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The Role of Global Value Chains during the Crisis: Evidence from Spanish and European Firms

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The Role of Global Value Chains during the Crisis: Evidence from Spanish and European Firms*

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Abstract

This paper analyzes the role that global value chains (GVC) have played during the sovereign debt crisis in Europe, and the key policy challenges that Spain faces. First, we provide a comparative analysis of the export performance and FDI activities of Spanish firms, using the firm-level information of the EFIGE dataset. Then, we use input-output tables from the WIOD database to identify the industries whose participation in GVCs should be promoted since they retain a larger share of domestic value added. Finally, we analyze the capacity of GVCs to amplify or act as built-in stabilizers following economic downturns. To do so, we compute the first round impact on Spanish gross exports and domestic value added of a 10% increase in final demand in selected areas of the world. Spain's gross exports would be worth 2.28% of GDP while the domestic value added from export would grow by 2.34%, which suggests that GVCs act as stabilizers since the promote more the domestic value added components.

KEYWORDS: Global value chains, FDI, exports, Great Recession
JEL CODES: F14, F17, F44

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1 Introduction

The recent economic crisis in Spain began as part of the global financial crisis and continued as part of the European sovereign debt crisis, which has affected primarily the southern European states and Ireland. On top of the economic and financial crisis, the world experienced a contraction in global trade between the third quarter of 2008 and the second quarter of 2009 that is now known as the "Great Trade Collapse". The severity of this drop in international trade, driven by the fall in internal demand around the globe, caused European trade volumes to fall abruptly to 2006 levels.

The "Great Trade Collapse" while extremely strong was also short-lived in comparison with the sovereign debt crisis in Europe. International trade started to grow again as early as 2010 and by 2011 trade volume had returned to the levels before the collapse. However, in most of Europe the recession lasted much longer. In countries like France and the United Kingdom the recession formally ended in the last quarter of 2012, while Spain and Italy did not exit the recession until the end of 2013. The aim of this paper is to shed light on the role of international trade and, in particular, the international fragmentation of production in the economic recovery of Spain and several other European countries.

The fragmentation of production is not a novel phenomena. Firms have been producing items with components sourced from around the globe for centuries. What has changed, however, is the speed, scale, depth and the extent of global interactions. Increasingly, new players have become active in what have come to be called Global Value Chains or global supply chains (GVCs). Decomposing gross trade flows in value added contributions, and mapping out how and where production activities are carried out, allows a much more accurate picture of the "real" integration of an economy with the rest of the world, provides an enhanced understanding of its implications, and leads to a better identification of barriers and bottlenecks.

The study of GVCs is also changing the way we think about some pressing policy issues. Firstly, it forces us to rethink the concept of competitiveness. Rather than the mere capacity to export goods, competitiveness should be understood as the capacity of an economy to capture income or value added from the ever more internationally fragmented production processes. Second, it is important to understand whether global supply chains amplify the trade decline following economic downturns, or whether the fixed costs of establishing production linkages and the existence of long term contracts associated with supply chains act as built-in stabilizers. Altomonte et al. (2012) document the "bullwhip

effect" of trade elasticities due to the adjustment of inventories of intermediate goods within supply chains in France and point out the necessity to understand the drivers behind exporting and foreign direct investment (FDI) by firms. Finally, the study of GVCs allows us to identify the real value that the different industries add to production (and exports), opening up new perspectives on specialization and comparative advantages.

We address each of these issues in turn, and compare Spain with the four largest economies in Europe: France, Germany, Italy and United Kingdom. We start by analyzing the recent evolution of the unit labor costs in these five countries and the connection between this standard measure of competitiveness and the export performance of these countries during the crisis.

Afterwards, we document some of the basic stylized facts related to trade, innovation and firm size using the firm-level information contained in the EFIGE dataset. This database combines measures of firms international activities with quantitative and qualitative information on items ranging from R&D and innovation, labor organisation, financing and pricing behavior. The objective of this comparative analysis is twofold: explain the factors that account for the resilience of Spanish exports during the crisis and identify the barriers that might limit the growth potential of exports in the near future. In line with most of the previous research, this analysis highlights the importance of the strong prevalence of small firms and the relatively low investment in R&D.

Finally, in a last step we use the input-output tables from the WIOD database to identify the segments of participation in GVCs that should be promoted if Spain wants to exploit the full potential gains from international trade. Our analysis uses two different criteria to select the most attractive segments: industries that retain a relatively large share of domestic value added and the industries in which Spain has a value added comparative advantage but not a gross exports comparative advantage.

The size distribution of firms is a classical argument for the cross country heterogeneity in firms' performance.[1] Our analysis reveals that Spain has a smaller number of large firms than the reference countries, but these large firms (more than 250 employees) were less affected by the financial crisis of 2008 than their European counterparts. Among these large firms, 89% either export or perform FDI or both. This suggest that Spanish international firms are competitive and that being an internationalized firm is key to overcome negative shocks.

[1] See Melitz (2003), Helpman et al. (2004) or Crespo (2012) among others.

A detailed analysis of firms' activities, reveals that Spanish firms perceive exporting and FDI to be more complex than their European counterparts — they reach fewer markets, their export intensity is smaller and there are less firms performing there. The most relevant factors for exporting are size, age, belonging to a group and being foreign owned. While the most relevant factor for FDI is being an exporter previously, at least 80% of the firms that perform FDI are also exporters in all the countries.

Next, we use the framework proposed by Koopman et al. (2014) in order to trace out the domestic value added embedded into the gross exports. Koopman's methodology is an accounting equivalence between a country's gross exports and the value added components by source, where the three main terms are: domestic value added content, foreign value added content, double-counted items' value added. Wang et al. (2013) has extended this methodology to decompose gross trade flows at the sector level. To our knowledge, while there have been attempts at measuring the domestic value added content of exports of some European countries (Cappariello and Felettigh (2014) for Italy and Amador and Stehrer (2014) for Portugal) we are the first ones to do so for Spain, both at the aggregate and at the sectorial level.

An initial first glance at the decomposition for all countries reveals two interesting patterns. First, the share of non-direct exports, that is the GVC component, has been rising the past decade in all countries confirming the importance that the international fragmentation of production now has. Second, the share of domestic value added (DVA) embodied in gross exports is counter cyclical, and thus the change in gross exports is not a sufficient statistic in order to determine the exports contribution to GDP growth, despite it being a usual assumption in business cycle analysis.

We then turn our focus to the Spanish economy. The foreign value added (FVA) at the industry level is a proxy for the extent to which industry value chains are segmented into distinct tasks and activities that generate trade, compounding the double counting effect. This along with a revised notion of a country-sector's revealed comparative advantage based on DVA in gross exports allows us to identify what are the key industries. *Chemical products* and *basic metals* are revealed as sectors in which we have comparative advantage with respect to the world, along with *textile products* which is the sector we rely on in times of crisis. Finally, the *refined petroleum* industry stands out by its fostering the domestic value added in the exports in the last decade despite it being the industry with a largest content in foreign value added.

Although these results give some indication of the barriers to growth that Spanish

firms face in comparison to the rest of the European countries considered and which are the industries we should promote, it does not say anything about the role that GVCs play in the propagation or relief to shocks. To quantify whether the increased participation in GVCs palliated the effects of the domestic crisis in Spain after the financial crisis from 2009, we compute the impact (first-round effect only) on Spanish gross exports and domestic value added when there is a 10% increase in final demand in selected areas of the world. We find that Spain's gross exports would be worth 2.281% of GDP while the domestic value added from export would grow by 2.337%. The analysis by areas shows the dependence of Spain on the final demand coming from inside the EU15, and particularly from France and Germany who represent half of the increase in exports. At the same time, it reveals a very small impact from increased internal demand in the rest of the European countries. Finally, it is worth noticing the impact of an increase in the final demand in areas like Asia, these countries are rapidly gaining terrain in the worlds gross export and have the highest domestic value added activation ratio for Spanish exports.

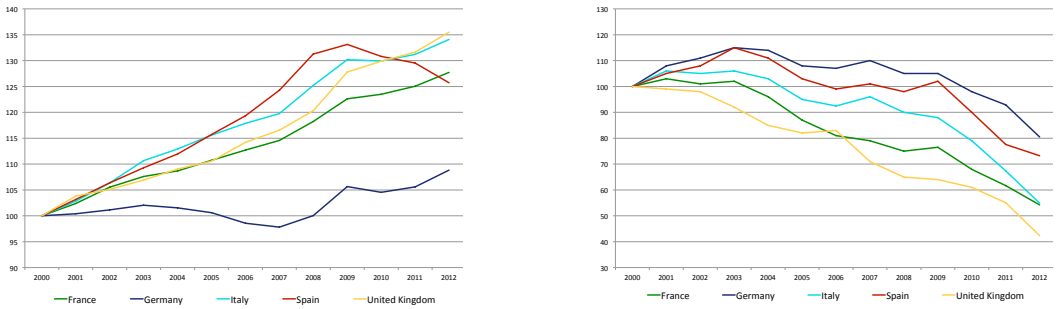
The rest of the paper is organized as follows. Section 2 presents the main stylised facts for the five European countries under study. Section 3 analyses the differences between Spanish and European firms. Section 4 maps out the economic relations that underlie Spanish trade with the rest of the world. In Section 5, we estimate the impact on Spanish GDP of a positive shock on foreign demand. Section 6 concludes.

2 Internationalization and firm competitiveness

The recent crisis has reopened the debate about the lack of competitiveness of the Spanish economy. The most widely-used measure of competitiveness in the European Union is the evolution of unit labor costs (ULC). The unit labor cost is a macroeconomic aggregate that measures the labor cost per unit of product and is calculated as the ratio of total labor costs to real output. A rise in labor costs higher than the rise in labor productivity may be a threat to an economy's cost competitiveness if other costs are not adjusted in compensation.

Inspection of the data reveals, however, that a simple comparison of the evolution of prices and costs between two countries may not be informative enough to determine the competitiveness of a country. If an increase in the ULC index indicates a loss in competitiveness of the country, then we should see a decrease in a country's export shares whenever aggregate ULC goes up. Figure 1 shows the so-called *Spanish competitiveness*

paradox, an example of the fact that a loss in competitiveness does not imply necessarily a loss in the world's export shares. Figure 1a shows the evolution of the ULC for Spain and the main developed economies, while Figure 1b shows the evolution of these countries world' export share during the 2000's. The Spanish ULC index has grown faster than that of our main trading partners in the period between 2000 and the start of the crisis, but its export shares have decreased less than those of the other countries, the only exception being Germany. After 2009, the ULC experimented a remarked improvement in Spain while the world' export share of all countrie decreased in favor of new players like China.



(a) Unit Labor Cost (ECB)

(b) Market Share Index (WTO)

Figure 1: Competitiveness Indicators Vis-á-Vis the Euro Area

Antràs et al. (2010) show that large Spanish firms experienced both lower ULC growth and higher export growth than their counterparts in other countries, yet this differential is not reflected in aggregate price indicators due to aggregation and dispersion bias (Altomonte et al. (2011)). In the calculation of the ULC all the firms are taken into account while to calculate the economy's total exports, only the exporters are taken into account. The different relative weights of firms in the aggregate ULC and in the economy's total exports, helps therefore to explain the Spanish paradox.

Recent literature in industrial organization and international trade has provided abundant empirical evidence (di Giovanni and Levchenko (2009) and Bernard et al. (2011)) supporting the idea that the evolution of macroeconomic aggregates is determined closely by the decisions and characteristics of the firms in the economy. For example, Crespo and Segura-Cayuela (2013) show that the evolution of the aggregate ULC is driven by the reallocation of resources within the firms of an economy, and point out the necessity of understanding the role of firms and their heterogeneity, in particular a subgroup of them:

the internationalized ones. Internationalized firms from a sector or a country, those that either export, import, are outsourcers or perform FDI, are a minority and in general those that behave better in terms of productivity, size and innovation (Altomonte et al. (2012) and Rubini et al. (2012)). The higher performance is present before these firms start any international activities (Clerides et al. (1998) and Bernard and Bradford Jensen (1999)).

Porter (1990) defines the competitiveness of a nation as the productivity with which a nation utilizes its human, capital and natural resources, while Krugman (1994) refers to competitiveness as a poetic way of speaking about productivity. Most of the definitions of competitiveness allude to the productivity of firms. Thus, in this section we analyze the differences in firm size distribution among the European countries and the importance that the size and the international status of a firm[2] have on productivity using the EFIGE dataset. The EFIGE data[3] consist of a representative sample at the country level for the manufacturing industry of firms owning establishments with more than ten employees in several European economies, although we will focus only on[4]: France, Germany, Italy, Spain and United Kingdom. The database combines measures of firms' international activities (e.g. exports, outsourcing, FDI, import) as well as quantitative and qualitative information on around 150 items ranging from R&D and innovation, labor organization, financing and organizational activities to balance sheet data of the firm.[5]

2.1 Size and Internationalization

Figure 2 depicts the firm size distributions in France, Germany, Italy, Spain and United Kingdom. The vertical axis shows the proportion of firms (in natural logs) that is larger than the firm size (also in natural logs) represented on the horizontal axis. At first sight, the number of large firms is comparatively low in Italy and Spain than in Germany, France and United Kingdom. In particular, the share of firms with more than 250 employees is 4.8 % in Italy and 5.2% in Spain, compared to 11% in Germany.

