

[DOI: 10.20472/BMC.2015.002.010](https://doi.org/10.20472/BMC.2015.002.010)

JOÃO LOPES

UECE, ISEG/University of Lisbon, Portugal

ANA SANTOS

ISEG/University of Lisbon, Portugal

VERTICAL SPECIALIZATION, GLOBAL VALUE CHAINS AND THE CHANGING GEOGRAPHY OF TRADE: THE PORTUGUESE RUBBER AND PLASTICS INDUSTRY CASE

Abstract:

The growing fragmentation of production in the last decades has changed the geography, and dynamics, of trade. It is very important, especially for small and open economies, a good position in regional and global value chains (GVC). The necessary increase in imports, namely of intermediate inputs, that this positioning implies must be accompanied by an adequate increase of exports, generating a substantial amount of domestic value added. In this paper, an empirical analysis is made of the changes in the geography of imports and exports of Portuguese rubber and plastics industry, as well as the growing vertical specialization of this sector, both with direct and total measures, in the period 1995-2011. To put the main trends in perspective, a comparison will be made with some northern and southern EU countries, the main trade partners of Portugal in this industry, and in fact in all the others. The rubber and plastics industry is a good case study in the context of GVC analysis, given the strong proportion of intermediate inputs in its output and trade.

Keywords:

Vertical specialization; Global value chains; Rubber and plastics industry; Portugal

JEL Classification: F14, F23, L65

Introduction

In the recent decades there has been a growing fragmentation of production activities worldwide that has changed the geography, and dynamics, of foreign trade, in the sequence of what Richard Baldwin (2006) calls the “second unbundling”.

The emergence and growth of the so-called Global Value Chains results in production processes split in several stages distributed by different countries along the supply chains, each one specializing not necessarily in goods but in “tasks” (Grossman and Rossi-Hansberg, 2008; Bayoumi et al, 2013; Baldwin and Robert-Nicoud, 2014). This process is by no means limited to manufacturing but encompasses also a substantial amount of service activities (Liu and Trefler, 2008; Amiti and Wei, 2009; Crino, 2010).

Another important consequence of GVC is the significant growth of trade as a share of global output, a trend reinforced since the 1980s by trade liberalization and lower trade barriers, declines in transport and communication costs and the acceleration of technological progress (Baldwin, 2012). This growth of trade is particularly strong when measured by gross exports, given the large increase in components and parts movement across the borders, back and forth, along the supply chains. The international fragmentation of production magnifies the so-called “double counting effect”, which has been extensively treated in the recent empirical trade literature with a focus on measuring trade in value added, i.e., the net contribution of primary factors (capital and labor) in each stage of the chain (see, among others, Johnson and Noguera, 2012; Koopman et al, 2014, Los et al, 2015).

In what regards competitiveness and economic growth, it is very important for all the countries in the world, but especially for small and open economies, to assure a good position in regional and global value chains (GVC). The inevitable increase in imports, namely of intermediate inputs, that this positioning implies must be accompanied by an adequate increase in exports, generating a substantial amount of domestic value added, which is only achievable with a virtuous specialization in high and medium-high technology industries and tasks. For interesting analysis of country studies in this context, see Stehrer and Stölinger (2013) for Austria, Duprez and Dress (2013) for Belgium, Amador and Stehrer (2014) for Portugal, Cappariello and Felettig (2014) for Italy, and di Mauro et al (2013) for EU countries.

In this paper, a contribution is made to better understanding the insertion of Portugal in the GVC, by means of quantifying the vertical specialization of the Portuguese economy in the period 1995-2011, along the lines of Amador and Cabral (2008) and Cardoso et al (2013). The main measures used for this quantification are the direct import content of exports proposed by Feenstra and Hanson (1999) and the total (direct plus indirect) import content of exports applied in the pioneering work of Hummels et al (2001). The

supporting data were collected in the well-known World Input-Output Database (WIOD) consisting of global Input-Output Tables for forty countries and the Rest of the World, with 35 sectors, described in Timmer et al (2012) and Dietzenbacher et al (2013).

The main value added of this paper is to focus attention on a particular industry, rubber and plastics, and to make a detailed analysis of the changes in the geography of imports and exports of this sector, as well as a comparison of the Portuguese case with some northern and southern EU countries, the main trade partners of Portugal in this industry, and in all the others, in fact. This choice is justified by the fact that the rubber and plastics industry is a good case study in the context of GVC analysis, given the strong share of intermediate inputs in its global output and foreign trade.

