MESTRADO EM ECONOMIA INTERNACIONAL E ESTUDOS
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TRABALHO FINAL DE MESTRADO

DISSERTAÇÃO

**THE EVOLUTION OF TRADE FLOWS BETWEEN PORTUGAL
AND CHINA: AN INTER-INDUSTRY APPROACH**

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Orientação: Professor Doutor João Carlos Lopes

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Abstract

After the policy of reform and opening-up, during the last 3 decades, China was the world's fastest-growing major country, with growth rate averaging over 10%. And China has become the biggest country of international trade and the second biggest economy in the world.

On the other hand, after joining the European Union, despite of the great recession of 2008/2009 and the Euro Zone crisis between 2010 and 2013, the Portuguese economy has a significant growth in the last few decades.

In addition, the trade between Portugal and China also expanded a lot. The growth of trade between two countries was very significant.

The object of this investigation is the trade flows between Portugal and China particularly in the global value chains. As we know, the European Union is the biggest trade partner of China with the annual value about 521 billion Euros in 2015. Portugal, as a member of the European Union, plays an important role in the bilateral trading.

This research involves the analysis of the trade flows in total gross value and gross value by sectors and the vertical specialization in global value chains, in order to explain the main characteristics of the evolution of trade flows between them. It is decided to use the Leontief Input-Output Model and the Vertical Specialization for the analysis of the data from the World Input-Output Database (WIOD).

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1. Introduction

In the recent few decades, the global trade has changed the whole world. The world is becoming integrated, and everyone depends more and more on each other because of the fast growing fragmentation of production activities. Each country concentrates on the production where it has the abundant productive factors. This is named by Richard Baldwin (2006) as the "second unbundling". After that, the booming global trade contributes to the extremely fast growth of the world. And Global Value Chains (GVC) became the paradigm for the production of most goods and services around the world. Production is nowadays vertically fragmented across different countries (Amador and Stehrer (2014)).

China, with the policy of reform and opening-up starting from the 80s, became to export more and more products to the rest of world and to play an important role in the global trade because of its low costs and cheap labor. As one of the largest economies in the world, the European Union becomes the first trade partner of China.

Meanwhile, Portugal, as one of the important members of the EU, despite of its small size in geography and economy, grew a lot in the recent decades with its concentration on the global trade. Nowadays the exports contribute more and more to the Portuguese economy.

Considering the two facts above, a study of the trade flows between Portugal and China could be very interesting.

The research is based on the data of World Input-Output Database (WIOD) and UN Comtrade. Created by the European Commission, available in http://www.wiod.org/, WIOD is the first public database that contains new information and opportunities to analyse the global trade flows and fragmentation by sectors. The WIOD provides time-series of world input-output tables for forty countries worldwide and the rest of the world, covering the period from 1995 to 2011 (Timmer (2012)). Moreover, UN Comtrade is a repository of official trade statistics and relevant analytical tables. It contains annual trade statistics starting from 1962 and monthly trade statistics since 2010, available in http://www.comtrade.un.org/.

To analyze, it is decided to take the years of 1995, 1999, 2004, 2008, 2009 and 2011. Because the year of 1995 was the first year that the WIOD begins. The year of 1999 was the year when Portugal joined the Euro Zone. The year of 2004 was the year when the largest single expansion of the European Union happened which is called the "2004 enlargement of the European Union". The year of 2008 was the year when the global financial crisis happened. And the year of 2009 was the second year of the financial crisis. Finally, the year of 2011 was the year that the WIOD ends.

Basically there are two ways to analyze the trade flows between Portugal and China: the gross value and the added value. Within Chapter 2, the analysis is based on the gross value and there are two parts. The first part is global value patterns: 1995-2015. The second part is trade by sector. The top ten sectors will be introduced both in value and in percentage. In Chapter 3, on the other way, the analysis is based on the added value in order to make a better understanding of the positions of the two countries in the global value chains (GVC). In this article, the concept of vertical specialization is used to analysis the added value. We use both direct foreign content of exports applied by Feenstra and Hanson (1999) and total (direct and indirect) foreign content of exports proposed by Hummels et al (2001) as two measures. Lately in Chapter 4, we are going to note out some possible errors in the data of WIOD, particularly in some exports of services from Portugal to China. Finally, Chapter 5 concludes, with the main findings as well as some limitations and possible future lines of research indicated.

2. Trade flows between Portugal and China

2.1 Global trade patterns: 1995-2015

2.1.1 Gross Value

In table 1 and table 2, "EXPC" means the exports from Portugal to China, "EXPW" means the exports from Portugal to the rest of the world, "EXCP" means the exports from China to Portugal and "EXCW" means the exports from China to the rest of the world.