[2]Participation of firm in different international activities like exporting, FDI or outsourcing.

[3]The database was collected by the European Firms in a Global Economy (EFIGE) project, whose objective was to examine the pattern of internationalization of European firms. Visit www.efige.org, for more information on the project.

[4]The sample includes as well Austria and Hungary, however due to missing information in several key variables, we do not include them in the analysis.

[5]Altomonte and Aquilante (2012) provides more information on the construction of the dataset and a comprehensive set of validation measures that have been used to assess the comparability of the survey data with official statistics.

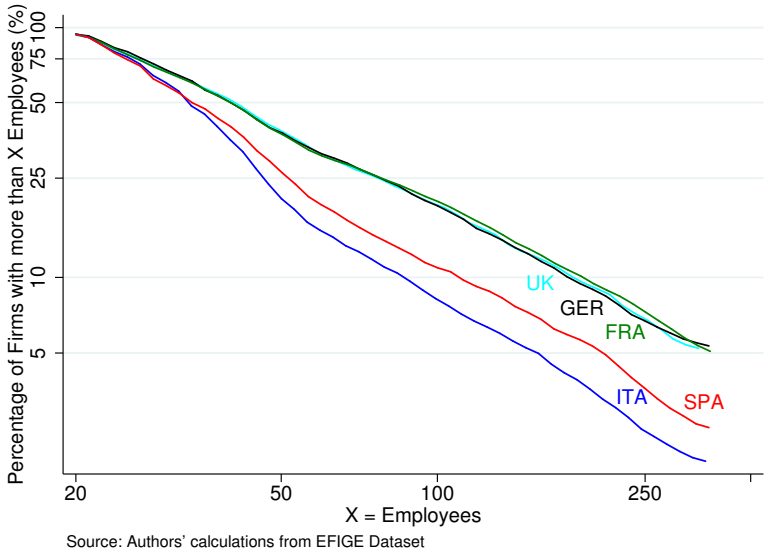
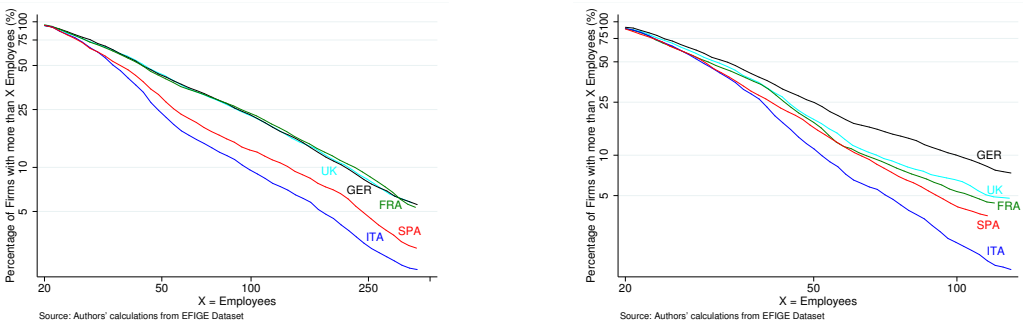


Figure 2: Firm Size Distribution (log-log, axes normal scale)

Figure 3a and Figure 3b present the same data, but now separating internationalized[6] firms from non-internationalized. While the internationalized firm follow the same pattern as shown in Figure 2, the differences between Italy and Spain and the other countries disappear for non-internationalized firms. This suggest that international trade is key for understanding the differences in the firm size distributions in different countries.



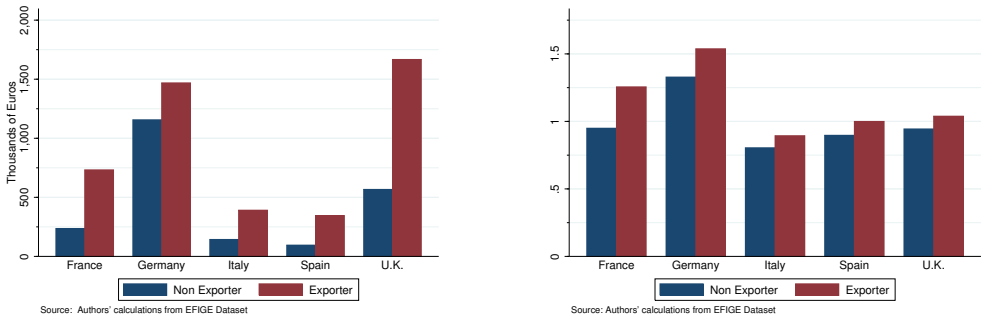
(a) Internationalized

(b) Non Internationalized

Figure 3: Firm Size Distribution Internationalized (log-log, axes normal scale)

[6]Internationalized firms include all firms that either exporter or importer of services or materials, are outsourcers (passsive or active) or/and perform FDI activites.

Internationalized firms are more productive and more profitable than non-internationalized firms (Altomonte et al. (2012), Rubini et al. (2012)). Figure 4a and Figure 4b document these same stylised facts. Figure 4a shows the average profits in thousands of euros for internationalized and non-internationalized firms by country.[7] In all countries, international firms have higher average profits than non intenationalized firms. The quality of the Amadeus data varies across countries[8], which explain the relatively high reported profits of both Germany and UK for which larger firms are over represented in this exercise. Figure 4b plots the total factor productivity (TFP)[9] for internationalized and non-internationalized firms by country. As expected, internationalized firms are, on average, more productive than non-internationalized firms in all countries, the gap being 8.6% in Spain.



(a) Profit

(b) TFP

Figure 4: Internationalized vs. non Internationalized

2.2 Econometric evidence

The relationships between firm competitiveness and internationalization activities can be further investigated by a cross-section econometric estimation, in which we regress the TFP of each firm, as measured in 2008, against the different categories of internationalization activities, adding country and sector fixed effects. In this way we can confirm our findings

[7] We use the Amadeus dataset, published by Bureau van Dijk, which mainly reports balance sheet data, to complement the EFIGE survey data.

[8] The coverage of the EFIGE firms within the Amadeus dataset was 92% for France, 28.5% for Germany, 94% for Italy, 88% for Spain and 22.3%

[9] TFP has been computed by Altomonte et al. (2011) using the EFIGE data

by excluding possible composition effects.

$$TFP = \beta_0 + \beta_1 Internationalactivities + \beta_2 Firmsize + \delta_1 Country + \delta_2 Sector + \epsilon \quad (1)$$

Table 1 shows the results for the importance of performing any kind of international activity. Active abroad includes being an exporter, an importer of services or materials, being an outsourcer (passive or active) and performing FDI. While in Table 2 we focus exclusively on two of these activities: exporting and FDI.

	Dependent Variable: ln(TFP)		
	O. Probit	OLS	OLS
	(1)	(2)	(3)
Active Abroad	0.204***	0.0825***	0.0457***
	(0.031)	(0.012)	(0.012)
Small firms			0.103***
(20-49 emp.)			(0.012)
Medium firms			0.219***
(50-249 emp.)			(0.015)
Large firms			0.384***
(over 250 emp.)			(0.028)
Country FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
N	8522	8522	8522

Robust standard errors in parenthesis and *** denotes statistical significance at the 1 percent level. The number of observations is given by the number of purely domestic oriented firms plus the number of firms active in the selected international activity.

Table 1: Active Abroad and TFP premium

In the first column we estimate an ordered probit model, in which the internationalization status is regressed across the decile categories of TFP. The coefficient is positive and significant, indicating that the higher the productivity deciles, the more likely that a firm will be involved in some internationalisation activity. This is true for all activities though the effect is strongest for FDI. The ordered probit serves a robustness checks for the OLS

results in columns (2) and (3).

The specification of column (2) includes sector and country fixed effects. As expected, the coefficient is positive and significant, that is, the 'productivity premium' increases with the complexity of internationalization activities. Once we focus on particular activities, like FDI and Exporting, the premia increases.

In the third column we control alsol for size of the firm, measured in terms of number of employees. While the TFP premium decreases significantly (it's almost half than when we do not control for size), it is still positive and significant. As can be seen, coefficients tend to grow larger with firm size because more productive firms manage to grow larger than their less productive counterparts. However, for a given size class of firms, the size premium tends to be smaller in more complex international activities such as FDI. This is further evidence of tougher selectivity at the top, as more complex activities are chosen by firms which have TFPs above already quite high thresholds.

	Dependent Variable: ln(TFP)					
	Exporter			FDI		
	(1)	(2)	(3)	(1)	(2)	(3)
	O. Probit	OLS	OLS	O.Probit	OLS	OLS
Activity	0.224***	0.133***	0.0788***	0.528***	0.175***	0.0866***
	(0.038)	(0.016)	(0.017)	(0.074)	(0.036)	(0.041)
Small firms			0.118***			0.102***
(20-49 emp.)			(0.018)			(0.021)
Medium firms			0.204***			0.158***
(50-249 emp.)			(0.023)			(0.034)
Large firms			0.394***			0.327***
(over 250 emp.)			(0.035)			(0.053)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
N	4309	4309	4309	2281	2281	2281

Robust standard errors in parenthesis and *** denotes statistical significance at the 1 percent level. The number of observations is given by the number of purely domestic oriented firms plus the number of firms active in the selected international activity.

Table 2: International Status and TFP premium

3 Firm Level Evidence on International Activities

The size distribution of firms might be the key to explaining the cross country heterogeneity in firms' performance. Figure 5 plots the change in profit margin between 2008 and 2009 by firm size, as measured by the number of employees, for Spain and compares these changes to the respective survey averages.

We have already reported that Spain has a larger number of small firms than our European trading partners. These small firms are also those that clearly fare worse than their European counterparts: 65.7 percent of the very small firms and 62.3 percent of the small firms in Spain report decreases in their profit margin, while the corresponding survey averages are 52.4 percent and 52.2 percent, respectively. Interestingly, for large firms this pattern is reversed. The share of firms reporting a decrease in profit margins in similar to the survey average, while the share of firms reporting an increase in their margins, 24.9%, lies substantially above the survey average of 18.4%. This result is tied to the internationalization of firms. Among the large firms, over 80% in all the countries are either FDI's, Exporters or both, compared to 89% in Spain.

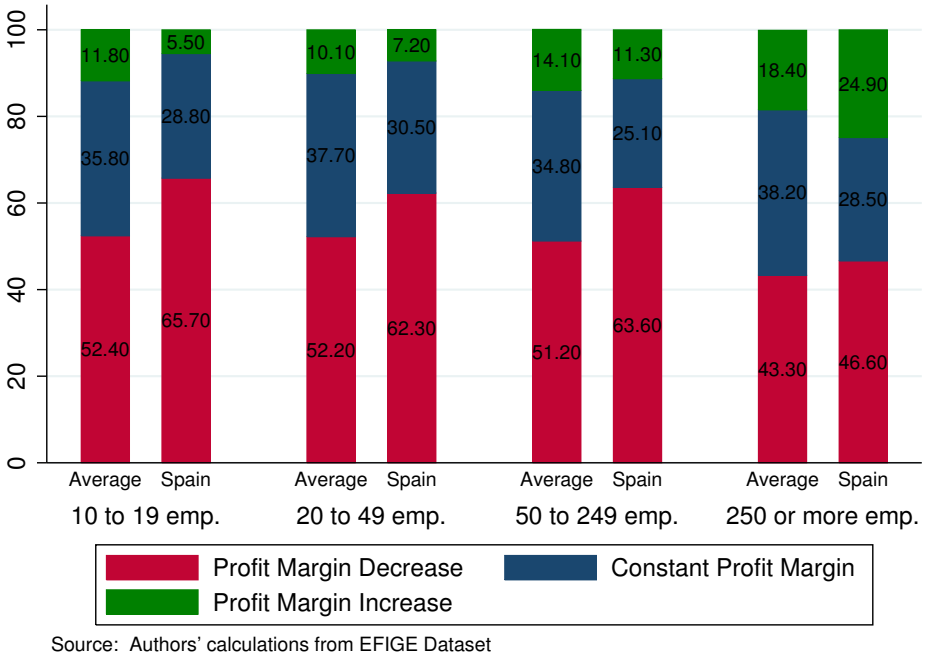


Figure 5: Share of firms by change in profit margin by firm size.

This results suggest that the large Spanish firms were less affected by the crisis than the small ones because the vast majority of them was involved in international activities. In this section, we explore the implications of exporting and FDI activities for Spanish firms and compare these firms to their European counterparts.

3.1 How Different are Spanish Exporters from European Exporters?

In the previous section, we have shown that exporting firms are more productive and bigger than non-internationalized firms, independently of country or sector. Now we seek to understand the differences between Spanish exporters and EU exporters.