The rest of the paper is organized as follows. Section 2 describes the main features of Portuguese rubber and plastics industry, in terms of output, value added, employment and labour productivity, in a comparative perspective with several EU countries. Section 3 presents the main changes in the geography, and dynamics, of rubber and plastics trade, identifying the main import and export partners of Portuguese firms in this sector. In Section 4 the measurement and results of vertical specialization in Portugal are shown, comparing the rubber and plastics industry of this country with those of its main EU partners. Section 5 concludes.

Main economic indicators of Rubber and Plastics industry: a comparative analysis

Rubber and plastics industry is an important source of intermediate and final products in every economy, but its relative weight in the economy is small in gross output, value added and employment, around 1% (see Table 1). In Portugal, this sector represents 0,9% of gross output, 0,54% of value added and 0,58% of employment, values around the mean of the EU countries selected for comparative purposes, some in the south of the Eurozone (Spain, Italy and Greece), some in the north (Germany, the Netherlands, Finland and Ireland). This industry is more important in Italy, Spain, and particularly in Germany, well above 1% in all indicators (except value added in 2009), although with a slightly decreasing trend.

Table 1: Relative weight of Rubber and Plastics Industry in the Economy

	Weight in Gross Output of the Economy (%)							
	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	0.806	1.129	0.647	1.513	1.013	1.473	0.796	0.934
2000	0.835	1.154	0.528	1.461	0.666	1.406	0.709	0.983
2005	0.916	1.060	0.525	1.324	0.496	1.437	0.680	0.906

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
2009	0.889	0.925	0.469	1.038	0.492	1.239	0.582	0.760
Weight in Value Added of the Economy (%)								
	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	0.565	0.769	0.403	0.983	0.723	1.119	0.573	0.756
2000	0.523	0.817	0.367	0.934	0.527	1.079	0.493	0.859
2005	0.516	0.673	0.372	0.778	0.422	1.085	0.424	0.767
2009	0.542	0.560	0.335	0.590	0.388	0.883	0.419	0.638
Weight in Employment of the Economy (%)								
	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	0.618	0.773	0.558	1.091	0.979	1.193	0.514	0.762
2000	0.612	0.838	0.498	1.186	0.846	1.172	0.516	0.924
2005	0.637	0.770	0.533	1.040	0.689	1.131	0.475	0.774
2009	0.576	0.723	0.464	0.882	0.586	1.106	0.425	0.598

Source: WIOD and authors' calculations

In what regards efficiency of Rubber and Plastics industry, measured by labour productivity (value added by working hour in real terms), in Portugal it grows 2,1% in the period 1995-2009, close to the average growth in northern countries, and well above the average growth in other southern countries. But this good Portuguese performance is explained by a significant growth until 2000, 5,12%, followed by a weak growth after this year (see Table 2).

Table 2: Rubber and Plastics Average growth of Productivity

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995-2000	5.12	0.30	-2.59	0.46	-0.32	2.15	1.03	-0.05
2000-2009	0.45	0.06	0.57	-0.64	7.03	2.36	2.17	3.08
1995-2009	2.10	0.14	-0.57	-0.25	4.34	2.28	1.76	1.95

Source: WIOD and authors' calculations

The changing geography of trade in Rubber and Plastics industry

Rubber and Plastics is an industry with a great exposure to foreign trade, and this openness has been growing in the last decades, accompanying the general movement of globalization and international fragmentation of production (see Table 3). Portugal is a good example of this trend, as the share of exports in gross output of this industry has more than doubled between 1995 (22.7%) and 2011 (49.8%), although the great recession of 2009 has been pernicious, with a fall of 3% in the exports/gross output ratio between 2008 and 2011. This evolution is in line with what has been happening in all the other EU countries, except Greece, which is much more closed in this industry (only around 20% of gross output is exported). Otherwise, this industry is very open in the

Netherlands, where the value of gross exports is more than 90% of gross output, although a significant part of exports has not been produced there, but imported and directly re-exported.

On the other hand, the share of rubber and plastics exports in total exports of Portugal more than doubled too, from 1.4% in 1995 to 3.4% in 2011, and the weight of this sector is much larger in foreign trade than in the other economic indicators previously mentioned (gross output, value added and employment). In 2011, only in Germany is this industry more important in total exports, and by a very thin margin. In the period 1995-2011, the relative share of Rubber and Plastics exports was unchanged in Spain, Italy and Germany, was decreasing in the Netherlands, Greece and Ireland, and, besides Portugal, has only increased in Finland (Table 3).