Table 1: Exports from Portugal to China (million US$)

Year	EXPC	EXPW	EXPC/EXPW
1995	33,74	23.369,99	0,14%
1996	32,36	23.180,97	0,14%
1997	46,65	23.524,90	0,20%
1998	19,67	24.217,87	0,08%
1999	32,43	24.493,55	0,13%
2000	48,62	24.327,67	0,20%
2001	53,80	24.086,41	0,22%
2002	75,98	25.825,58	0,29%
2003	169,61	31.833,58	0,53%
2004	125,56	44.354,99	0,28%
2005	210,02	38.672,07	0,54%
2006	267,97	44.777,44	0,60%
2007	241,27	52.483,61	0,46%
2008	259,77	57.246,28	0,45%
2009	304,43	44.249,98	0,69%
2010	304,01	49.414,05	0,62%
2011	551,95	59.588,30	0,93%
2012	1.000,47	58.140,50	1,72%
2013	872,83	62.794,14	1,39%
2014	1.114,05	63.885,57	1,74%
2015	930,93	55.241,09	1,69%

Source: Comtrade and own calculation

As we can see from the table 1, from 1995 to 2015, the exports from Portugal to China (EXPC) grew every year except 1996, 1998, 2004, 2007, 2013 and 2015. And during the two decades, EXPC has increased by about thirty times which was very significant. Along all the years, we can see that there were two biggest jumps in the year 2003 and

the year 2012. On the other hand, the exports from Portugal to the rest of the world (EXPW) only grew more or less two times in the same period, which is a big contrast comparing to EXPC.

What's more, considering the last column, the weight of EXPC in EXPW grew dramatically from 0.14% in 1995 to 1.69% in 2015. Although the growth was very great, the exports from Portugal to China did not consider to be an important part in the total exports of Portugal.

Table 2: Exports from China to Portugal (million US$)

Year	EXCP	EXCW	EXCP/EXCW
1995	106,05	148.779,50	0,07%
1996	133,80	151.047,46	0,09%
1997	166,15	182.791,58	0,09%
1998	200,59	183.808,98	0,11%
1999	219,94	194.930,78	0,11%
2000	260,82	249.202,55	0,10%
2001	260,57	266.098,21	0,10%
2002	300,88	325.595,97	0,09%
2003	406,26	438.227,77	0,09%
2004	588,26	593.325,58	0,10%
2005	911,95	761.953,41	0,12%
2006	1.359,66	968.935,60	0,14%
2007	1.834,75	1.220.059,67	0,15%
2008	2.317,10	1.430.693,07	0,16%
2009	1.923,52	1.201.646,76	0,16%
2010	2.513,32	1.577.763,75	0,16%
2011	2.801,43	1.898.388,43	0,15%
2012	2.501,16	2.048.782,23	0,12%
2013	2.506,86	2.209.007,28	0,11%
2014	3.136,97	2.342.343,01	0,13%
2015	2.897,55	2.281.855,92	0,13%

Source: Comtrade and own calculation

In terms of the exports from China to Portugal (EXCP), from 1995 to 2015, it expanded about twenty-seven times, which was quite remarkable. And in the same time, the exports from China to the rest of the world (EXCW) also grew about fifteen times. For the last two decades, the ratio of EXCP in EXCW increased from 0.07% in 1995 to 0.13% in 2015 (see Table 2).

Figure 1: Exports from Portugal to China and from China to Portugal
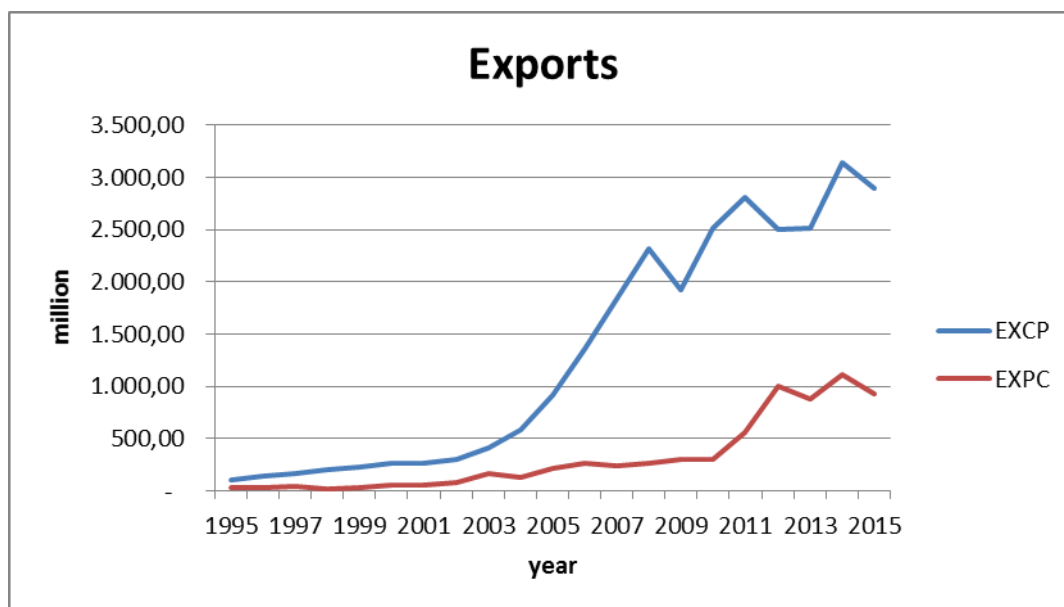
Source: Comtrade and own Calculation