By using firm-level data it is possible to decompose a country's manufacturing exports into two margins: the percentage of firms in manufacturing that export a fraction of their sales (the "extensive margin") and, only for exporters, the share of the export value over total turnover (the "intensive margin"). In Table 3 we report these two figures by country. Both margins vary substantially across countries and, as expected, both numbers are relative small in a large economy like Germany, while we obtain the largest numbers for Italy. Spain, despite being a smaller economy than France and United Kingdom, has both a smaller percentage of exporting firms and an smaller percentage of export volume, very close to German's levels.

	France	Germany	Italy	Spain	UK
Export Volume	27.3%	19.5%	32.8%	21.5%	25.8%
Exporting Firms	71.2%	65.2%	76.7%	67.8%	72.5 %

Table 3: Extensive and Intensive Export Margin by country

Figure 6 takes a closer look at the intensive margin distribution across the exporters in each country. The distribution of the other European countries is fatter and longer tails than the distribution of Spain. This, together with the fact that there are fewer large firms in Spain, implies a relatively small export intensity for Spanish firms. An interesting exception is the case of Italy. This country has even fewer large firms than Spain but at the same time has the fattest tail in the export intensity distribution, which explains the high percentages reported above.

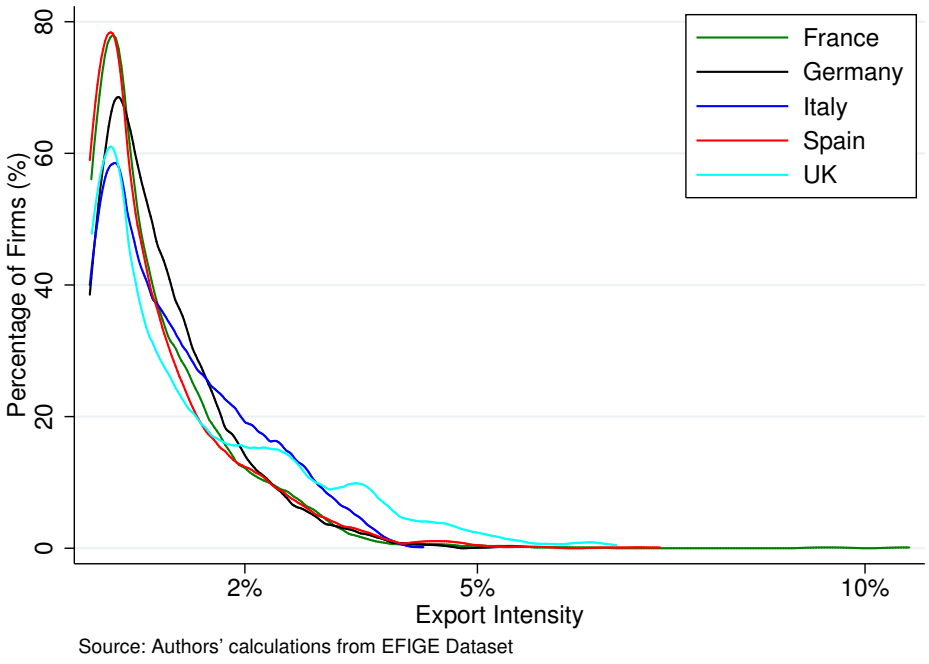


Figure 6: Intensive Margin distribution

This evidence suggests that size is not the only relevant firm characteristic for internationalization. Therefore, we perform a regression analysis to determine how important are other firm characteristics to determine export performance by country. Specifically, we estimate a linear probability model, where the dependent variable is a dummy which is equal to 1 if a firm exports and 0 otherwise, and a probit model for robustness, controlling for the number of employees, the age of the firm, the firm belonging to a group, the firm being foreign owned, and the innovation activities (product innovation and R&D) performed by the firm.

$$\begin{aligned} Pr(Exporter) &= \beta_0 + \beta_1 ln(Employees) + \beta_2 ln(Firm\ age) + \beta_3 Group \\ &+ \beta_4 Foreign\ owned + \beta_5 Product\ Innovation + \beta_6 RD\ share + \epsilon \end{aligned}$$

The results are reported in Table 4. In the first column of each country are the LPM coefficients, while in the second column of each country are the Probit coefficients.

Dependent Variable: Firm probability of exporting

	France		Germany		Italy		Spain		UK	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Log(Emp.)	0.052***	0.197***	0.041***	0.146***	0.052***	0.244***	0.060***	0.221***	0.027***	0.100**
	(0.0136)	(0.0376)	(0.005)	(0.0150)	(0.011)	(0.0469)	(0.012)	(0.0484)	(0.0132)	(0.0403)
Log(age)	0.059***	0.188***	0.014***	0.052***	0.055***	0.187***	0.092***	0.286***	0.038***	0.125***
	(0.0131)	(0.0358)	(0.00268)	(0.00879)	(0.0157)	(0.0524)	(0.0188)	(0.0645)	(0.00902)	(0.0348)
Group	0.070***	0.217***	0.112***	0.423***	−0.0228	−0.0838	0.0419*	0.136*	0.0919***	0.300***
	(0.0197)	(0.0624)	(0.0160)	(0.0691)	(0.0336)	(0.128)	(0.0229)	(0.0732)	(0.0232)	(0.0819)
Foreign Own	0.135***	0.763***	0.156***	0.967***	0.130***	01.434***	0.130***	1.065***	0.112***	0.542***
	(0.0306)	(0.141)	(0.0370)	(0.229)	(0.0275)	(0.379)	(0.0418)	(0.319)	(0.0478)	(0.288)
Prod. Inn.	0.0570**	0.193***	0.126***	0.402***	0.125***	0.444***	0.0754***	0.239***	0.118***	0.363***
	(0.00219)	(0.0651)	(0.0248)	(0.0722)	(0.0183)	(0.0647)	(0.0227)	(0.0736)	(0.0312)	(0.0897)
R&D	0.210***	0.595***	0.233***	0.677***	0.138***	0.443***	0.175***	0.532***	0.196***	0.593***
	(0.0138)	(0.0415)	(0.0326)	(0.0983)	(0.0045)	(0.0305)	(0.0238)	(0.0694)	(0.0281)	(0.0926)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2962	2962	2913	2913	2996	2996	2826	2826	2024	2024

Robust standard errors in parenthesis and *** denotes statistical significance at the 1 percent level.

Table 4: Probability of Exporting by Country in 2009

The estimated coefficient of firm size is visibly similar across countries, with the exception of United Kingdom it is smaller; the same is true for the firm being foreign owned and for performing R&D. The age of the firm has a particularly strong effect for Spanish firms, which is confirmed by the results for the Probit specification, with marginal effects twice as large as in any of the other countries. Product innovation is not as important for French and Spanish firms, but it is still significant and affects positively the probability of exporting. Finally, whether or not a firm is part of a group of firms has very different effects across the countries in our sample. While it is relevant in France, Germany and United Kingdom, it seems to have little to no effect in Italy and Spain.

Finally, an indicator of the complexity of the exporting activity is the number of foreign destination markets of firms. Eaton et al. (2004) found that the number of French exporters is strongly decreasing in the number of destination countries.[10] Table 5 shows that this is the case also in our sample.

In all countries, only a small share of firms export to more than 20 destinations. However, we can see some differences across countries. For each export percentile (according to their revenues), German exporters reach more destinations than their counterparts in the rest of the countries in the sample, while Spanish exporters are those who reach the lowest number of destinations. More importantly, the median exporter in Germany reaches twice the number of destinations that the median exporter in Spain does, which emphasizes the unevenness between two similar firms in both countries.

Country	10th p.	25th p.	median	75th p.	95th p.
France	1	3	6	12	40
Germany	2	4	8	20	50
Italy	1	3	6	15	40
Spain	1	2	4	10	32
UK	1	3	7	16	50

Table 5: Number of Export Destinations

[10] The number of firms selling to multiple markets falls with the number of destination areas. Using more recent data (2000-2006), Fontagnè and Gaulier (2010) show that most French exporters are involved in only one foreign market. In addition, they show that the number of served countries increases with firm size and productivity.

3.2 How Different are Spanish FDI makers from European FDI makers?

By using firm-level data it is also possible to decompose a country's manufacturing FDI activities into two margins: the percentage of firms in manufacturing that perform FDI (the "extensive margin") and, for FDI makers, the share of the FDI value over total turnover (the "intensive margin").

In Table 6 we report these two figures by country, along with the number of firms that both export and perform FDI. Again we find that both margins vary substantially across countries. Both France and United Kingdom stand out. France because it has the highest FDI volume and the number of French FDI makers is also one of the highest in the sample, whereas United Kingdom present one of the smallest FDI volumes despite having the largest number of FDI markers. More importantly, at least 80% of the firms that perform FDI are exporters, which indicates a complementarity between both activities.

	France	Germany	Italy	Spain	UK
FDI Volume	11.7%	7.1%	2.3 %	4.3%	2.9%
FDI firms	19.0%	21.1%	14.1%	9.6%	23.2%
FDI firms that export	87.9%	91.3%	96.1%	93.8%	80%

Table 6: Extensive and Intensive FDI Margin by country

Figure 7 takes a closer look at the intensive margin distribution across the FDI makers. The distribution of Spanish FDI makers is similar to that of the other EU countries, indicating that despite having a smaller percentage of firms doing FDI, the intensity of the FDI makers is up to par with the firms in the other countries.

We now perform a regression analysis to determine the relative importance of other firm characteristics as determinants of FDI performance, just as we did in the case of exporting firms. To be more precise, we estimate a linear probability model where the dependent variable is a dummy which is equal to 1 if a firm performs FDI and 0 otherwise, and a probit model for robustness, controlling for the number of employees, the age of the firm, the firm belonging to a group, the firm being foreign owned, and the innovation activities (product innovation and R&D) performed by the firm.

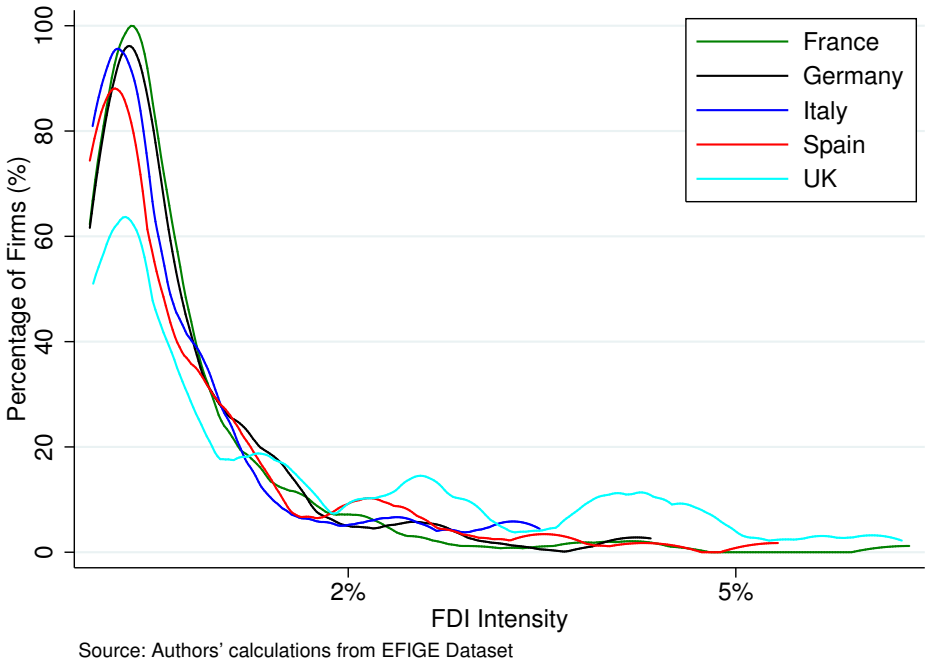


Figure 7: Intensive Margin distribution

$$\begin{aligned} Pr(FDI) &= \beta_0 + \beta_1 ln(Employees) + \beta_2 ln(Firm\ age) + \beta_3 Group \\ &+ \beta_4 Foreign\ owned + \beta_5 Product\ Innovation + \beta_6 RD\ share + \epsilon \end{aligned}$$

The results are reported in Table 7. In the first column of each country are the LPM coefficients, while the second column of each country reports the Probit coefficients. The estimated coefficient of firm size is visibly similar across countries; the same is true for the firm being foreign owned. The age of the firm and belonging to a group have diverse effects across countries.