Table 3. Exports of Rubber and Plastics industry
Share in Gross Output of the sector (%)

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	22.660	23.550	9.930	27.020	39.050	29.720	87.190	37.190
2000	37.460	30.570	17.440	27.820	30.090	40.480	92.870	37.590
2005	45.360	28.510	18.460	31.550	38.130	49.250	93.620	45.760
2008	52.890	28.410	23.300	34.780	36.700	55.990	94.270	43.730
2011	49.750	37.170	20.520	40.960	51.570	59.420	93.700	50.250

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	1.410	2.760	1.440	3.260	1.130	3.250	2.500	1.790
2000	2.250	2.760	1.040	3.200	0.470	3.150	2.280	1.690
2005	3.060	2.700	1.000	3.390	0.490	3.250	2.230	1.980
2008	3.180	2.550	1.090	3.120	0.480	3.250	1.920	1.720
2011	3.380	2.750	1.020	3.230	0.500	3.430	1.810	2.070

Source: WIOD and authors' calculations

In what concerns the geography of rubber and plastics Portuguese exports (Table 4), the main destinations are the EU partners, namely Germany, Spain and France that represent around 60% of the total. Spain was the main partner in 1995 but this role is now occupied by Germany, which has gained 8% in its share.

Table 4. The geography of Portuguese Rubber and Plastics exports

Rank	Country	1995		País	2011	
		Value*	%		Value*	%
1	ESP	100,45	25,73	DEU	460,94	23,71
2	FRA	80,81	20,7	ESP	411,18	21,15

3	DEU	62,26	15,95	FRA	317,5	16,33
4	GBR	40,25	10,31	GBR	90,61	4,66
5	BEL	15,73	4,03	BEL	60,52	3,11
6	ITA	15,02	3,85	ITA	57,13	2,94
7	NLD	8,64	2,21	USA	38,48	1,98
8	SWE	8,4	2,15	POL	36,02	1,85
9	AUT	8,01	2,05	CZE	28,06	1,44
10	USA	4,35	1,11	AUT	27,16	1,4
	RoW	46,43	11,89	RoW	416,59	21,43
	Total	390,38	100	Total	1944,2	100

Source: WIOD and authors' calculations (*million \$US)

The shares of Spain, France and UK have declined, and two eastern EU countries have arrived at the top 10 of export destinations, Poland and the Check Republic, a sign of the changing geography of trade associated with the regional global value chain, or of the “factory Europe”, mentioned in Baldwin and Lopez-Gonzalez (2015).

Regarding the Portuguese imports of rubber and plastics products, the main partner is Spain, and its share has been greatly reinforced, from 28,4% in 1995 to 45,4% in 2011 (see Table 5). The second partner, Germany, has lost importance as well as most of the others, except China, which upgraded from 10th place in 1995 to 6th in 2011, and the Check Republic and Indonesia that have arrived to the top 10 origins of rubber and plastics products. These are also important signs of the changing geography of trade, global value chains, or the “factory World” (Los et al, 2015).

Table 5. The geography of Portuguese Rubber and Plastics imports

Rank	Country	1995		Country	2011	
		Value*	%		Value*	%
1	ESP	266	28,39	ESP	831,07	45,44
2	DEU	216,58	23,11	DEU	281,78	15,41
3	FRA	103,13	11,01	ITA	130,09	7,11
4	ITA	87,47	9,33	FRA	129,93	7,1
5	GBR	54,08	5,77	NLD	100,7	5,51
6	NLD	47,09	5,03	CHN	64,5	3,53
7	BEL	33,32	3,56	BEL	50,69	2,77
8	JPN	16,4	1,75	GBR	49,19	2,69
9	AUT	10,3	1,1	CZE	16,91	0,92
10	CHN	9,79	1,04	IND	15,6	0,85
	ROW	92,86	9,91	ROW	158,5	8,67
	Total	937,01	100	Total	1828,96	100

Source: WIOD and authors' calculations (*million \$US)

Finally, it is worth analyzing the geographical origins of intermediate inputs of the Portuguese Rubber and Plastics industry. Once again, Spain is the main, and growing, supplier of these products, followed by Germany, the Netherlands and France, all of them with decaying shares. And once again China emerges in the top 10 of Rubber and Plastics Industry's suppliers (see Table 6).