In Figure 1, comparing EXPC and EXCP, EXCP is quite larger than EXPC, which means China has a big trade surplus with Portugal. From the very beginning, the exports from China to Portugal were bigger than the ones from Portugal and the difference became larger and larger. For example, in 2015 (the last year of this study), EXCP is almost three times of EXPC. But in terms of evolutions, both two had almost the same trend. When the exports from China to Portugal decreased, the exports from Portugal to China also decreased. When the exports from Portugal to China increased, the same thing happened to the ones from China to Portugal. And they both reached the peaks at the same time.

2.1.2 Weight in total exports

In another view, in Figure 2, EXPC/EXPW expanded a lot along these years from 0.14% in 1995 to 1.69% in 2015. This means that the weight of EXPC in EXPW has a

significant increase, but in terms of absolute value, it was still a small part of the total exports of Portugal.

Figure 2: Weight of exports from Portugal to China in total exports and Weight of exports from China to Portugal in total exports
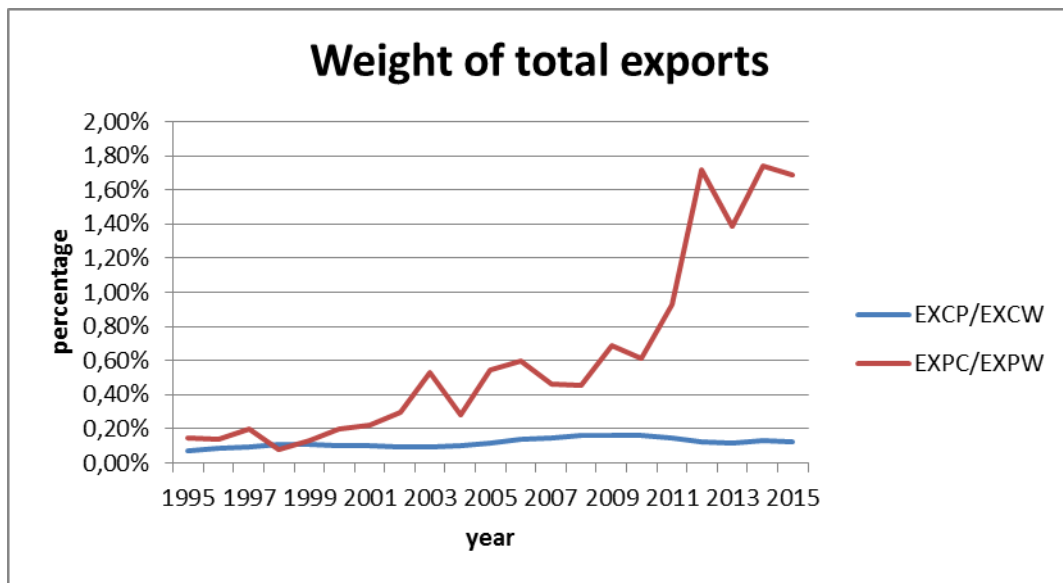
Source: Comtrade and own Calculation

Nevertheless, the occupation of EXCP in EXPW only has a small growth and continued seeming always the same level (Figure 2, blue line). The ratio was 0.07% in 1995 and 0.13% in 2015. It was always a small value in the total exports of China which means that the exports from China to Portugal were not an important component never.

Comparing Figure 1 and Figure 2, the exports from Portugal to China were smaller than the exports from China to Portugal, but the weight of exports from Portugal to China in total exports was much bigger than the one from China. It implies that along the two decades, the growth of total exports of Portugal were smaller than China.

2.2 Trade by sector

2.2.1 Gross exports from Portugal to China

From table 3 to table 26, the unit of the data is million US$. The years of 1995, 1999, 2004, 2008, 2009 and 2011 are chosen for the analysis. And the top ten sectors with biggest values are shown. From Table 3 to Table 26, "T" means total, "Z" means exports are for domestic production, and "Y" means exports are for final consumption.