	Dependent Variable: Firm probability of FDI									
	France		Germany		Italy		Spain		UK	
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
Log(Emp.)	0.049***	0.368***	0.0569***	0.405***	0.0351***	0.303***	0.0320***	0.332***	0.0312***	0.220***
	(0.0085)	(0.0424)	(0.00711)	(0.0356)	(0.0130)	(0.0832)	(0.00555)	(0.0593)	(0.00676)	(0.0429)
Log(age)	0.00378	0.681	0.0122***	0.923***	0.0107**	0.221***	0.00859	0.181	0.00387	0.0229
	(0.00373)	(0.0500)	(0.00307)	(0.0216)	(0.00353)	(0.0611)	(0.00610)	(0.122)	(0.00457)	(0.0321)
Group	0.0137	0.302***	0.0322*	0.275***	0.0372**	0.454***	0.0109	0.170	0.0971***	0.742***
	(0.00926)	(0.114)	(0.0149)	(0.0950)	(0.0131)	(0.143)	(0.00805)	(0.113)	(0.0226)	(0.132)
Foreign Owned	0.244***	1.189***	0.357***	1.403***	0.303***	1.478***	0.276***	1.343***	0.167***	0.753***
	(0.0423)	(0.141)	(0.0320)	(0.101)	(0.0394)	(0.110)	(0.0549)	(0.203)	(0.0395)	(0.136)
Prod. Inn.	0.00947	0.159	0.0292**	0.279***	0.00805	0.177	0.00811*	0.219**	0.00514	0.0631
	(0.00981)	(0.113)	(0.00955)	(0.0808)	(0.00673)	(0.140)	(0.00442)	(0.0938)	(0.00105)	(0.110)
R&D	−0.00651	0.0356	−0.00425	0.0863	0.00686	0.376**	0.0286***	0.699***	0.0198	0.208
	(0.00746)	(0.113)	(0.00845)	(0.108)	(0.00657)	(0.147)	(0.00667)	(0.144)	(0.0123)	(0.131)
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	2962	2962	2913	2913	2996	2996	2826	2826	2024	2024

Robust standard errors in parenthesis and *** denotes statistical significance at the 1 percent level.

Table 7: Probability of performing FDI by country in 2009

In this section we have explored the characteristics of Spanish firms that export and perform FDI and compare them to their European counterparts. Spanish firms perceive these activities to be more complex than their European counterparts and most of the firms who perform FDI are exporters beforehand. The most relevant factors for exporting are size, age, belonging to a group and being foreign owned, although belonging to a multinational is not as significant for Spanish firms as for European ones. While the most relevant factors for FDI are size, being foreign owned and R&D.

Exporting and FDI are two complementary but alternative ways of internationalization, which are jointly reflected by the globalization of value chains. Production processes are becoming increasingly fragmented geographically, and thus multinational firms play a prominent role as they have a global reach that allows them to co-ordinate production and distribution across many countries and shift their activities depending on changing demand and cost conditions. In the next section, we explore the position of Spain in the international fragmented production process.

4 Reconciling aggregate and firm-level evidence: the role of global value chains.

Trade and production networks are not new phenomena. Firms have been producing items with components sourced from around the globe for centuries. Businesses have continuously sought out new markets for their products. What have changed, however, are the speed, scale, depth and breadth of global interactions. Increasingly, new players have become active in what have come to be called global value chains or global supply chains. This process of organization has brought entirely new issues for consideration.

GVCs pose measurement challenges to the evaluation of a country's exposure to foreign shocks. As intermediates travel to their final destination by an indirect, possibly multi-country route, it becomes more complex to associate a country's production (and its domestic-value added content) with the final demand that activated it.

The propagation of GVCs has contributed to the growth of international trade in intermediate inputs, as sequential stages of production ("tasks") are often performed at several locations all over the world before assembly into the final product. As production becomes more and more internationally fragmented, conventional indicators based on gross exports are no longer informative and measurement challenges are posed to full evaluation of a

country's exposure to foreign shocks. First, the development of multi-country production linkages has made it more difficult to associate a country's production with the final demand that activated it since intermediates produced in one country can be processed in many other locations before they are ultimately exported and consumed (or invested) in the final destination country. Second, traditional gross trade statistics are increasingly affected by the well-known problem of "double counting" since intermediates crossing the border back and forth as they are being processed get recorded multiple times in trade statistics. This holds even for bilateral trade flows.

The main purpose of this section is to analyze the Spanish capacity to generate value added through exports, which depends critically on our position in the GVC and map out the economic relations that underlie Spanish trade with the rest of the world.

To this end, we use the global input-output database WIOD[11] and the approach developed by Koopman et al. (2014) in order to trace out how final internal demand around the world is diffused along global value chains and ultimately affects the creation of domestic value added across Spanish sectors. Essentially, WIOD tables match national input-output (supply and use) tables so that the foreign sector in each national table is broken down among partner countries both on the export (use) and on the import (supply) side. The outcome is a global input-output table where productive sectors are distinguished by their"country of residence". The papers by Koopman et al. (2014) and Wang et al. (2013) lay out the appropriate algebra in order to trace out the contributions of final internal demand in each country in activating Spanish exports and the value added contained therein.

The rest of the section is organized as follows. First, we describe the Koopman methodology. Then, we analyze the domestic value added embedded in each of the European countries' exports. After that, we focus on Spain and perform an industry analysis. Finally, we propose a new measure for comparative advantage and compare the differences with respect to the traditional estimators.

4.1 Decomposition of the Gross Exports

Koopman et al. (2014) is the first paper in the vertical specialization literature that develops a fully coherent accounting identity that breaks up a country's gross exports into value added components by source. The authors' methodology decomposes gross exports into

[11] See Timmer et al. (2014) for a description of the data or visit www.wiod.org for more information.

three main terms: domestic value added, foreign value added, double-counted value added.

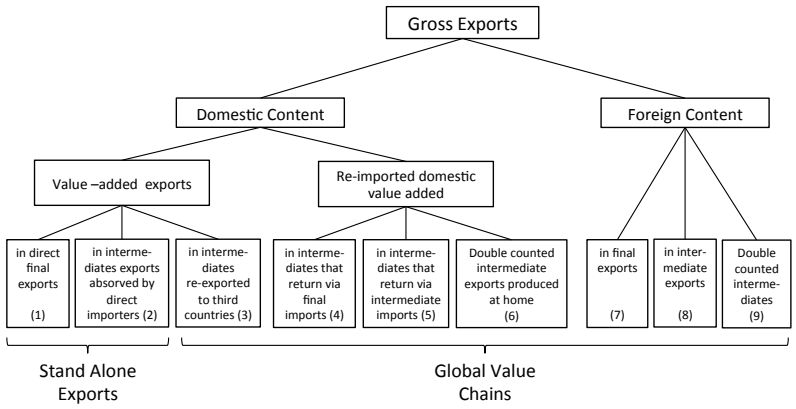


Figure 8: Decomposition of Gross Export Content

Figure 8 breaks down the gross exports into the nine sub-components specified by Koopman et al. (2012) depending on the use (final vs intermediate) of the exported goods and services and on the geographical origin (foreign vs. domestic) of the final demand that activated them. These sub-components can be grouped in two distinctive ways. On the one hand, we can distinguish between domestic value added (DVA), namely the Spanish GDP embodied in Spanish gross exports (components (1) to (5)), foreign value added (FVA) embodied via imports of intermediate inputs in Spanish gross exports (components (7) and (8)), and double-counted terms (components (6) and (9)). On the other hand, we can distinguish between stand-alone exports, that measures how much of a country's exports is created outside any supply chain (SE), given by sub-components (1) and (2), and the exports belonging to a global value chain (GVC), which measures exports generated by participation in an international fragmented production process, given by sub-components (3) and (9).

4.2 Domestic Value Added embedded in Gross Exports

Because not all exports constitute domestic value added, the share of value added trade captured by a country can be quite different from its share in global exports. Figure 9 depicts the domestic value added (DVA), the foreign value added (FVA) and the double-counted items (DC) as obtained from the Koopman decomposition for several European countries for 2011.

The domestic value added embodied in Spanish gross exports is the lowest among the countries considered, while the largest belongs to United Kingdom (70% and 78%) and double counting items are around 4% of the gross exports of all countries.

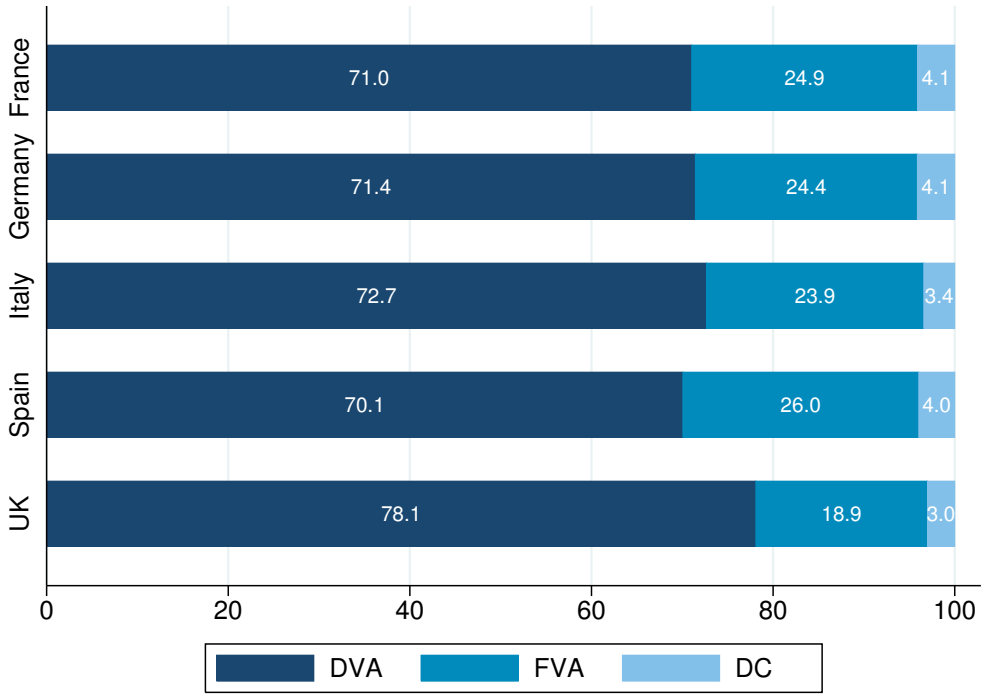


Figure 9: Breakdown of European Gross Exports in 2011

Factors that influence the share of domestic value added in exports include:

1. Size of the economy. Large economies tend to have significant value chains and to rely less on foreign inputs.

2. Composition of exports and position in GVCs. Countries with significant shares of natural resources, oil or other commodities in their exports, tend to have a higher relative value added trade share, as such exports are at the beginning of GVCs and require little foreign inputs. In contrast, countries with significant shares of exports in highly segmented industries may need to import more to generate exports.

3. Economic structure and export model. For example, countries with important processing trade sectors will capture less domestic value added.

The combination of these three factors explains the bulk of the differences in the domestic value added shares (net of policy factors). Furthemore, the average GVC share of exports of an industry provides a rough indication of the extent to which industries rely on internationally integrated production networks, as it proxies the extent to which intermediate goods and services cross borders until final consumption of the industry's output. Thus, Table 8 provides a breakdown of the domestic value added content of the exports from 2007 to 2011 of France, Germany, Italy, Spain and United Kingdom.[12] Particularly we provide, the total value of the gross exports in millions of dollars, and the percentages associated to each component according to the breakdown in Figure 8. For example, in 2009, 2.73% of the spanish gross exports is actually double counted items.

The fluctuations in 2009 indicate that the majority of the aggregates presented in Table 8 are sensitive to the business cycle. The share of DVA in gross exports is counter-cyclical, as for the complementary share, both FVA and double-counting are pro-cyclical. Similarly, since stand-alone exports (SE) constitute the greater part of DVA, the GVC (complementary share of the SE) is pro-cyclical. Since the DVA embodied in gross exports is counter-cyclical, the change in gross exports is not a sufficient statistic in order to determine their contribution to GDP growth, despite it being a usual assumption in business cycle analysis.

During the pre-crisis period, the share of domestic value added embodied in every country's gross exports declined over time. In particular, for Spain, it dropped from 74,18% to 10,39% between 2001 and 2008, rebounded to 75.75% in 2009, and dropping down below 2008 levels (70.06 %) by 2011. The pattern is similar across all the European countries considered, which indicates an increasing use of intermediates produced abroad and a strengthening of European producers' position in the international production process. However, there are some differences worth remarking. On the one hand, the average DVA embodied in UK's gross exports is almost 10% higher than any other, which might be explained by strong internal value chains.[13] On the other hand, Spanish DVA is the lowest among the five countries, which indicates we rely more on foreign inputs.

In the next subsection we center on the Spanish economy and identify which sectors are more integrated in the GVC process.

[12] A full decomposition of the nine components in Figure 8 and the complete description of the participation in fragmented production for each country for the 2001-2011 period can be found in the Appendix.

[13] Large economies tend to have significant internal value chains and rely less on foreign inputs, although according to the UNCTAD (2013) report there are important exceptions, including China and Germany.

