intuitively, we could expect a firm's performance to be more closely related with a country's performance if the firm exports (imports) more to (from) that country as a proportion of its total sales (costs). In reality, the import/export intensity's impact on the correlation depends on the degree of substitution between exports and internal demand, and the elasticity of substitution between imported and locally acquired inputs. To test empirically the importance of trade weights in the correlation, we changed the specification in (3.10) with one where the variables  $EX$  and  $IM$  are replaced by  $EXint$  and  $IMint$ , representing the export and import intensities, respectively. The new variables can take a value ranging from 0 (if no export/import relationship with that country) to 1 (if exports/imports from that country account for all sales/production costs of the firm). The new specification is:

$$\rho(\gamma_{ft}, \gamma_{ct}) = \alpha + \beta_1 EXint_{fc} + \beta_2 IMint_{fc} + \beta_3 AFF_{fc} + \beta_4 DS_{fjc} + \beta_5 US_{fjc} + \delta_f + \delta_c + \eta_{fc} . \quad (3.11)$$

In this specification, we would expect  $\beta_1$  to be higher, the higher the level of substitution between export destinations and local markets (or between export destinations) and  $\beta_2$  to be higher the higher the level of substitution between foreign and domestic inputs (or among foreign inputs). We also consider an alternative specification where we add the squared intensity

variables to test for potential concavity in the relation between growth correlation and trade links.

By nature, if the dependent variable is a correlation over time, the time dimension is collapsed in the analysis. While this approach has its advantages, it can potentially underestimate the impact of trade links on the correlation. Take the example of a firm that only starts trading with a country towards the end of the period of the analysis. In this case, the estimated correlation coefficient is likely to be lower than that of a firm that started trading earlier in the period, even if the firms' trade intensity was the same during the years both were trading. Another limitation of using the correlation coefficient is that, in order to make computation possible and avoid noise, it should be done only on a sample of countries, as we did following di Giovanni et al. (2018b). So, instead of collapsing the time dimension, we can collapse the export destination countries or import origin countries into one single yearly value representing a weighted average of those countries' GDP growth. We can then look at how the GDP growth in the destination/source countries (all of them) affects the value added growth of the firm in each of the years. We started by developing two firm and time specific indices of weighted GDP exposure through exports and imports:

$$GDPexp_{ft} = EXint_{ft-1} \sum_c \frac{Exp_{ftc}}{Exp_{ft}} \gamma_{ct}, \quad (3.12)$$

and

$$GDPimp_{ft} = IMint_{ft-1} \sum_c \frac{Imp_{ftc}}{Imp_{ft}} \gamma_{ct}, \quad (3.13)$$

where  $EXint_{ft-1}$  is the share of exports in total sales of firm  $f$  in period  $t - 1$ ,  $IMint_{ft-1}$  is the share of imports in total costs of firm  $f$  in period  $t - 1$ ,  $Exp_{ft}$  is the total exports of a firm in year  $t$ ,  $Imp_{ft}$  is the total imports of a firm in year  $t$ ,  $Exp_{ftc}$  is the total exports of firm  $f$  to country  $c$  in year  $t$ ,  $Imp_{ftc}$  is the total imports of firm  $f$  to country  $c$  in year  $t$ , and  $\gamma_{ct}$  is the GDP growth of country  $c$  in year  $t$ . In simple terms,  $GDPexp_t$  is the weighted average GDP growth of firm  $f$ 's export countries adjusted by the share of exports in total sales, and

$GDPimp_t$  is the weighted average GDP growth of firm  $f$ 's import countries adjusted by share of imports in total costs. The above indices are then introduced as regressors in a specification that has the firm's value added growth rate as a dependent variable:

$$\gamma_{ft} = \alpha + \beta_1 GDPexp_{ft} + \beta_2 GDPimp_{ft} + \delta_f + \delta_t + \eta_{ft} . \quad (3.14)$$

These intensity adjusted measures will allow us to size the impact of GDP growth in a source/destination country on the firms' value added. We will also use the same specification to evaluate the impact on other firm indicators, such as sales, number of employees, and total wages paid.

## 3.4 Results

### 3.4.1 Correlation analysis

Table 3.3 reports the results of estimating Equation 3.10 without the upstream and downstream effects included. Columns 1 to 5 are based on an analysis of growth rates of value added (baseline) and column 6 replicates the specification in column 3, but using firms' sales instead of value added. The first column presents the basic estimation without fixed effects. The estimates of the coefficient on the trade links are significantly positive and qualitatively similar to those obtained by di Giovanni et al. (2018b) for France. It is reassuring that estimates are similar to those obtained by di Giovanni et al. (2018b) (0.031 for importers versus 0.027, and 0.031 for exporters versus 0.035).<sup>8</sup>

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<sup>8</sup>The main difference stems from the impact of affiliates. In the case of Portugal the coefficient is negative unlike in the mentioned paper where it was positive and significant. This difference might be related with the limitation in data mentioned above or with the different profile of foreign investment in Portugal versus France.