Table 3: Exports Portugal/China: weight of top 10 sectors-1995

Sector	EXPCT95			EXPCZ95			EXPCY95		
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c30-Renting of M&Eq and Other Business Activities	1	78,67	28%	1	73,06	33%	4	5,61	9%
c28-Financial Intermediation	2	76,23	27%	2	60,11	27%	1	16,12	27%
c34-Other Community, Social and Personal Services	3	36,31	13%	3	24,28	11%	2	12,04	20%
c14-Electrical and Optical Equipment	4	17,05	6%	4	13,67	6%	6	3,38	6%
c9-Chemicals and Chemical Produts	5	12,69	4%	5	10,25	5%	8	2,44	4%
c4-Textiles and Textile Produts	6	9,56	3%	10	3,04	1%	3	6,51	11%
c31-Public Admin and Defence; Compulsory Social Security	7	7,74	3%	6	7,15	3%	11	0,59	1%
c6-Wood and Produts of Wood and Cork	8	5,70	2%	7	5,67	3%	29	0,03	0%
c2-Mining and Quarrying	9	5,23	2%	8	5,22	2%	32	0,01	0%
c13-Machinery, Nec	10	5,19	2%	17	1,04	0%	5	4,16	7%
Others		30,11	11%		21,21	9%		8,90	15%
Total		284,48	100%		224,69	100%		59,79	100%

Source: WIOD and own calculations

In 1995, the top 10 sectors of exports from Portugal to China in gross value are c30-Renting of Equipment and Other Business Activities, c28-Financial Intermediation, c34-Other Community, Social and Personal Services, c14-Electrical and Optical Equipment, c9-Chemical and Chemical Products, c4-Textiles and Textiles Products, c31-Pulbic Admin and Defense, Compulsory Social Security, c6-Wood and Products of Wood and Cork, c2-Mining and Quarrying and c13-Machinery, Nec.(see table 3)

Among them, the top 3 sectors (c30, c28 and c34) represent 68% of whole exports from Portugal to China. And then come c14 with 6%, c9 with 4% and c4 with 3%. It means that the majority of the exports from Portugal to China is services.

In terms of destination of exports, the major part of exports from Portugal to China in 1995 was for the domestic production of China. It was 224.69 million US$ for domestic production but was only 59.79 million for the final consumption of China.

Table 4: Exports Portugal/China: weight of top 10 sectors-1999

Sector		EXPCT99			EXPCZ99			EXPCY99	
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c30-Renting of M&Eq and Other Business Activities	1	167,25	36%	1	154,82	41%	3	12,43	15%
c28-Financial Intermediation	2	127,97	28%	2	100,92	27%	1	27,05	32%
c34-Other Community, Social and Personal Services	3	45,93	10%	3	30,51	8%	2	15,41	18%
c31-Public Admin and Defence; Compulsory Social Security	4	21,50	5%	4	19,79	5%	9	1,71	2%
c14-Electrical and Optical Equipment	5	15,05	3%	8	6,93	2%	4	8,12	10%
c7-Pulp, Paper, Paper , Printing and Publishing	6	12,29	3%	5	12,25	3%	26	0,04	0%
c9-Chemicals and Chemical Products	7	10,23	2%	6	7,71	2%	8	2,52	3%
c4-Textiles and Textile Products	8	9,05	2%	7	7,46	2%	10	1,59	2%
c18-Construction	9	6,53	1%	28	0,40	0%	5	6,14	7%
c6-Wood and Products of Wood and Cork	10	6,37	1%	9	6,34	2%	30	0,03	0%
Others		41,62	9%		31,75	8%		9,88	12%
Total		463,78	100%		378,87	100%		84,91	100%
Source: WIOD and own calculations									

From Table 4, as we can see, in 1999, the total amount of exports from Portugal to China increased a lot comparing to the amount of the year 1995. In 1995 it was 284.48 million US$ and 463.78 million in 1999. The biggest industry was still c30-Renting of Equipment and Other Business Activities with 167.25 million US$. But the principal destination of exports of c30 was the domestic consumption. The percentage of the top 3 sectors (c30-36%, c28-28%, c34-10%) increased to 74% in total exports. And another service c31-Public Admin and Defense increased to the fourth place, occupying 5% of whole exports. It implied that the services were very important components in the exports from Portugal to China.

On the other hand, in these sectors such as c14-Electrical and Optical Equipment, c9-Chemicals and Chemical Products and c4-Textiles and Textile Products, although the amounts of trade remained the same, the weight of the percentage decreased.

The principal exports from Portugal to China in 1999 was for domestic production with 378.87 million US$. And just 84.91 million was for the final consumption of China.

Table 5: Exports Portugal/China: weight of top 10 sectors-2004

	EXPCT04			EXPCZ04			EXPCY04		
Sector	Rank	Value	%	Rank	Value	%	Rank	Value	%
c30-Renting of M&Eq and Other Business Activities	1	818,01	47%	1	757,16	52%	2	60,84	22%
c28-Financial Intermediation	2	207,85	12%	2	170,91	12%	4	36,94	13%
c34-Other Community, Social and Personal Services	3	155,41	9%	3	104,72	7%	3	50,70	18%
c14-Electrical and Optical Equipment	4	112,94	7%	7	50,08	3%	1	62,86	22%
c31-Public Admin and Defence; Compulsory Social Security	5	105,40	6%	4	97,12	7%	8	8,28	3%
c20-Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	6	69,24	4%	5	57,68	4%	5	11,56	4%
c21-Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	7	54,96	3%	6	50,46	3%	11	4,49	2%
c13-Machinery, Nec	8	23,04	1%	10	12,44	1%	6	10,59	4%
c27-Post and Telecommunications	9	22,52	1%	8	19,76	1%	12	2,76	1%
c7-Pulp, Paper, Paper , Printing and Publishing	10	17,89	1%	9	17,76	1%	30	0,13	0%
Others		139,03	8%		108,34	7%		30,69	11%
Total		1726,28	100%		1446,43	100%		279,84	100%
Source: WIOD and own calculations									