Table 6. Imported intermediate inputs of Portuguese Rubber and Plastics sector

NO	País	1995		2011		
		VA*	%	País	VA*	%
1	ESP	93,73	24,76	ESP	353,53	34,19
2	DEU	74,37	19,64	DEU	155,01	14,99
3	FRA	38,12	10,07	NLD	87,48	8,46
4	NLD	30,81	8,14	FRA	65,73	6,36
5	BEL	23,77	6,28	ITA	59,05	5,71
6	GBR	22,89	6,05	BEL	44,05	4,26
7	ITA	21,56	5,69	GBR	36,93	3,57
8	USA	8,43	2,23	CHN	28,26	2,73
9	BRA	4,76	1,26	USA	26,22	2,54
10	SWE	3,51	0,93	BRA	19,19	1,86
	ROW	56,65	14,96	ROW	158,48	15,33
	Total	378,6	100	Total	1033,94	100

Source: WIOD and authors' calculations (*million \$US)

Measuring vertical specialization in the Rubber and Plastics industry

Concepts and measures of vertical specialization

Globalization has been associated with the development of a new organizational paradigm of international production (Daudin et al., 2011). This new paradigm has largely been the subject of study in the literature under different names: "disintegration of production", "relocation", "vertical specialization", "fragmentation", "outsourcing", among others (Feenstra, 1998). Baldwin (2006) calls it the "second unbundling". In this study, we will use the concept of vertical specialization introduced in Hummels et al. (1998) and subsequently developed in Hummels et al. (2001).

According to Hummels et al. (2001), vertical specialization involves the use of imported inputs in the production of goods that are subsequently exported. Thus, this implies that the production is made in at least two countries and that the goods pass through at least two borders.

Vertical specialization has always been present in international trade (Yeats, 1999), but in recent years it has increased substantially, and in 2004 already represented 27% of international trade (Daudin et al., 2011).

The methodology used in this paper was pioneered by Hummels et al. (2001) and followed by several other authors, namely Cadarso-Vecina et al. (2007), Zhang and Sun (2007), Johnson and Noguera (2012), Koopman et al. (2014) and Los et al (2015). According to Hummels et al. (2001), the vertical specialization of the good or sector i in country k can be determined as:

$$(1) \quad VS_{ki} = \left(\frac{\text{imported inputs}}{\text{output}} \right) \cdot \text{exports}$$

The first term of equation (1) can be defined as the share of imported intermediate inputs used in the production of the good or sector i .

Therefore, the vertical specialization of country k is merely the sum of the VS of all the sectors i , or $VS_k = \sum_i VS_{ki}$. In order to facilitate the analysis, it is useful to calculate the VS share in total exports of country k , X_k , given by:

$$(2) \quad \frac{VS_k}{X_k} = \frac{\sum_i VS_{ki}}{\sum_i X_{ki}}$$

The input-output tables are a key component of the methodology proposed by Hummels et al. (2001). These allow to obtain the VS for each sector, as they give us the value of imported intermediate inputs, by use sector.

In matrix form, equation (2) can be written as:

$$(3) \quad VS_k/X_k = \mathbf{u} \mathbf{A}^M \mathbf{x} / X_k$$

where \mathbf{u} is a summation vector, \mathbf{A}^M is the $n \times n$ matrix of imported intermediate input coefficients, \mathbf{x} is the $n \times 1$ vector of exports and X_k is the sum of exports of all the n sectors. This measure can be called the Direct VS measure of country k , as it only considers the imported intermediate inputs directly used in the production of the exported goods.

However, the input-output model allows the calculation of a Total VS measure, when the direct plus indirect and induced imported intermediate inputs of the industries are taken

into account, through the matrix of (domestic) production multipliers, the so-called Leontief inverse, $[I-A^D]^{-1}$ (for the deduction of this matrix, see Miller and Blair, 2009):

$$(4) \quad \frac{VS_k}{X_k} = \frac{uA^M[I-A^D]^{-1}x}{X^k}$$

This is the most useful measure of vertical specialization of a country and it can also be applied to individual sectors as well.

Quantifying vertical specialization

Using the methodology presented above, an empirical application was made for Portugal and other EU countries in the period 1995-2011, based on the global Input-Output Tables of the WIOD database.

The first and simplest indicator of the internationalization of production activities in a country or in a sector is the direct foreign content of its output, i.e. the proportion of imported intermediate inputs on gross output. In the case of Rubber and Plastics industry (Table 7), this share increases between 1995 and 2011, in Portugal and most of other cases, except Greece and Ireland. According with this criterion, this sector is particularly open in Ireland and the Netherlands, and relatively more closed in Spain and Italy, with Portugal close to the average (26,5% in 2011).