The introduction of firm fixed effects results in a sharp drop in the coefficients for both importers and exporters. When the country fixed effects are introduced in the third specification, the coefficient associated with exporters declines further, while the coefficient for importers actually increases. Country fixed effects are key to understanding the balance between importing and exporting because the trade relations with these 10 partners are very different. With Angola, the United States and the United Kingdom there are a lot of firms exporting but not many importing firms, while with Germany and China we have the opposite situation. Given this country trade bias, the importer and exporter coefficients in specifications (1) and (2) could be capturing country specific effects. It is clear that most of the effect captured for exporters in the first two specifications stemmed from common shocks affecting Portugal and its main exporting markets. The decline in the coefficient associated with importers only occurs when Country×Sector fixed effects are introduced in column 5. This indicates that some specific sectors face common shocks with specific countries, which were previously captured by the coefficient associated with imports. The coefficients are nevertheless significant at the usual levels, so we confirm that firm-level trade links increase the correlation between a firm's value added and the trade partner's GDP, even when controlling for common shocks and firm fixed effects. The coefficients are also of similar magnitude to those calculated for France in di Giovanni et al. (2018b).

Columns 4 to 6 check the robustness of the results to alternative specifications. In specification 4, we use Country×Region fixed effects to understand if specific regions are exposed to common shocks with foreign countries, similar to what we do with sectors in specification 5. The coefficients in specification 4 are identical to those in specification 3 and slightly different in specification 5. In specification 6, we use the correlation with sales growth instead of value added as dependent variable, confirming that also for sales the correlation is higher when there is a trade linkage.<sup>9</sup>

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<sup>9</sup>As explained in the Data section sales data are available for a larger number of firms that includes sole proprietor firms. These are typically very small firms.

Table 3.4 presents the results of estimating Equation 3.10 with downstream and upstream effects. In the first specification, we have firm and country fixed effects. The coefficients for importer and exporter decrease slightly with relation to specification 3 of the previous table. Both downstream and upstream effects are positive and significant, but the downstream effect is much stronger, which confirms the findings in di Giovanni et al. (2018b) and the literature on propagation effects. When we introduce Country  $\times$  Sector fixed effects, the coefficient for importer declines considerably while the one for exporter increases, in line with what happened previously when moving from column 3 to column 5 of Table 3.3. The coefficient for downstream effect declines significantly while the coefficient for upstream turns negative. As in di Giovanni et al. (2018b), we have a strong indication supporting the existence of downstream effects, while the evidence favoring upstream effects is not as clear.

### 3.4.2 Trade intensity

Table 3.5 presents our estimates of Equation 3.11, which replaces the binary variables for export and import with intensity variables, representing the importance of exports (imports) in the total sales (production costs) of the firms. In the first column, we only use the intensity variables alone with country and firm fixed effects. In the second column we introduce indirect effects and in the third column the affiliate dummy. The coefficients of interest do not change significantly, so we can look directly at the results of column 3, which can be compared with column 1 of Table 3.4.

According to our analysis, estimates on the direct effect are much higher than when we used the exporter dummy, indicating that the intensity of exporting in fact matters when it comes to the correlation between a firm's value added and a country's GDP. Firms that have their sales more concentrated in one country will tend to have their performance more highly correlated with that country's economic performance. On the other hand, when the indepen-

dent variable is the intensity of importing the coefficient associated drops significantly to the point of losing significance. The import intensity does not seem to have statistical significance even though it remains positive. This suggests that the mechanism through which economic shocks are transmitted through trade may be different for export and import linkages due to lower elasticity of substitution between domestic and foreign inputs and high elasticity of substitution between domestic and foreign demand. The transmission through exports is more intuitive: a shock in a foreign market affects the ability of that market to import from the firm, thus affecting its performance and growth. In other words, it works through a direct effect on sales. The transmission through imports works differently. What these results suggest is that the economic performance of a country that a firm imports from can have an impact even if the firm's dependence on that market is low. Even if the firm imports little from one country, a shock that affects the availability, quality, or sophistication of the inputs can have significant impact on the firm. Following the model described in section 2.2, this result indicates that imported inputs have a strong degree of complementarity. This finding also helps understanding the stylized fact that importing firms are more productive.<sup>10</sup> If a sector works with highly complementary inputs, some of which can only be imported, then we would expect importing firms to be more productive than those unable to pay the sunk cost of importing.

To confirm the hypothesis that the correlation between the growth of a firm's value added and the growth of a source country's GDP exists even for low import intensity and does not grow significantly with increasing import intensity, we developed two other specifications. In column 4 we test the possibility of a concavity in the effect of both import and export intensity, by introducing the squares of the intensities. When we introduce the possibility of a concave relationship, the coefficient associated with import intensity increases significantly (almost 20-fold), becoming statistically significant. However, the square of import intensity is also significant and negative and the overall marginal impact of import intensity remains quite low. Moreover, importing from a country only has a positive effect on performance correlation at

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<sup>10</sup>in Wagner (2012) we can see a long list of papers supporting this stylized fact, including Muûls and Pisu (2009) and Castellani, Serti, and Tomasi (2010).

low import levels. The coefficient for the square of export intensity is also negative, but it is not statistically significant for the usual significance levels indicating a more linear relation (the p-value is slightly above 0.10). Another way to confirm this difference between exports and imports is by reintroducing a binary variable for importer and exporter, as it is done in column 5. The coefficient for the binary variable for imports has the same value as in the first specification of Table 3.4 and the coefficient of import intensity even becomes negative. On the other hand, the coefficient for export intensity declines when compared with specification 3, but not by much, strongly indicating that exporting more to one country increases firms' exposure to that country's economic performance. Tables A3 to A5, in Appendix, present robustness tests with additional controls (Table A3), using data only after 2004 (Table A4) and presample intensities (Table A5).