Country	Year	Gross Exports (Millions of $)	SE (%)	GVC (%)	DVA (%)	FVA (%)	DC (%)
France	2007	636358.9	68.53	31.47	72.85	23.37	3.78
	2008	704818.9	67.47	32.53	71.76	24.34	3.90
	2009	564578.9	71.30	28.70	75.28	21.77	2.95
	2010	609073.8	68.82	31.18	72.79	23.72	3.49
	2011	691459.9	66.94	33.06	71.03	24.88	4.09
Germany	2007	1510356	67.84	32.16	71.93	23.99	4.08
	2008	1671980	66.96	33.04	71.09	24.68	4.22
	2009	1265888	71.21	28.79	75.18	21.63	3.19
	2010	1391739	68.77	31.23	72.74	23.55	3.71
	2011	1602979	67.42	32.58	71.44	24.44	4.11
Italy	2007	574777.9	70.65	29.35	74.59	22.30	3.11
	2008	620446.3	70.20	29.80	74.14	22.74	3.12
	2009	467638.6	74.79	25.21	78.44	19.34	2.22
	2010	514167.6	70.56	29.44	74.22	22.86	2.91
	2011	596636.7	68.96	31.04	72.66	23.94	3.41
Spain	2007	334952.9	66.33	33.67	70.50	25.62	3.88
	2008	366573.2	66.22	33.78	70.39	25.76	3.86
	2009	293688.2	71.87	28.13	75.75	21.52	2.73
	2010	322167.2	68.51	31.49	72.46	24.06	3.47
	2011	386533.8	66.19	33.81	70.06	25.98	3.96
UK	2007	703544.6	76.58	23.42	81.51	15.95	2.54
	2008	737461.6	74.90	25.10	79.65	17.58	2.77
	2009	572279.8	76.71	23.29	81.03	16.70	2.27
	2010	617534.5	74.93	25.07	79.32	18.08	2.61
	2011	701475.4	73.66	26.34	78.10	18.90	3.00

Table 8: Participation in Fragmented Production in Europe

4.3 An industry analysis of Spain's gross exports

We first look at the decomposition for the gross exports of the textile industry and the sector of refined petroleum products. The first sector is one of the traditionally most relevant export sectors for Spain and represents around 4% of total gross exports. The second sector is of particular interest because of Spains dependence on energy imports. Figure 10 provides a graphical presentation of the decomposition of gross exports. The four components clearly exhibit different levels and trends in the two sectors.

On the one hand, the evolution of the components in the textile product sector (Figure 10a) is fairly constant over the last ten years. On average, domestic value added that is ultimately absorbed abroad (DVA) is about 75% of gross exports, while foreign value added (FVA) that is embedded in Spanish textile exports is around 20% of the gross exports. The remaining parts consist of returned domestic value added (RDV) and pure double counting (DC), which together are around 5%.

On the other hand, the evolution of the components in the refined petroleum sector (Figure 10b) fluctuates over the whole sameple. On average, domestic value added that is ultimately absorbed abroad (DVA) is between 20% and 40% of gross exports, with a clear decreasing pattern, which highlights the dependence of Spain in these products. Complementary, foreign value added (FVA) presents an increasing pattern and represents between 40% and 60%of the gross exports. Interestingly, this sector presents the highest rate of gross exports being double counted. The intermediates crossing the border back and forth as they are being processed represent around 20% in the refined petroleum sector.

(a) Textile Products

(b) Refined Petroleum

Figure 10: Evolution of the Gross Exports Composition

While FVA in exports is not a fully fledged indicator of the GVC complexity of industries, its analysis can provide insights on the extent of cross-industry production of goods and services. At the country level, foreign value added in exports indicates what part of country's gross exports consist of inputs that have been produced by other countries, or the extent to which a country's exports are dependent on imported content. At the industry level, the average foreign value added is a proxy for the extent to which industry value chains are segmented into distinct tasks and activities that generate trade, compounding the double counting effect.

Figure 11 plots the evidence for the foreign value added content and its contribution to the total Gross Exports of the different sectors. We have highlighted several sectors. The *Textile Products* (in green), is the sector whose FVA content and contribution to gross exports are equal to the mean of the economy. The sectors whose FVA content and contribution to exports are above the mean of the economy in red, and those whose FVA content is below the mean but their contribution to exports are above the mean in blue.

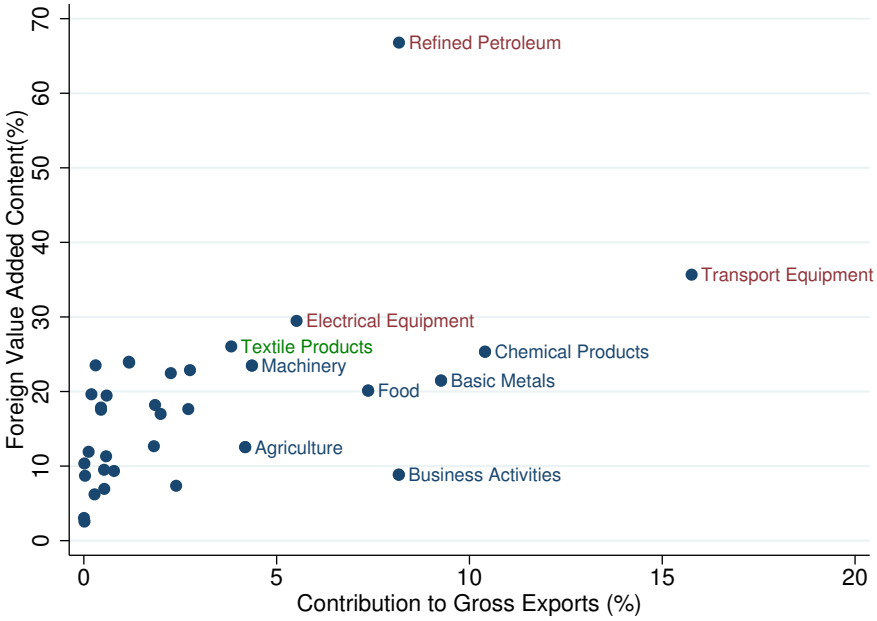


Figure 11: FVA vs. importance for the Gross Exports

The red sectors could be considered the bad or unattractive sectors of the economy, but they are also those who have been traditionally considered to be at the forefront of

value chain segmentation and of associated trends such as outsourcing and offshoring. The electronics and automotive industries, where products can be broken down into discrete components that can be separately produced, easily transported, and assembled in low-cost locations, have led the way in shaping GVCs and consequently rank highest by share of foreign value added in trade. A number of industries that incorporate and process outputs from extractive industries and traded commodities (e.g. petroleum products, plastics, basic chemicals) follow closely behind. The blue sectors, could be considered the good or attractive sectors of the economy, but particularly some of them like telecommunications, business services and utilities, rank low in terms of imported content of exports as they use fewer intermediate inputs and their involvement in FVCs typically occurs through value added incorporated in manufactured goods.

The identification of the industries which not only contribute more to the gross exports, but also that are less susceptible of suffering foreign shocks is important for policy design in fields such as industrial development, or trade and investment promotion.

4.4 Revealed Comparative Advantage of Spanish Industries

The previous discussion naturally leads to a revised notion of a country-sector's revealed comparative advantage. The traditional definition of a country-sector's revealed comparative advantage (TRCA) is based on a country's gross exports (e) and is defined as as the share of that country-sector's gross exports in the country's total gross exports relative to that sector's gross exports from all countries as a share of the world total gross exports.

$$TRCA_i^c = \frac{\frac{e_i^c}{\sum_{i=1}^{N} e_i^c}}{\frac{\sum_{c=1}^{G} e_i^c}{\sum_{i=1}^{N}\sum_{c=1}^{G} e_i^c}}, \tag{2}$$

where $i \in (1, ..., N)$ indicates sector and $c \in (1, ..., G)$ indicates country. When the RCA exceeds one, the country is said to have a revealed comparative advantage in that sector; when the RCA is below one, the country is said to have a revealed comparative disadvantage in that sector.

The traditional RCA ignores both domestic production sharing and international production sharing. To be more specific, it ignores the fact that a country-sector's value added may be exported indirectly via the country's exports in other sectors. Second, it also ignores the fact that a country-sector's gross exports partly reflect foreign contents

(which show up both FVA and a portion of DC items). A conceptually correct measure of comparative advantage needs to exclude foreign-originated value added and pure double counted terms in gross exports but include indirect exports of a sector's value added through other sects of the exporting country. Taking this into account, we define a new measure of a country sector's revealed comparative advantage (NRCA) as the share of a country-sector's domestic content dc in exports in the country's total domestic content in exports relative to that sector's domestic content in exports from all countries as a share of global domestic value added in exports.

$$NRCA_i^c = \frac{\frac{dc_i^c}{\sum_{i=1}^{N} dc_i^c}}{\frac{\sum_{r=1}^{G} dc_i^r}{\sum_{i=1}^{N}\sum_{r=1}^{G} dc_i^r}} \tag{3}$$

In Figure 12 we depict the evolution of both measures for selected sectors of the Spanish economy[14]: Textiles, Paper and Printing, Refined Petroleum, Chemical Products, Basic Metals and Transport Equipment.

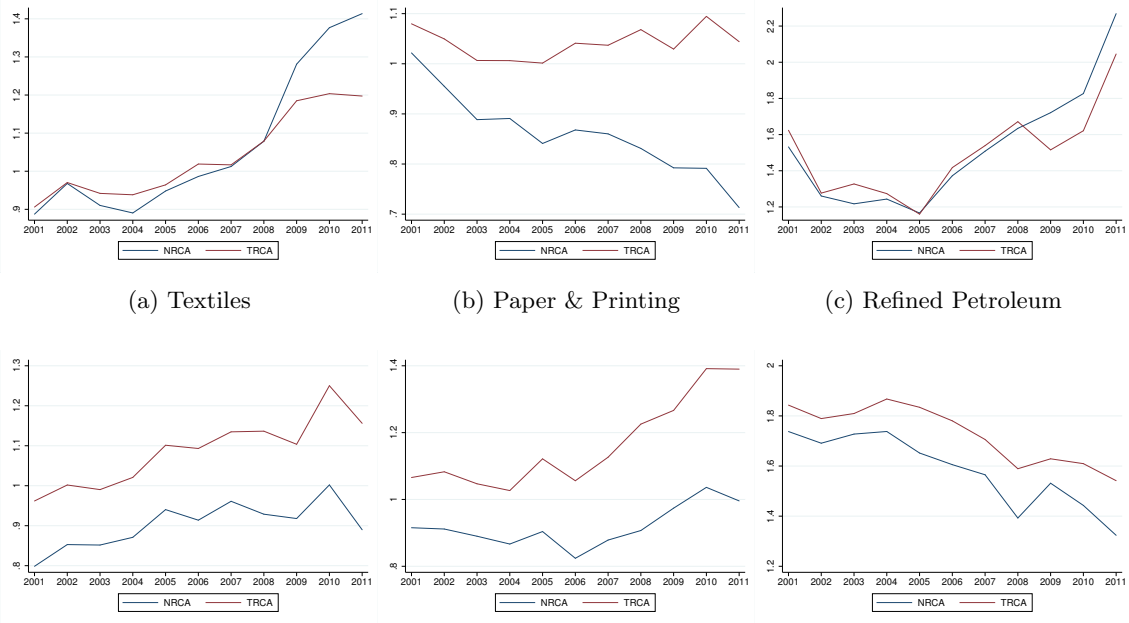
Paper and Printing, Chemical Products and Basic Metals are three cases where the traditional relative comparative advantage would indicate that we have a comparative advantage in them while the new indicator would indicate the opposite. At the same time, the three of them follow very different paths. For Paper and Printing the paths of both indicators are divergent, particularly, the traditional indicator remains more or less constant over the last decade while the new indicator decreases, indicating a rapid loss in competitive advantage that would have been lost were we not to able to distinguish between the gross exports and the domestic content in the gross exports. For Chemical Products and Basic Metals the paths of both indicators are similar, and rising. Particularly, the new indicators of comparative advantage which indicated a disadvantage at the beginning of the 2000, have kept rising despite the crisis and are near to indicating comparative advantage in these sectors. This, together with the evidence on the contribution to the Exports while not depending excessively on the foreign components, suggest that they are attractive sectors on which we should focus more in the future.

Refined Petroleum and Transport Equipment are two sectors of particular interest since they are two of the largest contributors to Gross Exports, but their exports contain a high percentage of foreign value added, that is, value that does not remain in Spain. On the

[14]See the appendix for the evolution of both measures for all the sectors of the economy

one hand, the comparative advantage indicators of Refined Petroleum is growing without interruption since 2005, which indicates that despite the high presence of foreign value content in the exports, the participation in the global value chain is also fostering the domestic value added in the exports, and hence why the new indicator is not falling below the traditional indicators. On the other hand, the comparative advantage indicators of Transport Equipment present a decrease since 2004. Furthermore, the new indicator being lower than the traditional one indicates that the presence of foreign value content in exports is not fostering the domestic value content in them. We should aim to decrease the foreign content in both while maintaining our export quotas.

Finally, Textile Products is a sector where both indicators have similar values until the start of the crisis, when the new indicator starts to rise much faster than the traditional one, indicating an strengthening of the domestic content in the gross exports. This combined with the fact that it happened during the crisis years and the contribution of the exports are above the sectorial mean, imply that it is a sector on which we rely in times of crisis and that can help us grow, and therefore should be promoted.