In 2004, the exports from Portugal to China (1726.28 million US$) was already more or less four times of the value of the year 1999 (463.78 million US$). The top 3 sectors (c30-47%, c28-12%, c34-9%) continued reinforcing its percentage in the exports from Portugal to China with total 68%. The sector of c14-Electrical and Optical Equipment also increased a lot both in the percentage and in the absolute value. And it is noted that these sectors like c20-Wholesale Trade and Commission Trade and c21-Retail Trade became to play an important role in the exports from Portugal to China. But the weight was still small. And as it can be seen that besides the top 10 sectors, all the others sectors only had 8% of the weight with 139.03 million US$ which means the exports from Portugal to China was unbalanced. Moreover, considering the destination of exports, 1446.43 million US$ was intermediate goods and 279.84 million was for the final consumption (see Table 5).

Table 6: Exports Portugal/China: weight of top 10 sectors-2008

Sector		EXPCT08			EXPCZ08			EXPCY08	
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	283,61	26%	1	213,09	28%	1	70,52	21%
c27-Post and Telecommunications	2	171,25	15%	2	142,64	18%	3	28,61	8%
c4-Textiles and Textile Products	3	42,94	4%	10	5,92	1%	2	37,02	11%
c9-Chemicals and Chemical Products	4	32,94	3%	3	32,79	4%	18	0,15	0%
c13-Machinery, Nec	5	26,98	2%	5	12,85	2%	5	14,12	4%
c15-Transport Equipment	6	26,39	2%	7	9,73	1%	4	16,66	5%
c6-Wood and Products of Wood and Cork	7	22,55	2%	4	22,50	3%	22	0,05	0%
c12-Basic Metals and Fabricated Metal	8	16,89	2%	8	8,03	1%	8	8,86	3%
c3-Food, Beverages and Tobacco	9	12,67	1%	24	0,14	0%	6	12,54	4%
c5-Leather, Leather and Footwear	10	12,27	1%	14	1,95	0%	7	10,32	3%
Others		462,71	42%		322,75	42%		139,97	41%
Total		1111,19	100%		772,38	100%		338,80	100%
Source: WIOD and own calculations									

In Table 6 of the year 2008, the exports from Portugal to China decreased almost 36% with the total value of 111.19 million US$. And suddenly the original top 3 service sectors disappeared from the top 10 list. Instead, the sector of c14-Electrical and Optical Equipment became the largest industry which exports to China with 283.61 million US$. Even it was the largest in all sectors, it was smaller than c30 in the year 2004 (818.01 million US$, see in Table 5). After c14, c27-Post and Telecommunications also had a large amount of exports from Portugal to China, ranking the second place in the top 10 list. What's more, c15-Transport Equipment, C12-Basic Metals and Fabricated Metal, c3-Food, Beverages and Tobacco and c5-Leather, Leather and Footwear appeared in the top 10 list for the first time. In another point of view, all the other sectors took 42% of the total exports which was much bigger comparing to 8% in the year of 2004 (see Table 5). And it seems that the difference of amount between intermediate goods (772.38 million US$) and final consumption goods (338.8 million US$) became smaller than in the year of 2004.

Table 7: Exports Portugal/China: weight of top 10 sectors-2009

Sector		EXPCT09			EXPCZ09			EXPCY09	
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	164,65	26%	1	113,50	26%	2	51,15	24%
c27-Post and Telecommunications	2	116,63	18%	2	97,05	22%	4	19,58	9%
c15-Transport Equipment	3	74,65	12%	8	15,20	4%	1	59,45	28%
c7-Pulp, Paper, Paper , Printing and Publishing	4	50,99	8%	3	50,93	12%	22	0,06	0%
c2-Mining and Quarrying	5	41,97	7%	4	41,95	10%	26	0,02	0%
c4-Textiles and Textile Products	6	41,16	6%	11	7,05	2%	3	34,12	16%
c9-Chemicals and Chemical Products	7	31,94	5%	5	31,79	7%	19	0,14	0%
c13-Machinery, Nec	8	29,49	5%	7	15,80	4%	5	13,70	6%
c6-Wood and Products of Wood and Cork	9	16,77	3%	6	16,51	4%	15	0,26	0%
c3-Food, Beverages and Tobacco	10	13,26	2%	26	0,07	0%	6	13,19	6%
Others		62,15	10%		42,21	10%		19,94	9%
Total		643,67	100%		432,06	100%		211,61	100%

Source: WIOD and own calculations

After one year, in 2009, the exports from Portugal to China decreased for another time almost 58%, which were only 643.67 million US$. C14-Electrical and Optical Equipment still ranked in the first place with 164.65 million US$. Comparing to the year of 2008, the rising of sector of c15-Transport Equipment was very significant. The sectors of c7-Pulp, Paper, Printing and Publishing and c2-Mining and Quarrying also increased a lot. And the others sectors only occupied 10% of the total exports. In terms of destination of exports, the intermediate goods were 432.06 million US$ and the final consumption goods were 211.61 million (see Table 7).