The main takeaway from Table 3.5 is that trade intensity has different effects on the magnitude of the correlation between a firm's value added and its trading partners' GDP growth. For exports, the correlation is higher the larger the intensity of the trade relation. For imports, that is not the case. According to our theoretical model, these results mean that export destinations have a higher degree of substitution (high elasticity of substitution among demand sources) while imports origins are complementary (low elasticity of substitution between domestic and imported inputs).

### **3.4.3 Impact measurement**

The contemporaneous analysis intends to get a more accurate measurement of the impact of trade partners' economic growth in the firms' performance, which is now the dependent variable. In this analysis, extreme variations (below -50% and above 100%) are excluded to avoid noise from smaller firms with irregular financial results, which eliminates many entries. In Table 3.6 we only include the direct effects. As stated earlier, the specification controls

for a firm fixed effect, year (to account for general national shocks), combined Sector $\times$ Year (to account for specific yearly sector shocks) and location. All coefficients are positive and significant at 1% level. In the first column, we have the results for the firms' value added. An additional 1 percentage point growth in the trade partner's intensity adjusted weighted GDP growth is associated with an additional 0.239pp of growth in a firm's value added in case of imports, and 0.246pp in the case of exports. The production chain (imports) and market effects (exports) are similar. For the remaining dependent variables the production chain effect is always larger than the market effect. In the Appendix, we can see several robustness tests that reach similar, or even higher, estimates (tables A6, A7 and A8). Firms' performance seems to be more closely associated with the economic growth of countries they import from than countries they export to. It is also interesting to understand the differences between the coefficients associated with sales versus value added, and employment versus wage costs. When sales is the dependent variable the coefficient associated with imports is higher than when the dependent variable is the value added, but the coefficient associated with exports is almost half in the specification using sales than in the specification using value added. This is a strong indication that firms are more able to adapt the cost structure to shocks derived from production chain effects than from market effects. The larger coefficients when the dependent variable is wage expenditure than when it is the number of employees clearly suggests that, when exposed to shocks, firms adjust wages more than they do employment, potentially due to specific rigidities in the Portuguese labor market.

### **3.5 Conclusion**

This paper aimed at answering two questions. First, whether trade intensity affects business cycle comovement. Second, if the effect of trade intensity is different for import and export links.

Higher export intensity with one country is associated with higher correlation between the firm value added and that country's GDP, but the same is not true for imports. Firms importing from a given country tend to have higher correlation between their value added and the economic growth of that country, even when those imports are only a small share of its costs. Increasing the firm-level import exposure to a country does not seem to increase significantly the correlation between the firm's value added and the country's GDP.

Thus, we can divide the effects of trade in business cycle comovement in two different categories: the "Demand effect" and the "Production chain effect". The "Demand effect" occurs when a variation in GDP of an export destination affects directly the potential demand of the firm due to a reduction of exports. The more a firm is exposed to that market, the higher the correlation between its value added and the country's GDP. The "Production chain effect" is aligned with the literature on downstream propagation effects [see Carvalho et al. (2016)] in that a shock in one firm (or, in this case, a country) can affect another through the production line and the quality of intermediate inputs. In this case, the intensity with which a firm trades with one country loses relevance, since even an input that does not represent a large share of the total cost of the firm can affect the overall value added of the firms. Since business cycle transmission can occur even with low level of imports, a shock in one country can affect another one even when import intensity is low as long as enough firms in one country import from the other.

This has implications both for the understanding of how trade affects business cycle comovement and why firms that import are more productive than firms that do not [as stated in Muûls and Pisu (2009) and Castellani et al. (2010), among others]. By identifying that imported inputs have a high degree of complementarity with domestic inputs, we also helped finding an explanation for why importing firms are more productive than non importing firms: they have access to inputs that complement and enhance the productivity of locally sourced inputs. In a paper using the case study of trade liberalization in India, Topalova and Khandelwal (2011) reached a similar conclusion: access to a wider variety of imported intermediate inputs

bring productivity increases to firms.

We also concluded that the findings from di Giovanni et al. (2018b) are directly replicable in Portugal, with the coefficients associated with direct trade links showing the same signs and similar magnitude to those in the original analysis for France and confirmed that the indirect downstream effects are large and significant, while the direction of the upstream effects are less clear.