(a) Textiles (b) Paper & Printing (c) Refined Petroleum

(d) Chemical Products (e) Basic Metals (f) Transport Equipment

Figure 12: Evolution RCA Sectors Spain

5 GVCs as an stabilizer in times of crisis

In the previous section, we have argued that since the DVA embodied in gross exports is counter-cyclical, the change in gross exports is not a sufficient statistic in order to determine their contribution to GDP growth.

Table 9 provides the growth rates of output, gross export, domestic value added and foreign value added from 2007 to 2011 of France, Germany, Italy, Spain and United Kingdom. The year 2009 is a striking example; according to WIOD data, gross exports contributed for 19.88% to the 2009 contraction of nominal GDP. The correct computation uses the domestic value added content of exports (DVA) in the place of gross export, and results in a negative contribution to GDP growth worth 13.63% percentage points. The contraction in Spanish DVA was contained thanks to the increase in the DVA share. The latter (5.36%) was mainly mirrored in a reduction of the foreign value added embodied in gross exports (4.24%). This is consistent with Spanish exporters adjusting their production function in favour of relatively inflexible inputs (domestic labour and capital) and at the disadvantage of more flexible inputs such as imported intermediates (and inventories thereof). Part of the explanation is also the sharp contraction in prices of imported oil and other raw materials.

The increased participation in GVCs implies we are more open to foreign shocks, but at the same time it provides relief in cases of domestic shocks. In 2009 the financial crisis hit most of the developed economies, which shows up not only in the contraction of all the economies considered, but also in the heavy contraction through the FVA component. The crisis, while temporary for some countries, was more permanent for some others such as Spain, as can be seen by the negative output growth in 2010. Exports, however, grew by 9.70%, thanks to our presence in GVCs and the growth in FVA exports. The presence in GVCs has palliated the effects of the domestic crisis felt in Europe after 2009 as can be seen by the more rapid growth of gross exports than output, and the increased growth in foreign value added.

Year		France	Germany	Italy	Spain	UK
2007	Output Growth	14.62	14.92	19.33	16.58	14.54
	Export Growth	13.67	19.99	19.33	20.36	15.80
	DVA Growth	12.91	18.83	18.41	19.28	16.11
	FVA Growth	14.85	22.73	21.58	21.77	14.63
2008	Output Growth	10.76	10.17	7.95	12.42	-4.49
	Export Growth	10.76	10.70	7.95	9.44	4.82
	DVA Growth	9.14	9.44	7.36	9.39	2.63
	FVA Growth	15.37	13.91	10.11	10.02	15.47
2009	Output Growth	-9.07	-12.89	-24.63	-8.85	-18.47
	Export Growth	-19.90	-24.29	-24.63	-19.88	-22.40
	DVA Growth	-15.88	-19.83	-20.14	-13.63	-20.91
	FVA Growth	-28.36	-33.66	-35.89	-33.06	-26.26
2010	Output Growth	-1.07	2.89	9.95	-6.62	2.95
	Export Growth	7.88	9.94	9.95	9.70	7.91
	DVA Growth	4.34	6.40	4.02	4.99	5.65
	FVA Growth	17.56	19.71	29.97	22.67	16.79
2011	Output Growth	7.59	11.32	16.04	6.94	7.25
	Export Growth	13.53	15.18	16.04	19.98	13.59
	DVA Growth	10.67	12.92	13.55	16.00	11.83
	FVA Growth	19.08	19.54	21.48	29.55	18.77

Table 9: Growth in Output, Exports, Domestic VA and Foreign VA across Europe (%)

In Table 10 we present the impact (first-round effect only) on Spanish gross exports and domestic value added when there is a 10 percent increase in final demand in selected areas of the world. The last column is the ratio of the first two, namely the domestic value added intensity (the Spanish GDP content of one dollar of exports). The year of reference utilized has been the last one in the sample, 2011. Since composition effects have not been

taken into account, the results have to be interpreted with caution.

A 10 percent increase in world final demand in 2011 would led to an increase of Spanish gross exports worth 2.281 percentage points of GDP whereas the domestic value added in GDP grew by 2.337 percent. The analysis by areas shows the dependence of Spain on the final demand coming from inside the EU15, and particularly from our close neighbours who represent half of the increase in exports. At the same time, it reveals a very small impact from increased internal demand in the rest of the European Countries, where despite having a good DVA/Gross Exports ratio, the increase in exports is only 0.1%. Finally, it is worth noticing the impact of an increase in the final demand in areas like Asia, countries which are rapidly gaining terrain in the worlds gross export that have a high activation ratio for Spanish exports.

Countries and Areas:	Exports	DVA	DVA/Exports
EU 15 countries	1.105	1.119	1.013
France	0.250	0.246	0.985
Germany	0.248	0.253	1.017
Italy	0.168	0.172	1.024
United Kingdom	0.159	0.164	1.031
Rest of the World	1.182	1.224	1.036
Other EU countries	0.101	0.106	1.045
Asia	0.304	0.321	1.056
US & Canada	0.422	0.431	1.021
Russia and Turkey	0.088	0.090	1.015
Total	2.287	2.343	1.025

Table 10: Impact on Spanish Exports of a 10% increase in selected areas final internal demand

6 Conclusions

As production becomes more and more internationally fragmented, countries become more vulnerable to foreign shocks but also more resilient to domestic shocks. This paper has analyzed the role that global value chains (GVC) have played during the sovereign debt crisis in Europe, and the key policy challenges that Spain faces.

The analysis confirmed earlier findings about the contrasting performance of Spanish firms. Spain's largest firms are remarkably competitive and well managed to maintain their share in world exports during the crisis, but the overall export share of Spain is low by international standard due to the abundance of small firms that only serve the domestic market. Moreover, a careful analysis of the latest available input-output data reveals that the share of domestic value added (DVA) is low compared to the corresponding shares for our main European trading partners. This evidence points at a relatively unfavorable position of Spanish exporters in the global value chains.

GVCs have the capacity to act as built-in stabilizers following economic downturns if they are promoted in the right industries. In the second part of the analysis we compute the first round impact on Spanish gross exports and domestic value added of a 10% increase in final demand in selected areas of the world, concluding that Spain's gross exports would be worth 2.28% of GDP while the domestic value added from export would grow by 2.34%. Even though this exercise is only a partial equilibrium analysis, it provides us with insight of how Spanish GDP can be activated through Spanish exports by foreign demand. The geographical analysis shows the dependence Spain has on the final demand coming from inside the EU15, and particularly from France and Germany who represent half of the potential increase in exports, but also highlight the potential impact of an increase in the final demand in Asia, which would be the most effective in activating domestic value added exports in Spain.

A sustained improvement in the export performance of Spanish firms requires both an increase in the number of large firms and a reorientation of production towards the sectors in which Spanish producers manage to capture a relatively large share of total value added. In the second part of the analysis we propose novel indicators of revealed comparative advantage based on the domestic value-added content of exports at the industry level. A comparison between these novel indicators and standard indicators of revealed comparative advantage (based on the gross value of exports) reveal significant differences, suggesting substantial gains from an appropriate reorientation of production. Our results provide a clear indication that future reforms should focus on measures that stimulate firm growth and remove barriers to the sectoral reallocation of firms and workers.

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Appendix A — The Algebra of Koopman et al. (2014) Decomposition

In this section we briefly describe the application of the decomposition of gross exports developed by Koopman et al. (2014) to the WIOD Data. In our analysis there are three countries, Spain (H) , the EU15[15] (F) and the Rest of the World[16] (RW) and in each of the three countries there are $N = 1, ..., n$ industries.

All gross exports of country s are used as an intermediate and final good abroad, according the following definition:

$$E^{s*} = \sum_{r \neq s}^{C} E^{sr} = \sum_{r \neq s}^{C} (A^{sr} X^r + Y^{sr})$$

where A^{sr} is a N× N block input-output coefficient matrix, for any $s, r = H, F, RW$; X^s is the N×1 gross output vector of country s; $Y^s = Y^{ss} + Y^{sr}$ is a N×1 vector that gives the demand in country in countries s and r, for goods produced in country s; E^{s*} is the 3N×1 vector of N products exported by country s to the 3 regions; and E^{sr} is the N×1 vector of gross exports from country s to r.

These exports can be fully decomposed into various value added and double counted components described in Figure 8 as follows

$$\begin{aligned}
E^{H*} &= V^H B^{HH} Y^{HF} + V^H B^{HH} Y^{HRW} && (1)\\
&+ V^H B^{HF} Y^{FF} + V^H B^{HRW} Y^{RWRW} && (2)\\
&+ V^H B^{HF} Y^{FRW} + V^H B^{HRW} Y^{RWF} && (3)\\
&+ V^H B^{HF} Y^{FH} + V^H B^{HRW} Y^{RWH} && (4)\\
&+ V^H B^{HF} A^{FH} X^H + V^H B^{HRW} A^{RWH} X^H && (5)+(6)\\
&+ V^F B^{FH} Y^{HF} + V^F B^{FH} Y^{HRW} + V^{RW} B^{RWH} Y^{HRW} + V^{RW} B^{RWH} Y^{HF} && (7)\\
&+ V^F B^{FH} A^{HF} X^F + V^F B^{FH} A^{HRW} X^{RW} + V^{RW} B^{RWH} A^{HRW} X^{RW} + V^{RW} B^{RWH} A^{HF} X^F && (8)+(9)
\end{aligned}$$

The terms 5 and 7 on the RHS of the equation, they can be decomposed easily into terms (5) and (6), and (8) and (9) respectively, using the following identity: $X^s = Y^{ss} + A^s X^s +$

[15] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden and United Kingdom

[16] Brazil, Bulgaria, Canada, China, Cyprus, Czech Republic, Estonia, Hungary, India, Indonesia, Japan, Korea, Latvia, Lithuania, Malta, Mexico, Poland, Romania, Russia, Slovak Republic, Slovenia, Taiwan, Turkey, United States and RoW

$\sum_{r\neq s}^{C} E^{sr}$. Then it is easy to show that $X^s = (I - A^{ss})^{-1}Y^{ss} + (I - A^s s)^{-1}\sum_{r\neq s}^{C} E^{sr}$.

$$
\begin{aligned}
V^H B^{HF} A^{FH} X^H \quad &+ \quad V^H B^{HRW} A^{RWH} X^H = \\
&= \quad V^H B^{HF} A^{FH} (I - A^{HH})^{-1} Y^{HH} + V^H B^{HRW} A^{RWH} (I - A^{HH})^{-1} Y^{HH} \qquad (5) \\
&+ \quad V^H B^{HF} A^{FH} (I - A^{HH})^{-1} E^{HF} + V^H B^{HRW} A^{RWH} (I - A^{HH})^{-1} E^{HRW} \\
&+ \quad V^H B^{HF} A^{FH} (I - A^{HH})^{-1} E^{HRW} + V^H B^{HRW} A^{RWH} (I - A^{HH})^{-1} E^{HF} \qquad (6)
\end{aligned}
$$

$$
\begin{aligned}
V^F B^{FH} A^{HF} X^F \quad &+ \quad V^F B^{FH} A^{HRW} X^{RW} + V^{RW} B^{RWH} A^{HRW} X^{RW} + V^{RW} B^{RWH} A^{HF} X^F = \\
&= \quad V^F B^{FH} A^{HF} (I - A^{FF})^{-1} Y^{FF} + V^F B^{FH} A^{HRW} (I - A^{RWRW})^{-1} Y^{RWRW} \\
&+ \quad V^{RW} B^{RWH} A^{HRW} (I - A^{RWRW})^{-1} Y^{RWRW} + V^{RW} B^{RWH} A^{HF} (I - A^{FF})^{-1} Y^{FF} \qquad (8) \\
&+ \quad V^F B^{FH} A^{HF} (I - A^{FF})^{-1} E^{FH} + V^F B^{FH} A^{HRW} (I - A^{RWRW})^{-1} E^{RWH} \\
&+ \quad V^{RW} B^{RWH} A^{HRW} (I - A^{RWRW})^{-1} E^{RWH} + V^{RW} B^{RWH} A^{HF} (I - A^{FF})^{-1} E^{FH} \\
&+ \quad V^F B^{FH} A^{HF} (I - A^{FF})^{-1} E^{FRW} + V^F B^{FH} A^{HRW} (I - A^{RWRW})^{-1} E^{RWF} \\
&+ \quad V^{RW} B^{RWH} A^{HRW} (I - A^{RWRW})^{-1} E^{RWF} + V^{RW} B^{RWH} A^{HF} (I - A^{FF})^{-1} E^{FRW} \qquad (9)
\end{aligned}
$$

where:

- B^{sr} is the N×N Leontief inverse matrix, which is the total requirement matrix giving the amount of gross output produced in country s required for a one-unit increase in final demand in country r.
- V^s is the 1xN direct VA coefficient vector, $V^s = u(I - \sum_i A^{ss})$. Each element of V^s gives the share of direct domestic VA in total output.

While the algebra to obtain the previous equation may be a bit tedious, expressing a country's gross exports as the sum of these nine terms is very useful. We try to explain briefly their economic interpretations.