Therefore, the financial and economic crisis indeed affected a lot the exports from Portugal to China in 2009.

Table 8: Exports Portugal/China: weight of top 10 sectors-2011

Sector		EXPCT11			EXPCZ11			EXPCY11	
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c15-Transport Equipment	1	210,00	23%	12	6,49	1%	1	203,51	52%
c14-Electrical and Optical Equipment	2	195,09	21%	1	138,27	27%	2	56,82	14%
c27-Post and Telecommunications	3	120,62	13%	2	100,06	19%	5	20,56	5%
c7-Pulp, Paper, Paper , Printing and Publishing	4	79,02	9%	3	78,97	15%	22	0,05	0%
c2-Mining and Quarrying	5	45,06	5%	4	45,04	9%	26	0,02	0%
c4-Textiles and Textile Products	6	44,79	5%	9	10,44	2%	4	34,35	9%
c3-Food, Beverages and Tobacco	7	41,22	5%	21	0,46	0%	3	40,76	10%
c9-Chemicals and Chemical Products	8	38,24	4%	5	36,95	7%	12	1,29	0%
c13-Machinery, Nec	9	36,23	4%	7	22,14	4%	6	14,09	4%
c6-Wood and Products of Wood and Cork	10	25,18	3%	6	24,85	5%	17	0,33	0%
Others		72,34	8%		51,23	10%		21,11	5%
Total		907,77	100%		514,90	100%		392,87	100%

Source: WIOD and own calculations

In 2011 (see Table 8), the exports from Portugal to China recovered and the total amount reached 907.77 million US$. The sector C15-Transport Equipment has surpassed C14-Electrical and Optical Equipment and ranked first with 210.00 million US$. And this almost tripled the value of the year of 2009. C14-Electrical and Optical Equipment ranked second with 195.09 million US$ which was also bigger than in the year of 2009.The other sectors remained around the original level, accounting 8%. Nevertheless, the exports from Portugal to China for final consumption reached 398.87 million, reducing the difference with the exports for domestic production of China (514.90 million US$).

2.2.2 Weight of exports Portugal/China versus Portugal/world in each sector

Firstly, it is declared that the weight in Chapter 2.2.2 is the ratio of the exports from Portugal to China over the exports from Portugal to the world in each sector.

Table 9: Exports Portugal/China versus Portugal/world in each sector-1995

Sector	Rank	EXPCT95/PW	Rank	EXPCZ95/PW	Rank	EXPCY95/PW
c18-Construction	1	28%	10	5%	1	36%
c34-Other Community, Social and Personal Services	2	18%	1	19%	3	16%
c28-Financial Intermediation	3	15%	2	14%	2	16%
c21-Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	4	12%	3	12%	4	11%
c32-Education	5	11%	4	12%	6	8%
c29-Real Estate Activities	6	11%	5	11%	5	9%
c31-Public Admin and Compulsory Social Security	7	11%	6	11%	7	8%
c30-Renting of M&Eq and Other Business Activities	8	10%	7	11%	8	7%
c33-Health and Social Work	9	7%	8	7%	9	5%
c19-Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	10	5%	9	6%	10	2%
Source: WIOD and own calculations						

In 1995, the exports of c18-Construction to China accounted the biggest percentage of the exports to the world of this industry, representing 28%. C34-Other community, Social and Personal Service represented 18%. Then came c28-Financial Intermediation with 15%, c21-Retail Trade with 12%, c32-Education with 11%, c29-Real Estate Activities with 11% and c31-Public Admin and Compulsory Social Security with 11%. On the other hand, c18 had more weight in final consumption (36%) than in

intermediate goods (5%). C-28 also had more weight in final consumption (16%) than in intermediate goods (14%). However, all the other sectors had more weight in intermediate goods than final consumption. In summary, the exports to China of construction industry and some other services played an important role in the total exports of each sector in Portugal (see in Table 9).