Finally, we quantified the effect of a trading partner's intensity adjusted GDP growth on firm's performance, concluding that one additional percentage point of growth in a firm's trade partners is linked to a 0.24 to 0.25 percentage point increase in a firm's value added. The effects on employment and wages are also statistically significant, especially when it comes to the production chain effects.

This paper has helped shed some light on why countries that trade have more synchronized business cycles, by identifying two mechanisms through which that happens. Nevertheless, understanding the implications of foreign shocks in the job market and the channels through which it occurs remains a promising avenue for future research.

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## Tables

**Table 3.1.** Summary statistics

| <b>Panel A: Total firms</b>             |           |                    |           |                |
|-----------------------------------------|-----------|--------------------|-----------|----------------|
|                                         | No. Firms | Value Added(Euro)  |           |                |
|                                         |           | Mean               | Median    | Share in total |
| All Firms                               | 2,852,722 | 255,983            | 24,831    | 1.00           |
| Importers                               | 104,786   | 1,239,370          | 140,488   | 0.74           |
| Exporters                               | 78,449    | 1,209,328          | 140,576   | 0.67           |
| Affiliates                              | 7,483     | 3,534,447          | 442,948   | 0.25           |
| <b>Panel B: Manufacturing firms</b>     |           |                    |           |                |
|                                         | No. Firms | Value Added (Euro) |           |                |
|                                         |           | Mean               | Median    | Share in total |
| All Firms                               | 175,407   | 548,202            | 69,453    | 1.00           |
| Importers                               | 17,831    | 1,617,829          | 364,263   | 0.88           |
| Exporters                               | 22,863    | 1,308,598          | 245,737   | 0.89           |
| Affiliates                              | 1,138     | 6,397,622          | 1,787,688 | 0.27           |
| <b>Panel C: Non-manufacturing firms</b> |           |                    |           |                |
|                                         | No. Firms | Value Added (Euro) |           |                |
|                                         |           | Mean               | Median    | Share in total |
| All Firms                               | 2,698,716 | 215,332            | 21,596    | 1.00           |
| Importers                               | 89,157    | 1,128,940          | 101,438   | 0.68           |
| Exporters                               | 57,576    | 1,172,524          | 105,355   | 0.59           |
| Affiliates                              | 6,696     | 2,995,452          | 334,915   | 0.24           |

Notes: This table reports the number of distinct firms, mean and median value added, and the share of total value added by category of firm for the 1997-2016 period (1996 is excluded as the data for that year is only used to calculate 1997 growth rates). The categories of firms are not mutually exclusive since some firms are categorized as manufacturing in some years and non-manufacturing in other.

**Table 3.2.** Firm exposure to each country (1996-2016)

|                | <b>Imports</b> |       |       | <b>Exports</b> |       |       |
|----------------|----------------|-------|-------|----------------|-------|-------|
|                | Average        | > 50% | < 10% | Average        | > 50% | < 10% |
| Angola         | 2%             | 1%    | 96%   | 11%            | 8%    | 76%   |
| Belgium        | 5%             | 2%    | 88%   | 5%             | 2%    | 87%   |
| China          | 2%             | 1%    | 95%   | 4%             | 1%    | 92%   |
| France         | 7%             | 3%    | 83%   | 18%            | 12%   | 59%   |
| Germany        | 8%             | 4%    | 78%   | 13%            | 8%    | 70%   |
| Italy          | 10%            | 4%    | 73%   | 7%             | 3%    | 83%   |
| Netherlands    | 7%             | 3%    | 81%   | 8%             | 4%    | 81%   |
| Spain          | 17%            | 9%    | 55%   | 19%            | 12%   | 54%   |
| United Kingdom | 4%             | 1%    | 88%   | 11%            | 6%    | 73%   |
| United States  | 3%             | 1%    | 92%   | 7%             | 3%    | 81%   |

Notes: This table reports the weight of imports (exports) from a country in the firm's production costs (sales). The first column under imports (exports) reports the average weight of imports (exports) from (to) that country in the total production costs (sales) of firms importing (exporting) to that country. The second column reports the percentage of firms importing (exporting) from (to) that country whose total imports (exports) represent more than 50% of total production costs (sales). The third column is similar to the second, but represents the % of firms importing (exporting) less than 10% of total production costs (sales).

**Table 3.4.** Estimation results: Direct and indirect effects on correlation

|                                            | (1)                 | (2)                 |
|--------------------------------------------|---------------------|---------------------|
| Dep. Var: $\rho(\gamma_{ft}, \gamma_{Ct})$ |                     |                     |
| Importer                                   | 0.011***<br>(0.002) | 0.007***<br>(0.001) |
| Exporter                                   | 0.007***<br>(0.002) | 0.009***<br>(0.002) |
| Affiliate of foreign MNE                   | -0.007<br>(0.005)   | -0.008*<br>(0.004)  |
| $DS_{fjc}$                                 | 0.483***<br>(0.028) | 0.131***<br>(0.038) |
| $US_{fjc}$                                 | 0.023**<br>(0.009)  | -0.051**<br>(0.020) |
| Observations                               | 2999342             | 2999332             |
| Adjusted $R^2$                             | 0.493               | 0.495               |
| Firm FE                                    | Yes                 | Yes                 |
| Country FE                                 | Yes                 | No                  |
| Country $\times$ Sector FE                 | No                  | Yes                 |
| # of Xing links                            | 82,035              | 82,028              |
| # of Ming links                            | 142,022             | 142,013             |
| # of HQ links                              | 4,028               | 4,028               |
| # of Firm FEs                              | 299,943             | 299,942             |
| # of Country FEs                           | 10                  |                     |
| # of Country $\times$ Sector FEs           |                     | 803                 |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table reports the results of estimating Equation 3.10, including indirect effects.