Table 7. Share of imported intermediate inputs in gross output: Rubber and Plastics industry (%)

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	21,98	15,49	22,13	14,94	38,8	14,22	32,14	16,48
1996	20,69	15,12	19,72	13,48	39,08	14,07	30,75	17,31
1997	21,03	16,8	21,04	14,05	38,7	15,27	31,94	17,90
1998	22,15	17,28	21,7	13,75	35,02	16,68	31,2	17,04
1999	23,04	17,94	21,62	13,59	37,99	17,9	30,54	16,05
2000	25,75	16,8	22,53	15,34	38,11	17,71	32,98	18,01
2001	25,19	16,81	21,47	15,06	36,19	18,23	31,21	17,56
2002	25,37	16,42	19,08	14,22	32,57	16,48	30,28	17,04
2003	24,65	16,5	18,2	14,74	29,75	16,75	30,4	16,84
2004	25,7	16,48	19,53	15,24	29,81	17,94	32,52	16,46
2005	26,81	16,94	21,51	16	29,84	19,35	34,18	18,91
2006	26,83	17,96	22,43	17,16	28,98	21,48	35,57	20,05
2007	27,00	18,57	25,01	17,42	29,02	21,89	35,73	20,77
2008	28,48	17,4	24,77	16,91	32,32	22,52	37,35	21,15

2009	23,62	15,53	20,98	14,77	31,24	21,38	31,83	16,29
2010	25,43	17,54	20,92	17,03	34,13	23,15	34,99	21,20
2011	26,46	18,03	20,97	18,64	35,74	24,78	35,28	21,95

Source: WIOD and authors' calculations

Comparing the values of Table 7 with those of Table 8 (imported intermediates/gross output ratio for the whole economy), we find that the proportion of imported inputs (directly) used by the Rubber and Plastics industry is significantly higher than the economy's average share, in all countries.

Regarding the direct share of vertical specialization (VS) in exports, the EU countries did not undergo considerable changes between 1995 and 2011. The higher values are found in Ireland (38.6% in 2001) and the lowest in Italy throughout this period. Portugal is the only country where, from 1995 to 2011, the direct share of VS exports declined. In 2008, VS represented 24.14% of the country's exports, but since then it drops, probably an effect of the financial and economic crisis of 2008/2009 and the difficulty of recovery thereafter (see Table 9).

Table 8. Share of imported intermediate inputs in gross output: economy (%)

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	10,40	6,8	7,46	7,06	20,47	6,63	15,27	9,89
1996	10,36	6,9	7,47	6,39	20,31	6,74	15,28	10,02
1997	10,59	7,57	8,26	6,61	20,47	7,33	15,99	10,37
1998	10,65	7,79	8,42	6,65	22,56	7,55	15,5	9,84
1999	10,53	8,13	9,17	6,55	24,2	7,87	15,57	9,92
2000	11,50	9,92	11,91	7,81	26,96	9,2	16,76	11,86
2001	11,03	9,3	11,94	7,61	27,01	9,21	16,09	10,95
2002	10,78	8,71	10,96	7,1	25,06	8,75	15,11	10,92
2003	10,52	8,38	10,07	7,01	23,4	8,9	15,03	10,4
2004	10,86	8,63	10,12	7,41	24,27	9,59	15,77	11,21
2005	11,22	8,81	10,2	7,93	24,15	10,37	16,41	12,83
2006	11,93	9,4	11,71	8,92	23,48	11,33	17,22	13,39
2007	11,8	9,76	12,04	9,07	22,91	11,8	17,02	13,53
2008	12,79	9,61	12,92	9,13	24,43	12,21	18,47	14,16
2009	10,11	7,53	10,42	7,67	25,25	9,98	16,69	11,65
2010	10,13	8,97	10,27	9,21	26,82	11,25	18,61	12,97
2011	10,34	9,71	10,38	9,9	27,55	12	19,56	13,7

Source: WIOD and authors' calculations (*million \$US)

Recall that the total (direct plus indirect) share of vertical specialization in exports of countries is the main measure for VS. As can be seen in Table 10, Ireland distinguishes

once more by presenting a VS higher than other countries (45,4% in 2011). In the second place of this ranking is the Netherlands with 41.2% and in third Finland with 35.9%. In Portugal, total VS share in exports is 29.2%, below the 2008 value (34.5%), as a result of the great recession already mentioned.