Terms (1) and (2) are the direct value added exports, i.e., the source country value added absorbed by direct importer, country r. Term (3) is, instead, its value added exported to country r and, after some processing in r, finally absorbed in a third country t. Terms (4) and (5) include source country's value added which is first exported but return in both final and intermediate imports to be consumed or re-exported by country s. The sum of the first five terms corresponds to the definition of " domestic value added exports". Terms (7) and (8) represent foreign value added in the source country's exports, including

foreign value added embodied in both final and intermediate products. Term (6) and (9) are the two pure double counted terms that sum up the double counted share of two way intermediate trade from all bilateral routes.

Appendix B — Tables and Figures

Code	NACE	Industry	Description
C01	AtB	Agriculture	Agriculture, Forestry and Fishing
C02	C	Mining	Mining and Quarrying
C03	15t16	Food	Food, Beverages and Tobacco
C04	17t18	Textile Products	Textile and Textile Products
C05	19	Leather and Footwear	Leather, Footwear and Leather Products
C06	20	Wood Products	Wood and Products of Wood and Cork
C07	21t22	Paper and Printing	Pulp, Paper, Printing and Publishing
C08	23	Refined Petroleum	Coke, Refined Petroleum and Nuclear Fuel
C09	24	Chemical Products	Chemicals and Chemical Products
C10	25	Rubber and Plastics	Rubber and Plastics
C11	26	Other Non-Metal	Other Non-Metallic Mineral
C12	27t28	Basic Metals	Basic Metals and Fabricated Metals
C13	29	Machinery	Machinery and Equipment n.e.c.
C14	30t33	Electrical Equipment	Electrical and Optical Equipment
C15	34t35	Transport Equipment	Transport Equipment
C16	36t37	Recycling	Manufacturing n.e.c. and Recycling
C17	E	Electricity, Gas and Water	Electricity, Gas and Water Supply
C18	F	Construction	Construction
C19	50	Sale of Vehicles and Fuel	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
C20	51	Wholesale Trade	Wholesale Trade and Commission Trade, except of Motor Vehicles

Continued on next page

Code	NACE	Industry	Description
C21	52	Retail Trade	Repair of Household Goods and Retail Trade except Motor Vehicles
C22	H	Hotels and Restaurants	Hotels and Restaurants
C23	60	Inland Transport	Inland Transport
C24	61	Water Transport	Water Transport
C25	62	Air Transport	Air Transport
C26	63	Other Transport	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
C27	64	Post and Telecommunications	Post and Telecommunications
C28	J	Financial Intermediation	Financial Intermediation
C29	70	Real Estate	Real Estate Activities
C30	71t74	Business Activities	Renting of M & Eq and Other Business Activities
C31	L	Public Administration	Public Administration and Defense; Compulsory Social Security
C32	M	Education	Education
C33	N	Health and Social Work	Health and Social Work
C34	O	Other Services	Other Community, Social and Personal Services
C35	P	Private Households	Private Households with Employed Persons

Table B.1: List of WIOD Industries

Year	Total X	T1	T2	T3	T4	T5	T6	T7	T8	T9
2001	348540	32.70	38.95	2.98	0.62	0.39	0.37	10.98	10.44	2.57
2002	366869.1	33.06	39.29	3.08	0.62	0.39	0.36	10.59	10.16	2.45
2003	427267.4	33.34	39.43	3.11	0.64	0.41	0.35	10.38	9.90	2.43
2004	492932.3	32.79	38.95	3.10	0.65	0.41	0.36	10.77	10.30	2.66
2005	517609.8	31.98	38.70	3.08	0.62	0.40	0.35	11.23	10.82	2.83
2006	559843.1	31.37	37.78	3.17	0.60	0.40	0.37	11.74	11.38	3.18
2007	636358.9	30.78	37.75	3.31	0.61	0.41	0.38	11.81	11.56	3.40
2008	704818.9	30.31	37.16	3.32	0.58	0.40	0.36	12.28	12.07	3.53
2009	564578.9	31.83	39.47	3.04	0.56	0.38	0.30	10.90	10.87	2.64
2010	609073.8	30.75	38.07	3.08	0.52	0.37	0.33	12.02	11.71	3.16
2011	691459.9	29.06	37.88	3.15	0.55	0.38	0.37	12.35	12.54	3.71

Table B.2: Gross Export Decomposition in France

Year	Total X	SE	GVC	DVA	FVA	DC
2001	348540	71.65	28.35	75.64	21.43	2.94
2002	366869.1	72.35	27.65	76.44	20.75	2.81
2003	427267.4	72.77	27.23	76.93	20.28	2.79
2004	492932.3	71.74	28.26	75.90	21.08	3.02
2005	517609.8	70.69	29.31	74.78	22.05	3.18
2006	559843.1	69.15	30.85	73.32	23.13	3.55
2007	636358.9	68.53	31.47	72.85	23.37	3.78
2008	704818.9	67.47	32.53	71.76	24.34	3.90
2009	564578.9	71.30	28.70	75.28	21.77	2.95
2010	609073.8	68.82	31.18	72.79	23.72	3.49
2011	691459.9	66.94	33.06	71.03	24.88	4.09

Table B.3: Participation in Fragmented Production in France

Year	Total X	T1	T2	T3	T4	T5	T6	T7	T8	T9
2001	636044.3	32.83	39.91	2.59	1.04	0.55	0.63	10.01	10.14	2.31
2002	695201.4	33.63	40.40	2.60	1.01	0.50	0.61	9.65	9.50	2.09
2003	839065.9	33.24	40.14	2.63	1.05	0.53	0.65	9.78	9.77	2.20
2004	1007507	31.26	40.75	2.62	1.02	0.55	0.72	9.95	10.66	2.47
2005	1096000	30.50	40.01	2.57	0.97	0.52	0.75	10.50	11.50	2.67
2006	1258715	29.35	39.21	2.60	1.00	0.50	0.81	10.90	12.55	3.06
2007	1510356	28.76	39.08	2.63	0.95	0.50	0.87	11.07	12.92	3.22
2008	1671980	28.54	38.42	2.71	0.92	0.50	0.86	11.44	13.24	3.37
2009	1265888	31.00	40.21	2.56	0.92	0.49	0.66	10.50	11.13	2.52
2010	1391739	29.57	39.20	2.63	0.84	0.49	0.75	11.32	12.23	2.97
2011	1602979	27.91	39.51	2.58	0.90	0.54	0.84	11.39	13.05	3.27

Table B.4: Gross Export Decomposition in Germany

Year	Total X	SE	GVC	DVA	FVA	DC
2001	636044.3	72.73	27.27	76.91	20.15	2.94
2002	695201.4	74.03	25.97	78.15	19.15	2.71
2003	839065.9	73.38	26.62	77.60	19.55	2.86
2004	1007507	72.01	27.99	76.20	20.61	3.20
2005	1096000	70.51	29.49	74.58	22.00	3.42
2006	1258715	68.56	31.44	72.67	23.45	3.88
2007	1510356	67.84	32.16	71.93	23.99	4.08
2008	1671980	66.96	33.04	71.09	24.68	4.22
2009	1265888	71.21	28.79	75.18	21.63	3.19
2010	1391739	68.77	31.23	72.74	23.55	3.71
2011	1602979	67.42	32.58	71.44	24.44	4.11

Table B.5: Participation in Fragmented Production in Germany

Year	Total X	T1	T2	T3	T4	T5	T6	T7	T8	T9
2001	278622.9	38.10	37.68	2.92	0.47	0.30	0.19	9.71	8.73	1.92
2002	289677	38.91	37.70	2.96	0.48	0.29	0.18	9.40	8.29	1.78
2003	341425.3	38.75	37.66	3.02	0.47	0.32	0.19	9.41	8.36	1.83
2004	405297.4	36.17	38.96	3.12	0.48	0.34	0.21	9.39	9.22	2.11
2005	428302.3	35.07	38.63	3.10	0.45	0.32	0.20	9.89	10.04	2.29
2006	481657	33.40	37.85	3.15	0.44	0.33	0.23	10.68	11.20	2.71
2007	574777.9	33.12	37.53	3.18	0.43	0.33	0.24	10.97	11.33	2.87
2008	620446.3	33.93	36.27	3.23	0.40	0.31	0.23	11.40	11.34	2.89
2009	467638.6	37.56	37.23	3.01	0.37	0.27	0.16	9.98	9.36	2.06
2010	514167.6	34.96	35.60	3.05	0.35	0.26	0.18	11.52	11.34	2.73
2011	596636.7	32.67	36.29	3.07	0.35	0.28	0.22	11.61	12.33	3.19

Table B.6: Gross Export Decomposition in Italy

Year	Total X	SE	GVC	DVA	FVA	DC
2001	278622.9	75.77	24.23	79.45	18.45	2.10
2002	289677	76.62	23.38	80.35	17.69	1.96
2003	341425.3	76.41	23.59	80.22	17.76	2.02
2004	405297.4	75.13	24.87	79.07	18.62	2.32
2005	428302.3	73.70	26.30	77.58	19.93	2.49
2006	481657	71.26	28.74	75.18	21.88	2.94
2007	574777.9	70.65	29.35	74.59	22.30	3.11
2008	620446.3	70.20	29.80	74.14	22.74	3.12
2009	467638.6	74.79	25.21	78.44	19.34	2.22
2010	514167.6	70.56	29.44	74.22	22.86	2.91
2011	596636.7	68.96	31.04	72.66	23.94	3.41

Table B.7: Participation in Fragmented Production in Italy

Year	Total X	T1	T2	T3	T4	T5	T6	T7	T8	T9
2001	144886.6	32.90	37.55	3.15	0.34	0.24	0.16	12.21	10.81	2.64
2002	158476.8	34.23	37.31	3.19	0.34	0.25	0.16	11.98	10.06	2.49
2003	195988.3	33.54	37.96	3.28	0.38	0.27	0.17	11.58	10.26	2.57
2004	229314.2	32.34	37.94	3.22	0.40	0.27	0.18	11.96	10.90	2.80
2005	245985.9	31.76	37.68	3.24	0.41	0.27	0.17	12.14	11.35	2.98
2006	278285.2	29.62	37.48	3.32	0.40	0.28	0.18	12.61	12.71	3.40
2007	334952.9	28.92	37.41	3.46	0.41	0.30	0.19	12.80	12.82	3.69
2008	366573.2	28.71	37.51	3.54	0.34	0.29	0.17	12.47	13.29	3.69
2009	293688.2	32.73	39.15	3.33	0.29	0.26	0.14	10.88	10.64	2.59
2010	322167.2	30.12	38.39	3.46	0.26	0.23	0.15	11.67	12.39	3.32
2011	386533.8	28.10	38.09	3.40	0.25	0.23	0.17	12.02	13.97	3.78

Table B.8: Gross Export Decomposition in Spain

Year	Total X	SE	GVC	DVA	FVA	DC
2001	144886.6	70.45	29.55	74.18	23.02	2.80
2002	158476.8	71.54	28.46	75.31	22.04	2.65
2003	195988.3	71.50	28.50	75.42	21.83	2.75
2004	229314.2	70.28	29.72	74.17	22.86	2.97
2005	245985.9	69.44	30.56	73.36	23.50	3.14
2006	278285.2	67.10	32.90	71.10	25.32	3.58
2007	334952.9	66.33	33.67	70.50	25.62	3.88
2008	366573.2	66.22	33.78	70.39	25.76	3.86
2009	293688.2	71.87	28.13	75.75	21.52	2.73
2010	322167.2	68.51	31.49	72.46	24.06	3.47
2011	386533.8	66.19	33.81	70.06	25.98	3.96