Table 10: Exports Portugal/China versus Portugal/world in each sector-1999

Sector	Rank	EXPCT99/PW	Rank	EXPCZ99/PW	Rank	EXPCY99/PW
c18-Construction	1	52%	6	16%	1	61%
c34-Other Community, Social and Personal Services	2	24%	1	23%	3	24%
c28-Financial Intermediation	3	22%	2	22%	2	24%
c31-Public Admin and Defence; Compulsory Social Security	4	21%	3	21%	4	19%
c32-Education	5	20%	4	21%	5	16%
c30-Renting of M&Eq and Other Business Activities	6	19%	5	19%	6	13%
c29-Real Estate Activities	7	13%	7	15%	8	6%
c21-Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	8	13%	8	14%	7	11%
c33-Health and Social Work	9	9%	9	10%	9	5%
c27-Post and Telecommunications	10	2%	10	2%	12	1%
Source: WIOD and own calculations						

In Table 10 of the year 1999, the export to China in c18-Construction has already accounted more than a half of the total exports of Portugal to world with a weight of 52%. And as it showed that it has more weight in final consumption (61%) than in intermediate goods (16%). All those implied that the construction industry became a key industry between the two countries. C34-Other community, Social and Personal Services occupied 24% of the total exports, taking the second place. After came c28-Financial Intermediation with 22%. C31-Public Admin and Defense represented 21% and c32-Education 20%. They all increased comparing to the data of the year 1995 (see in Table 9). It meant that the exports to China were more important than in 1995.

Table 11: Exports Portugal/China versus Portugal/world in each sector-2004

Sector	Rank	EXPCT04/PW	Rank	EXPCZ04/PW	Rank	EXPCY04/PW
c31-Public Admin and Defence; Compulsory Social Security	1	55%	1	56%	1	49%
c32-Education	2	52%	2	53%	4	44%
c30-Renting of M&Eq and Other Business Activities	3	50%	3	51%	3	47%
c34-Other Community, Social and Personal Services	4	48%	4	48%	2	49%
c21-Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	5	36%	5	46%	6	11%
c28-Financial Intermediation	6	26%	6	25%	5	32%
c18-Construction	7	17%	7	24%	7	5%
c29-Real Estate Activities	8	14%	8	17%	8	4%
c19-Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	9	7%	9	8%	9	4%
c20-Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	10	5%	11	6%	11	3%
Source: WIOD and own calculations						

In Table 11 of the year 2004, there were four sectors representing more or less half in the total exports of each sector, which were c31-Public Admin and Defense (55%), c32-Education (52%), c30-Renting of Equipment (50%) and c34-Other Community, Social and Personal Services (48%). These services mentioned were already key sectors of the exports from Portugal to China instead of the c18-Construction (17%). The rise of service sectors was really a big change not only because they exceeded the construction industry but also because they had really big weight in the total exports in each sector.

Table 12: Exports Portugal/China versus Portugal/world in each sector-2008

Sector	Rank	EXPCT08/PW	Rank	EXPCZ08/PW	Rank	EXPCY08/PW
c27-Post and Telecommunications	1	12,89%	1	12,83%	1	13,21%
c14-Electrical and Optical Equipment	2	4,15%	2	4,95%	2	2,79%
c6-Wood and Products of Wood and Cork	3	1,19%	5	1,22%	15	0,12%
c9-Chemicals and Chemical Products	4	1,02%	4	1,31%	24	0,02%
c2-Mining and Quarrying	5	0,97%	7	0,98%	10	0,28%
c1-Agriculture, Hunting, Forestry and Fishing	6	0,97%	3	1,98%	17	0,08%
c13-Machinery, Nec	7	0,82%	6	1,02%	5	0,69%
c4-Textiles and Textile Products	8	0,79%	9	0,74%	4	0,80%
c5-Leather, Leather and Footwear	9	0,62%	8	0,91%	6	0,59%
c18-Construction	10	0,39%	10	0,29%	7	0,56%
Source: WIOD and own calculations						

In Table 12 of the year 2008, c27-Post and Telecommunications occupied 12.89% in the first place. C14-Eletrical and Optical Equipment occupied 4.15% in the second place. There were only four sectors with a weight more than 1% of the total exports of each sector. All the service sectors disappeared from the top 10 list. And C18-

Construction only ranked the 10th place with only 0.39% of the total exports in construction. It showed that China was no longer a very important trade partner like before except in c27-Post and Telecommunications.

Table 13: Exports Portugal/China versus Portugal/world in each sector-2009

Sector	Rank	EXPCT09/PW	Rank	EXPCZ09/PW	Rank	EXPCY09/PW
c27-Post and Telecommunications	1	10,51%	1	10,45%	1	10,83%
c2-Mining and Quarrying	2	8,44%	2	8,49%	10	0,49%
c14-Electrical and Optical Equipment	3	4,09%	3	4,62%	2	3,27%
c15-Transport Equipment	4	1,48%	11	0,62%	3	2,32%
c7-Pulp, Paper, Paper , Printing and Publishing	5	1,36%	7	1,40%	21	0,05%
c9-Chemicals and Chemical Products	6	1,34%	6	1,87%	25	0,02%
c6-Wood and Products of Wood and Cork	7	1,22%	10	1,24%	6	0,68%
c13-Machinery, Nec	8	1,19%	5	1,91%	5	0,83%
c4-Textiles and Textile Products	9	0,99%	9	1,25%	4	0,95%
c1-Agriculture, Hunting, Forestry and Fishing	10	0,95%	4	2,35%	19	0,08%
Source: WIOD and own calculations						