As about the total VS share of exports in the Rubber and Plastics industry, in Portugal it has been always significantly higher than the average for the whole economy, and the same goes for Italy and the Netherlands (see Table 11). The value of this indicator in the Portuguese case is high, and only surpassed by the Irish and the Netherland cases. It is also worth mentioning its increase between 1995 (31.5%) and 2008 (39,6%), followed by a decline thereafter (36% in 2011). This trend is a clear sign of the greater participation of Portuguese Rubber and Plastics industry in the regional (European) and global value chains.

Table 9. Direct vertical specialization (VS) of exports in the economy (%)

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	19,18	13,26	12,99	11	30,78	12,56	24,58	15,17
1996	19,3	13,09	12,93	9,97	31,18	12,85	24,72	15,67
1997	19,46	14,13	16,49	10,34	31,23	13,8	25,93	16,32
1998	20,21	14,82	16,44	10,45	32,51	14,16	24,99	15,47
1999	20,15	15,58	19,76	10,36	34,39	14,87	25,13	15,47
2000	21,26	18,02	23,76	12,34	38,04	16,31	27,22	18,26
2001	20,87	16,7	27,27	11,99	38,35	16,19	25,63	16,62
2002	20,58	15,82	24,37	11,4	34,56	15,48	24,17	16,72
2003	21,02	15,97	20,82	11,6	32,96	15,97	24,23	16,36
2004	21,8	16,75	23,1	12,3	33,82	17,17	25,63	18,27
2005	21,94	16,95	20,97	13,2	33,08	18,29	26,79	21,06
2006	23,09	18,75	23,63	14,63	31,94	19,74	28,32	22,89
2007	22,64	19,34	23,23	15,06	30,67	20,28	27,85	22,8
2008	24,14	19,51	24,91	15,31	31,76	20,93	29,98	23,2
2009	18,61	15,47	20,42	12,63	32	17,9	27,33	19,61
2010	18,57	18,15	20,23	15,58	32,83	19,9	30,64	21,84
2011	18,93	20,56	20,46	16,89	34,23	20,8	32,33	23,14

Source: WIOD and authors' calculations (*million \$US)

Table 10. Total vertical specialization (VS) of exports in the economy (%)

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	28,96	21,65	19,87	19,69	40,84	18,82	33,03	24,71
1996	28,95	21,56	20,08	17,8	40,83	19,12	33,42	25,38

1997	29,54	22,98	23,41	18,55	40,92	20,48	34,65	26,26
1998	29,95	23,76	23,09	18,72	41,43	20,98	33,82	24,72
1999	29,46	24,73	25,38	18,66	42,85	21,82	33,96	24,65
2000	31,61	28,66	31,44	21,89	47,01	24,38	36,16	29,22
2001	30,97	26,84	33,15	21,3	47,13	24,17	34,46	26,58
2002	30,12	25,65	30,73	20,36	43,18	22,87	32,79	26,27
2003	30,31	25,55	27,1	20,51	42,01	23,47	32,63	25,94
2004	31,43	26,84	28,53	21,7	43,1	24,93	33,97	28,39
2005	32,23	27,67	26,85	23,22	43,36	26,61	35,19	32
2006	33,39	30,03	29,4	25,7	42,33	28,6	36,78	34,67
2007	32,92	30,65	29,08	26,3	41,77	29,38	36,71	34,31
2008	34,52	30,68	30,62	26,72	43,1	30,17	38,9	35,64
2009	28,77	25,14	24,82	22,29	43,77	25,95	36,19	31,46
2010	28,75	28,56	24,77	26,64	44,51	28,53	39,42	34,11
2011	29,12	31,04	24,86	28,26	45,37	29,88	41,2	35,96

Source: WIOD and authors' calculations (*million \$US)

To sum up, it can be stated that the rubber and plastics industry, despite its weak absolute and relative share in terms of Gross Output, Value Added and employment, is an important sector for the Portuguese economy in terms of foreign trade and vertical specialization, as well as the participation of Portugal in the global value chains.