**Table 3.5.** Estimation results: Direct and indirect effects on correlation, with trade intensity

|                                            | (1)                 | (2)                 | (3)                 | (4)                  | (5)                 | (6)                 |
|--------------------------------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
| Dep. Var: $\rho(\gamma_{ft}, \gamma_{Ct})$ |                     |                     |                     |                      |                     |                     |
| Import intensity                           | 0.007<br>(0.009)    | 0.003<br>(0.009)    | 0.004<br>(0.009)    | 0.076***<br>(0.021)  | -0.016*<br>(0.009)  | 0.009<br>(0.009)    |
| Export intensity                           | 0.066***<br>(0.011) | 0.059***<br>(0.011) | 0.060***<br>(0.011) | 0.091***<br>(0.027)  | 0.049***<br>(0.011) | 0.055***<br>(0.011) |
| Square of import intensity                 |                     |                     |                     | -0.120***<br>(0.035) |                     |                     |
| Square of export intensity                 |                     |                     |                     | -0.041<br>(0.042)    |                     |                     |
| Importer                                   |                     |                     |                     |                      | 0.011***<br>(0.002) |                     |
| Exporter                                   |                     |                     |                     |                      | 0.005**<br>(0.002)  |                     |
| $DS_{fjc}$                                 |                     | 0.494***<br>(0.027) | 0.494***<br>(0.027) |                      | 0.482***<br>(0.027) | 0.144***<br>(0.038) |
| $US_{fjc}$                                 |                     | 0.025***<br>(0.009) | 0.025***<br>(0.009) |                      | 0.024***<br>(0.009) | -0.041**<br>(0.019) |
| Affiliate of foreign MNE                   |                     |                     | -0.006<br>(0.005)   |                      | -0.007<br>(0.005)   | -0.008*<br>(0.005)  |
| Observations                               | 3,023,820           | 2,999,342           | 2,999,342           | 3,023,820            | 2,999,342           | 2,999,332           |
| Adjusted $R^2$                             | 0.493               | 0.493               | 0.493               | 0.493                | 0.493               | 0.495               |
| Firm FE                                    | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | Yes                 |
| Country FE                                 | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | No                  |
| # of Country FEs                           | 10                  | 10                  | 10                  | 10                   | 10                  |                     |
| # of Country $\times$ Sector FEs           |                     |                     |                     |                      |                     | 830                 |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table reports the results of estimating Equation 3.11 for the whole economy.

**Table 3.6.** Estimation results: weighted average growth rate of trade partners - direct effects

| Dependent variable      | Value added        | Sales              | Total emp          | FT emp             | Wages              |
|-------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| GDPg - Import countries | 0.239***<br>-0.065 | 0.332***<br>-0.056 | 0.462***<br>-0.032 | 0.505***<br>-0.039 | 0.600***<br>-0.05  |
| GDPg - Export countries | 0.246***<br>-0.062 | 0.113*<br>-0.061   | 0.102***<br>-0.027 | 0.130***<br>-0.034 | 0.282***<br>-0.045 |
| Observations            | 2,620,925          | 2,879,605          | 3,549,803          | 2,764,465          | 2,837,849          |
| Adjusted $R^2$          | 0.037              | 0.085              | 0.013              | 0.014              | 0.085              |
| Firm FE                 | Yes                | Yes                | Yes                | Yes                | Yes                |
| Control for size        | Emp                | Emp                | Sales              | Sales              | Sales              |
| # of firm FEs           | 409,254            | 415,996            | 509,288            | 406,089            | 399,847            |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. Includes year fixed effects. This table reports the results of estimating Equation 3.14 for the whole economy. Excludes observations from single proprietor firms (2,061,548 firms in the period considered), firms with only one observation (117,045 firms) and those firms that do not have observations within the defined bounds of growth rates (-50% and +100%) for the dependent variables (between 164,841 for total employees and 274,282 for wages) .