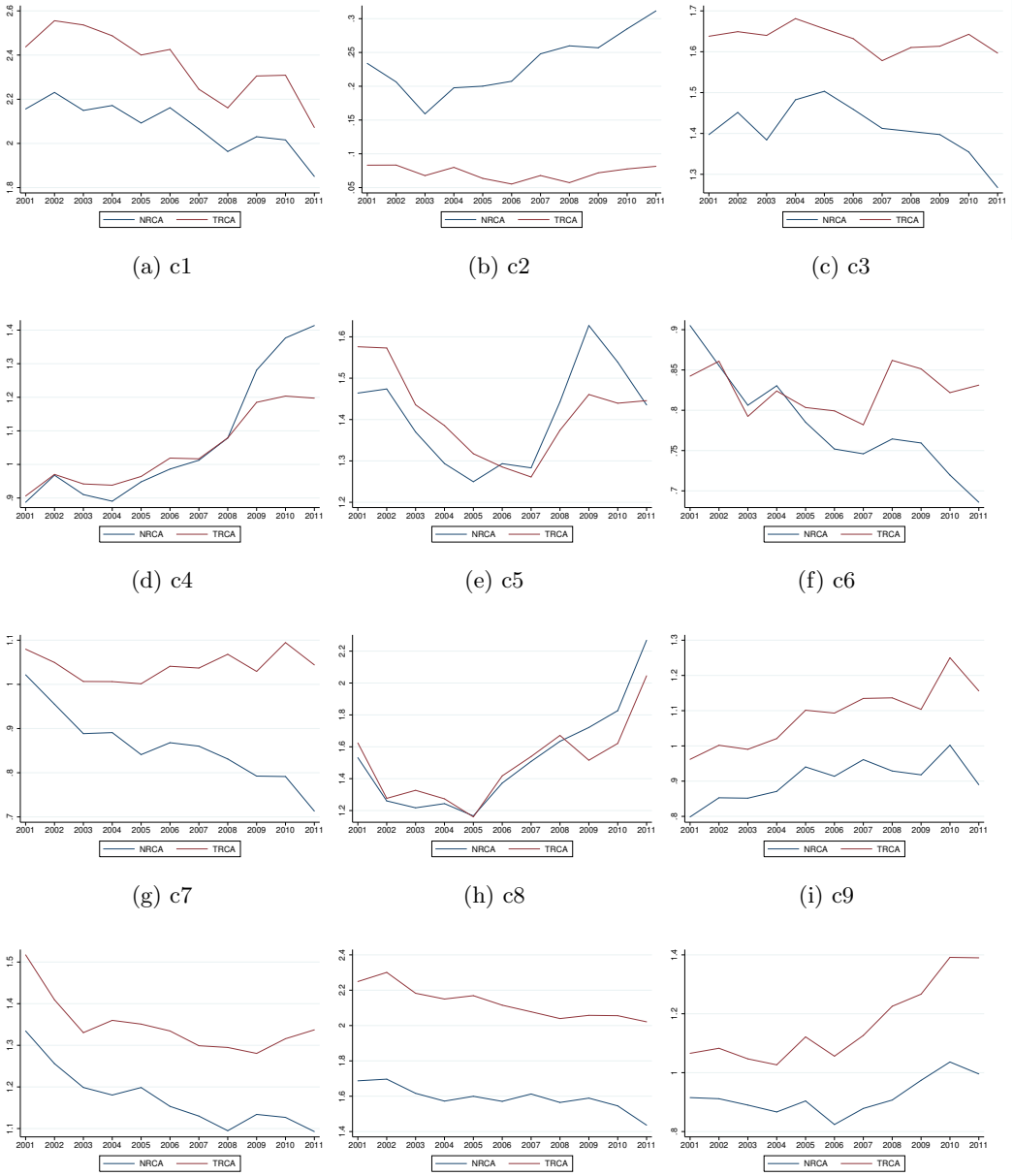
Table B.9: Participation in Fragmented Production in Spain

Year	Total X	T1	T2	T3	T4	T5	T6	T7	T8	T9
2001	368615.6	27.29	49.38	3.17	0.82	0.53	0.32	7.46	8.98	2.06
2002	386747.8	27.92	49.82	3.14	0.82	0.50	0.29	7.34	8.29	1.88
2003	443194.3	28.04	49.73	3.19	0.78	0.49	0.28	7.39	8.26	1.84
2004	523620.8	26.82	50.85	3.19	0.73	0.53	0.27	7.12	8.57	1.91
2005	547244.8	26.57	50.74	3.38	0.74	0.53	0.26	7.17	8.58	2.02
2006	607572.8	25.58	50.78	3.65	0.74	0.56	0.28	7.17	8.94	2.30
2007	703544.6	24.84	51.74	3.65	0.74	0.54	0.27	6.99	8.96	2.26
2008	737461.6	24.29	50.61	3.65	0.61	0.49	0.27	7.76	9.81	2.50
2009	572279.8	25.35	51.35	3.35	0.54	0.43	0.23	7.50	9.20	2.04
2010	617534.5	25.19	49.74	3.45	0.53	0.40	0.23	8.41	9.67	2.37
2011	701475.4	24.03	49.63	3.51	0.54	0.39	0.25	8.44	10.46	2.75

Table B.10: Gross Export Decomposition in UK

Year	Total X	SE	GVC	DVA	FVA	DC
2001	368615.6	76.67	23.33	81.19	16.44	2.38
2002	386747.8	77.74	22.26	82.20	15.64	2.16
2003	443194.3	77.77	22.23	82.23	15.65	2.12
2004	523620.8	77.68	22.32	82.13	15.69	2.19
2005	547244.8	77.31	22.69	81.96	15.76	2.28
2006	607572.8	76.36	23.64	81.30	16.12	2.58
2007	703544.6	76.58	23.42	81.51	15.95	2.54
2008	737461.6	74.90	25.10	79.65	17.58	2.77
2009	572279.8	76.71	23.29	81.03	16.70	2.27
2010	617534.5	74.93	25.07	79.32	18.08	2.61
2011	701475.4	73.66	26.34	78.10	18.90	3.00

Table B.11: Participation in Fragmented Production in UK



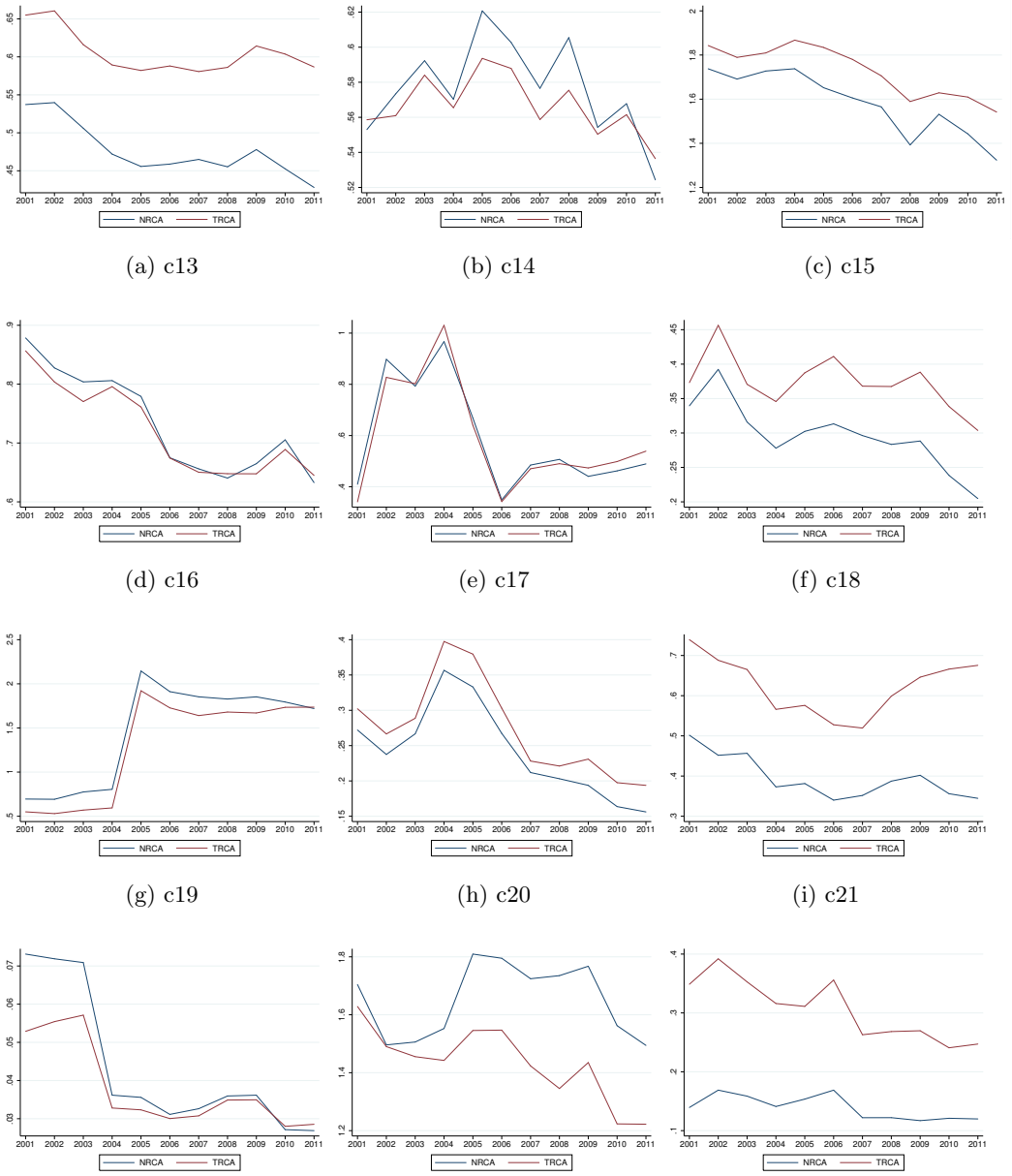
(a) c1 (b) c2 (c) c3

(d) c4 (e) c5 (f) c6

(g) c7 (h) c8 (i) c9

(j) c10 (k) c11 (l) c12

Figure B.1: Evolution RCA Sectors Spain



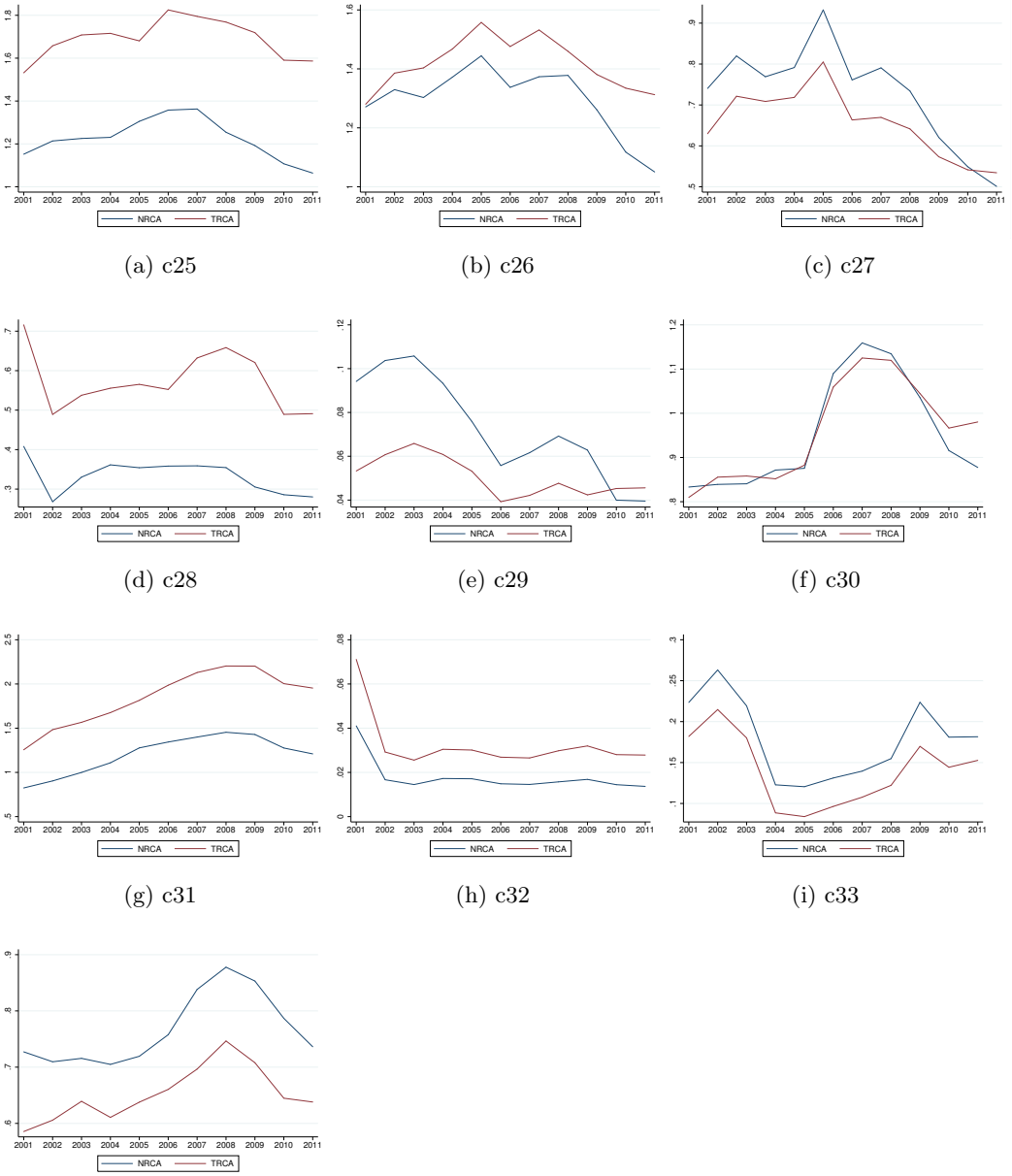
(a) c13 (b) c14 (c) c15

(d) c16 (e) c17 (f) c18

(g) c19 (h) c20 (i) c21

(j) c22 (k) c23 (l) c24

Figure B.2: Evolution RCA Sectors Spain



(a) c25 (b) c26 (c) c27

(d) c28 (e) c29 (f) c30

(g) c31 (h) c32 (i) c33

(j) c34

Figure B.3: Evolution RCA Sectors Spain

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