Table 11. Total vertical specialization (VS) of exports in the R&P industry (%)

	PRT	ESP	GRC	ITA	IRL	DEU	NLD	FIN
1995	31,46	24,35	29,68	24,31	48,51	19,74	38,98	24,87
1996	29,52	23,62	26,93	22,04	48,6	19,38	37,58	25,52
1997	30,38	25,72	28,95	23,14	48,93	20,97	39,14	26,25
1998	31,52	26,37	29,59	22,72	45,69	22,24	38,44	24,87
1999	32,31	27	29,23	22,66	48,43	23,32	37,65	23,52
2000	36,67	27,32	30,81	25,68	48,3	24,43	40,57	27,11
2001	35,7	27,32	30,65	25,23	45,08	24,82	38,96	26,19
2002	35,38	26,42	26,63	24,08	41,87	22,66	37,77	25,44
2003	34,6	26,32	25,11	24,74	40,32	23,14	37,74	25,26
2004	36,22	26,53	26,61	25,62	40,36	24,49	39,98	25,21
2005	38,12	28,31	28,45	26,85	42,04	26,4	41,75	28,92
2006	37,77	30,04	29,25	29,2	41,22	28,96	43,33	30,52
2007	37,84	30,58	31,53	29,44	42,96	29,41	43,37	30,89
2008	39,59	29,86	31,56	29,16	45,83	29,95	45,19	32,45
2009	34,64	26,53	26,7	25,92	45,72	27,68	39,24	26,77
2010	36,06	29,16	26,65	29,54	47,82	29,71	42,97	31,55
2011	36,88	29,92	26,66	31,29	48,85	31,37	43,48	32,53

Source: WIOD and authors' calculations (*million \$US)

Concluding remarks

Regional and global value chains have changed the organization of international production and the geography and dynamics of foreign trade. These changes have been extensively studied and cataloged under different names, such as “disintegration of production”, “relocation”, “vertical specialization”, “fragmentation”, “outsourcing”, “offshoring”, among others. Thus, one important feature of the new international and globalized economy is the significant increase of intermediate goods trade, crossing several borders along the supply chains.

The main purpose of this paper was to measure the vertical specialization of the Portuguese economy in the period 1995-2011, with a particular focus on an individual industry, rubber and plastics that is an interesting case study in this context, as a source of intermediate goods with many utilizations.

To put the results in perspective, a comparison is made with the main EU partners of Portugal, geographically divided in two groups, northern (Germany, the Netherlands, Finland and Ireland) and southern (Spain, Italy and Greece). This empirical application is based on the global input-output tables of the WIOD database.

The analysis is based on three indicators: the percentage of imported intermediates on gross output; the direct foreign content of exports (direct Vertical Specialization); the direct plus indirect foreign content of exports (total Vertical Specialization).

The main result confirms the growing importance of foreign intermediate goods content of exports in all economies, in the period from 1995 until 2008, but the great recession has inverted this trend, and in 2011 most of the countries have not yet recovered to pre-crisis values. The Portuguese economy has an average degree of openness, between highly opened economies, Ireland and the Netherlands, and relatively more closed ones, Greece, Italy and Germany.

Another important result is that Rubber and Plastics industry is much more open than the average of the industries in all economies, as expected, and the trends described above are also verified in this sector. The vertical specialization, both direct and total, of this industry in Portugal is remarkable (30% in 1995; 35% in 2008), pointing to a good integration in global, and particularly regional (European) value chains. In fact, the main trading partners of Portugal are close neighbours (Spain, France and Germany), but the role of China has been growing, as well as those of Eastern EU countries, Poland and the

Check Republic. This diversification of trade patterns is good and it is expected that it will be strengthened in the future.