## Appendix

Table A1: Correlation for directly connected and not directly connected firms

| Country        | Directly connected |          |                                  | Not Directly Connected |          |                                  |
|----------------|--------------------|----------|----------------------------------|------------------------|----------|----------------------------------|
|                | No. Firms          | Combined | Mean                             | No. Firms              | Combined | Mean                             |
|                |                    | share    | $\rho(\gamma_{ft}, \gamma_{Ct})$ |                        | share    | $\rho(\gamma_{ft}, \gamma_{Ct})$ |
| Angola         | 28,428             | 0.46     | 0.09                             | 402,977                | 0.54     | 0.07                             |
| Belgium        | 13,824             | 0.52     | 0.09                             | 417,581                | 0.48     | 0.05                             |
| China          | 21,987             | 0.54     | 0.07                             | 409,418                | 0.46     | 0.07                             |
| France         | 23,194             | 0.64     | 0.09                             | 408,211                | 0.36     | 0.03                             |
| Germany        | 20,985             | 0.62     | 0.06                             | 410,420                | 0.38     | 0.01                             |
| Italy          | 21,227             | 0.59     | 0.10                             | 410,178                | 0.41     | 0.05                             |
| Netherlands    | 16,925             | 0.58     | 0.11                             | 414,480                | 0.42     | 0.06                             |
| Spain          | 34,492             | 0.69     | 0.11                             | 396,913                | 0.31     | 0.08                             |
| United Kingdom | 17,458             | 0.60     | 0.08                             | 413,947                | 0.40     | 0.04                             |
| United States  | 26,135             | 0.65     | 0.06                             | 405,270                | 0.35     | 0.03                             |
| Average        | 22,466             | 0.59     | 0.08                             | 408,940                | 0.41     | 0.05                             |

Notes: This table reports the features of directly connected and not directly connected firms for each partner country. The columns report the number of firms, their combined share in aggregate value added (averaged across years), and the mean correlation between firm value added growth and the foreign country's GDP growth.

Table A2 - Directly connected firms: by connection type

| Country        | Exporters |                |                                       | Importers |                |                                       | Affiliates of multinationals |                |                                       |
|----------------|-----------|----------------|---------------------------------------|-----------|----------------|---------------------------------------|------------------------------|----------------|---------------------------------------|
|                | No. Firms | Combined share | Mean $\rho(\gamma_{ft}, \gamma_{ct})$ | No. Firms | Combined share | Mean $\rho(\gamma_{ft}, \gamma_{ct})$ | No. Firms                    | Combined share | Mean $\rho(\gamma_{ft}, \gamma_{ct})$ |
| Angola         | 28,298    | 0.447          | 0.089                                 | 1,109     | 0.141          | 0.101                                 | 20                           | 0.000          | 0.101                                 |
| Belgium        | 5,759     | 0.282          | 0.096                                 | 10,749    | 0.495          | 0.097                                 | 106                          | 0.003          | 0.052                                 |
| China          | 4,000     | 0.240          | 0.035                                 | 20,496    | 0.517          | 0.067                                 | 25                           | 0.001          | 0.112                                 |
| France         | 9,858     | 0.373          | 0.101                                 | 18,136    | 0.611          | 0.090                                 | 1,179                        | 0.059          | 0.065                                 |
| Germany        | 7,429     | 0.340          | 0.081                                 | 17,925    | 0.607          | 0.056                                 | 446                          | 0.037          | 0.080                                 |
| Italy          | 6,339     | 0.296          | 0.108                                 | 19,041    | 0.580          | 0.098                                 | 241                          | 0.005          | 0.078                                 |
| Netherlands    | 6,257     | 0.289          | 0.106                                 | 13,833    | 0.554          | 0.110                                 | 207                          | 0.008          | 0.069                                 |
| Spain          | 12,726    | 0.422          | 0.100                                 | 29,814    | 0.671          | 0.117                                 | 1,495                        | 0.040          | 0.112                                 |
| United Kingdom | 7,021     | 0.349          | 0.097                                 | 13,847    | 0.579          | 0.081                                 | 418                          | 0.020          | 0.062                                 |
| United States  | 9,263     | 0.430          | 0.080                                 | 21,830    | 0.621          | 0.062                                 | 627                          | 0.039          | 0.038                                 |
| Average        | 9,695     | 0.347          | 0.089                                 | 16,678    | 0.538          | 0.088                                 | 476                          | 0.021          | 0.077                                 |

Notes: This table reports the features of different types of directly connected firms. The columns report the number of firms, their combined share in aggregate value added (average across years), and the mean correlation between firm value added growth and the foreign country's GDP growth.

Table A3 - Robustness test for Table 3.5 with controls for Sector×Country and Sector×Region

|                                            | (1)                 | (2)                 | (3)                 | (4)                  | (5)                 | (6)                 |
|--------------------------------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
| Dep. Var: $\rho(\gamma_{ft}, \gamma_{ct})$ |                     |                     |                     |                      |                     |                     |
| Import intensity                           | 0.007<br>(0.009)    | 0.008<br>(0.009)    | 0.010<br>(0.009)    | 0.065***<br>(0.020)  | -0.001<br>(0.009)   | 0.010<br>(0.009)    |
| Export intensity                           | 0.057***<br>(0.011) | 0.056***<br>(0.011) | 0.057***<br>(0.011) | 0.065**<br>(0.025)   | 0.045***<br>(0.011) | 0.057***<br>(0.011) |
| Square of import intensity                 |                     |                     |                     | -0.100***<br>(0.033) |                     |                     |
| Square of export intensity                 |                     |                     |                     | -0.011<br>(0.040)    |                     |                     |
| Importer                                   |                     |                     |                     |                      | 0.006***<br>(0.002) |                     |
| Exporter                                   |                     |                     |                     |                      | 0.007***<br>(0.002) |                     |
| $DS_{fjc}$                                 |                     | 0.148***<br>(0.038) | 0.148***<br>(0.038) |                      | 0.142***<br>(0.038) | 0.148***<br>(0.038) |
| $US_{fjc}$                                 |                     | -0.037*<br>(0.019)  | -0.037*<br>(0.019)  |                      | -0.039**<br>(0.019) | -0.037*<br>(0.019)  |
| Affiliate of foreign MNE                   |                     |                     | -0.008*<br>(0.005)  |                      | -0.009*<br>(0.005)  | -0.008*<br>(0.005)  |
| Observations                               | 3,023,820           | 2,999,332           | 2,999,332           | 3,023,820            | 2,999,332           | 2,999,332           |
| Adjusted $R^2$                             | 0.495               | 0.496               | 0.496               | 0.495                | 0.496               | 0.496               |
| Firm FE                                    | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | Yes                 |
| Country FE                                 | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | No                  |
| # of Country FEs                           |                     |                     |                     |                      |                     |                     |
| # Country×Region FEs                       | 80                  | 80                  | 80                  | 80                   | 80                  | 80                  |
| # of Country×Sector FEs                    | 830                 | 830                 | 830                 | 830                  | 830                 | 830                 |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table replicates the analysis in Table 3.5 while assuming Country×Region and Country×Sector fixed effects for all specifications. Country fixed effects are eliminated due to redundancy.

Table A4 - Robustness test for Table 3.5 with data only after 2004

|                                            | (1)                 | (2)                 | (3)                 | (4)                  | (5)                 | (6)                 |
|--------------------------------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
| Dep. Var: $\rho(\gamma_{ft}, \gamma_{Ct})$ |                     |                     |                     |                      |                     |                     |
| Import intensity                           | 0.006<br>(0.009)    | 0.006<br>(0.009)    | 0.008<br>(0.009)    | 0.060***<br>(0.020)  | 0.004<br>(0.009)    | 0.008<br>(0.009)    |
| Export intensity                           | 0.052***<br>(0.011) | 0.053***<br>(0.011) | 0.053***<br>(0.011) | 0.060**<br>(0.025)   | 0.036***<br>(0.011) | 0.053***<br>(0.011) |
| Square of import intensity                 |                     |                     |                     | -0.095***<br>(0.033) |                     |                     |
| Square of export intensity                 |                     |                     |                     | -0.014<br>(0.039)    |                     |                     |
| Importer                                   |                     |                     |                     |                      | 0.001<br>(0.002)    |                     |
| Exporter                                   |                     |                     |                     |                      | 0.011***<br>(0.002) |                     |
| $DS_{f,j,c}$                               |                     | 0.167***<br>(0.038) | 0.167***<br>(0.038) |                      | 0.167***<br>(0.038) | 0.167***<br>(0.038) |
| $US_{f,j,c}$                               |                     | -0.007<br>(0.021)   | -0.007<br>(0.021)   |                      | -0.011<br>(0.021)   | -0.007<br>(0.021)   |
| Affiliate of foreign MNE                   |                     |                     | -0.010**<br>(0.005) |                      | -0.010**<br>(0.005) | -0.010**<br>(0.005) |
| Observations                               | 2,984,440           | 2,959,222           | 2,959,222           | 2,984,440            | 2,959,222           | 2,959,222           |
| Adjusted $R^2$                             | 0.505               | 0.505               | 0.505               | 0.505                | 0.505               | 0.505               |
| Firm FE                                    | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | Yes                 |
| Country FE                                 | Yes                 | Yes                 | Yes                 | Yes                  | Yes                 | No                  |
| # of Country FEs                           | 10                  | 10                  | 10                  | 10                   | 10                  |                     |
| # of Country $\times$ Sector FEs           |                     |                     |                     |                      |                     | 830                 |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table replicates the analysis in Table 3.5 while using data only after 2004, the year in which the database changed to include more smaller firms.

Table A5 - Robustness test for Table 3.5 with presample intensities (1996)