References

- AMADOR, J. and CABRAL, S. (2008). Vertical specialization in Portuguese international trade. *Economic Bulletin and Financial Stability Report Articles, Summer*.
- AMADOR, J. and STEHRER, R. (2014). Portuguese Exports in the Global Value Chains. Banco de Portugal, Economic Bulletin, April.
- AMITI, M. and WEI, S. J. (2009), Service offshoring and productivity: Evidence from the US. *World Economy*, 32(2), 203-220.
- BALDWIN, R. (2006). *Globalisation: the great unbundling(s)*. Research paper of the project "Globalisation Challenges for Europe and Finland", 20 September 2006, Secretariat of the Economic Council of Finland.
- BALDWIN, R. (2012). Global supply chains: Why they emerged, why they matter, and where they are going. *CEPR Discussion Papers 9103*, Centre for Economic Policy Research.
- BALDWIN, R. and ROBERT-NICOUD, F. (2014). Trade-in-goods and trade-in-tasks: An integrating framework. *Journal of International Economics* 92(1), 51–62.
- BAYOUMI, T.; SAITO, M. and TURUNEN, J. (2013). Measuring Competitiveness: Trade in Goods or in Tasks?, IMF Working Paper 13/xx, Washington: International Monetary Fund.
- CAPPARIELLO, R. and FELETTIGH, A. (2014). How does foreign demand activate domestic value added? A dashboard for the Italian economy, *mimeo*.
- CARDOSO, F.; ESTEVES, P. S. and RUA, A. (2013). The import content of global demand in Portugal. *Economic Bulletin and Financial Stability Report Articles, Autumn*.
- CADARSO-VECINA, M.-A.; GÓMEZ-SANZ, N.; LÓPEZ-SANTIAGO, L.-A. and TOBARRA-GÓMEZ, M.-Á. (2007). *Vertical specialisation in EU manufacturing and services sectors*. Paper presented at the 16th International Input-Output Conference, Istanbul, Turkey, 2-6 July 2007.
- CRINO, R. (2010). Service Offshoring and White-Collar Employment," *Review of Economic Studies*, Vol. 77, No. 2, pp. 595-632.
- DIETZENBACHER, E.; LOS, B.; STEHRER, R.; TIMMER, M. P. and DE VRIES, G. (2013). The Construction of World Input-Output Tables in the WIOD Project. *Economic Systems Research* 25(1): 71– 98.
- DAUDIN, G.; RIFFLART, C. and SCHWEISGUTH, D. (2011). Who produces for whom in the world economy? *Canadian Journal of Economics*, 44(4), 1403-1437.
- DI MAURO, F.; PLAMPER, H. and STEHRER, R. (2013). Global Value Chains: A Case for Europe to Chher Up, CompNet Policy Brief 03/2013, ECB.
- DUPREZ, C. and DRESSE, L. (2013). The Belgian economy in global value chains: An exploratory analysis. *National Bank of Belgium Economic Review (II)*, 07–21.
- FEENSTRA, R. C. (1998). Integration of Trade and Disintegration of Production in the Global Economy. *Journal of Economic Perspectives*, 12(4), 31-50.
- FEENSTRA, R. C. and HANSON, G. H. (1999). The impact of outsourcing and high technology capital on wages: Estimates for the United States, 1979-1990. *The Quarterly Journal of Economics* 114(3), 907–940.

- HUMMELS, D.; RAPOPORT, D. and YI, K.-M. (1998). Vertical Specialization and the Changing Nature of World Trade. *FRBNY Economic Policy Review*, 79-99.
- HUMMELS, D.; ISHII, J. and YI, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, 54(1), 75-96.
- GROSSMAN, G. and ROSSI-HANSBERG, E. (2008). Trading Tasks: A Simple Theory of Offshoring, *American Economic Review*, 98, 1978-1997.
- JOHNSON, R. C. and NOGUERA, G. (2012). Accounting for intermediates: Production sharing and trade in value added. *Journal of International Economics*, 86, 224-236.
- KOOPMAN, R.; WANG, Z., and WEI, S.-J. (2014). Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*, 104(2), 459-494.
- LOS, B.; TIMMER, M. and DE VRIES, G. J. (2015). How global are global value chains? A new approach to measure international fragmentation, *Journal of Regional Science*, 55(1), 66-92.
- LIU, R. and TREFLER, D. (2008). Much Ado About Nothing: American Jobs and the Rise of Service Outsourcing to China and India, NBER Working Paper No. 14061 (Cambridge, MA: The National Bureau of Economic Research).
- MILLER, R. E. and BLAIR, P. D. (2009). *Input-Output Analysis: Foundations and Extensions* (2^a ed.). Cambridge: Cambridge University Press.
- STEHREER, R. and STÖLLINGER, R. (2013). Positioning Austria in the global economy: Value added trade, international production sharing and global linkages. *FIW Research Reports series V-002, FIW*.
- TIMMER, M.; ERUMBAN, A.; GOUMA, R.; LOS, B.; TERMUSHOEV, U.; VRIES, G.; ARTO, I.; ANDREONI, V.; GENTY, A.; NEUWAHL, F.; RUEDA-CANTUCHE, J.; VILLANUEVA, A.; FRANCOIS, J.; PINDYUK, O.; POSCHL, J.; STEHERER, R. and STREICHER, G. (2012), The world input-output database (WIOD): Contents, sources and methods, WIOD Working Paper 10, World Input-Output Database (WIOD).
- TIMMER, M. P.; LOS, B.; STEHRER, R. and VRIES, G. J. (2013). Fragmentation, incomes and jobs: an analysis of European competitiveness. *Economic Policy*, 28(76), 613-661.
- YEATS, A. J. (1999). Just How Big Is Global Production Sharing? *Policy Research Working Papers*, The World Bank.
- ZHANG, X. and SUN, J. (2007). An analysis of China's global industrial competitive strength based on vertical specialization. *Frontiers of Economics in China*, 2(1), 57-73.