|                                            | (1)                 | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
|--------------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Dep. Var: $\rho(\gamma_{ft}, \gamma_{Ct})$ |                     |                     |                     |                     |                     |                     |
| Import intensity                           | -0.001<br>(0.011)   | -0.001<br>(0.011)   | -0.001<br>(0.011)   | 0.012<br>(0.024)    | -0.019*<br>(0.011)  | -0.001<br>(0.011)   |
| Export intensity                           | 0.066***<br>(0.012) | 0.061***<br>(0.012) | 0.061***<br>(0.012) | 0.132***<br>(0.028) | 0.044***<br>(0.012) | 0.047***<br>(0.012) |
| Square of import intensity                 |                     |                     |                     | -0.020<br>(0.041)   |                     |                     |
| Square of export intensity                 |                     |                     |                     | -0.109**<br>(0.044) |                     |                     |
| Importer                                   |                     |                     |                     |                     | 0.013***<br>(0.002) |                     |
| Exporter                                   |                     |                     |                     |                     | 0.009***<br>(0.002) |                     |
| $DS_{fjc}$                                 |                     | 0.339***<br>(0.066) | 0.339***<br>(0.066) |                     | 0.269***<br>(0.067) | -0.040<br>(0.092)   |
| $US_{fjc}$                                 |                     | 0.031*<br>(0.019)   | 0.031*<br>(0.019)   |                     | 0.023<br>(0.019)    | 0.028<br>(0.030)    |
| Affiliate of foreign MNE                   |                     |                     | -0.003<br>(0.006)   |                     | -0.004<br>(0.006)   | -0.006<br>(0.006)   |
| Observations                               | 276,320             | 273,856             | 273,856             | 276,320             | 273,856             | 273,846             |
| Adjusted $R^2$                             | 0.510               | 0.510               | 0.510               | 0.510               | 0.510               | 0.516               |
| Firm FE                                    | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Country FE                                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 | No                  |
| # of Country FEs                           | 10                  | 10                  | 10                  | 10                  | 10                  |                     |
| # of Country $\times$ Sector FEs           |                     |                     |                     |                     |                     | 830                 |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table replicates the analysis in Table 3.5 but taking into account presample import and export intensities, thus decreasing the number of observations.

Table A6 - Robustness tests for Table 3.6 - No fixed effects

| Dependent variable      | Value added         | Sales               | Total emp           | FT emp              | Wages               |
|-------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| GDPg - Import countries | 0.548***<br>(0.050) | 0.798***<br>(0.047) | 0.542***<br>(0.026) | 0.570***<br>(0.031) | 0.904***<br>(0.041) |
| GDPg - Export countries | 0.416***<br>(0.046) | 0.495***<br>(0.044) | 0.155***<br>(0.021) | 0.175***<br>(0.026) | 0.344***<br>(0.036) |
| Observations            | 2,737,959           | 2,978,584           | 3,658,984           | 2,860,537           | 2,929,371           |
| Adjusted $R^2$          | 0.011               | 0.023               | 0.008               | 0.009               | 0.018               |
| Firm FE                 | No                  | No                  | No                  | No                  | No                  |
| Control for size        | Emp                 | Emp                 | Sales               | Sales               | Sales               |
| # of firm FEs           | 0                   | 0                   | 0                   | 0                   | 0                   |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table replicates the analysis in Table 3.6 without considering firm fixed effects.

Table A7 - Robustness tests for Table 3.6 - 3 years rolling average for trade weights

| Dependent variable      | Value added         | Sales               | Total emp           | FT emp              | Wages               |
|-------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| GDPg - Import countries | 0.151**<br>(0.070)  | 0.136**<br>(0.059)  | 0.420***<br>(0.036) | 0.417***<br>(0.042) | 0.357***<br>(0.053) |
| GDPg - Export countries | 0.349***<br>(0.068) | 0.307***<br>(0.065) | 0.115***<br>(0.031) | 0.125***<br>(0.037) | 0.274***<br>(0.050) |
| Observations            | 2,485,080           | 2,854,941           | 3,330,794           | 2,696,172           | 2,767,049           |
| Adjusted $R^2$          | 0.038               | 0.085               | 0.008               | 0.014               | 0.085               |
| Firm FE                 | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Control for size        | Emp                 | Emp                 | Sales               | Sales               | Sales               |
| # of firm FEs           | 393,030             | 413,846             | 496,452             | 400,289             | 393,863             |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table replicates the analysis in Table 3.6 assuming 3 years rolling average for trade weights instead of the year in question for variables *GDPg*.

Table A8 - Robustness tests for Table 3.6 - Presample weights

| Dependent variable      | Value added         | Sales               | Total emp          | FT emp            | Wages              |
|-------------------------|---------------------|---------------------|--------------------|-------------------|--------------------|
| GDPg - Import countries | 0.405*<br>(0.211)   | 0.633***<br>(0.188) | 0.274**<br>(0.109) | 0.228*<br>(0.117) | 0.319**<br>(0.143) |
| GDPg - Export countries | 0.653***<br>(0.164) | 0.617***<br>(0.160) | 0.154<br>(0.099)   | 0.175*<br>(0.105) | 0.089<br>(0.115)   |
| Observations            | 39,694              | 40,367              | 43,427             | 41,590            | 41,752             |
| Adjusted $R^2$          | 0.041               | 0.108               | 0.086              | 0.091             | 0.125              |
| Firm FE                 | Yes                 | Yes                 | Yes                | Yes               | Yes                |
| Control for size        | Emp                 | Emp                 | Sales              | Sales             | Sales              |
| # of firm FEs           | 3118                | 3082                | 3188               | 3142              | 3137               |

Notes: Standard errors clustered at the firm level. \* \* \*: significant at the 1% level; \*\*: significant at the 5% level; \*: significant at the 10% level. This table replicates the analysis in Table 3.6 assuming presample import and export weights.