In 2009, after the financial crisis, c27-Post and Telecommunications ranked the first place by 10.51% and C2-Mining and Quarrying ranked the second place by 8.44%. Comparing to the year 2008, in terms of weight in total exports of each sector, all sectors grew except c27-Post and Telecommunications. All the top 10 sectors had a weight more than 1% or near 1%. Despite the financial crisis, actually there was a good trend for the exports from Portugal to China. (see Table 13)

Table 14: Exports Portugal/China versus Portugal/world in each sector-2011

Sector	Rank	EXPCT11/PW	Rank	EXPCZ11/PW	Rank	EXPCY11/PW
c27-Post and Telecommunications	1	10,74%	1	10,64%	1	11,25%
c2-Mining and Quarrying	2	8,95%	2	9,00%	12	0,52%
c14-Electrical and Optical Equipment	3	4,79%	3	5,37%	3	3,80%
c15-Transport Equipment	4	4,12%	15	0,31%	2	6,83%
c7-Pulp, Paper, Paper , Printing and Publishing	5	2,08%	6	2,17%	26	0,03%
c6-Wood and Products of Wood and Cork	6	1,81%	9	1,83%	8	0,87%
c9-Chemicals and Chemical Products	7	1,59%	7	1,97%	18	0,24%
c13-Machinery, Nec	8	1,44%	5	2,40%	7	0,89%
c4-Textiles and Textile Products	9	1,06%	10	1,16%	6	1,04%
c3-Food, Beverages and Tobacco	10	1,05%	19	0,19%	4	1,10%
Source: WIOD and own calculations						

Finally, in the last year 2011, as we can see in Table 14, C27-Posted and Telecommunications continued ranking the first place with 10.74% of occupation in

the total exports of this sector. Comparing to the year 2009, the top 10 sectors didn't changed a lot. But it is to be noted that the weight of c15-Transport Equipment rose from 1.48% in 2009 to 4.12% in 2011.

2.2.3 Gross exports from China to Portugal

Table 15: Exports China/Portugal: weight of top 10 sectors -1995

Sector	EXCPT95			EXCPZ95			EXCPY95		
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	34,23	17%	2	11,50	12%	1	22,73	22%
c22-Hotels and Restaurants	2	28,15	14%	1	20,06	21%	4	8,09	8%
c4-Textiles and Textile Products	3	27,37	14%	5	9,12	10%	2	18,26	18%
c12-Basic Metals and Fabricated Metal	4	18,81	10%	4	10,03	11%	3	8,79	8%
c27-Post and Telecommunications	5	12,77	6%	3	10,66	11%	11	2,11	2%
c1-Agriculture, Hunting, Forestry and Fishing	6	10,53	5%	7	3,90	4%	6	6,63	6%
c10-Rubber and Plastics	7	9,79	5%	6	4,91	5%	7	4,88	5%
c5-Leather, Leather and Footwear	8	9,22	5%	16	1,18	1%	5	8,04	8%
c13-Machinery, Nec	9	5,86	3%	15	1,41	1%	9	4,45	4%
c34-Other Community, Social and Personal Services	10	5,83	3%	8	3,89	4%	13	1,94	2%
Others		34,83	18%		17,33	18%		17,50	17%
Total		197,39	100%		93,97	100%		103,42	100%

Source: WIOD and own calculations

In terms of gross value, in the first year, 1995, c14-Electrical and Optical Equipment ranked first (34.23 million US$), following by c22-Hotels and Restaurants (28.15 million US$) and C4-Texitles and Textile Products (27.37 million US$). All the top 10 sectors had a weight of 82%. And the total exports from China to Portugal were 197.37 million US$. Considering the destination, we can find that the exports for final consumption (103.42 million) were bigger than the exports for domestic production (93.97 million US$). (see Table 15)

Table 16: Exports China/Portugal: weight of top 10 sectors -1999

Sector	EXCPT99			EXCPZ99			EXCPY99		
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	44,62	16%	2	21,65	14%	1	22,97	19%
c4-Textiles and Textile Products	2	33,59	12%	5	14,28	9%	2	19,31	16%
c20-Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	3	33,52	12%	1	28,94	19%	12	4,57	4%
c22-Hotels and Restaurants	4	20,43	7%	4	14,54	9%	6	5,88	5%
c10-Rubber and Plastics	5	18,73	7%	7	10,34	7%	4	8,40	7%
c12-Basic Metals and Fabricated Metal	6	15,87	6%	6	10,35	7%	7	5,53	5%
c30-Renting of M&Eq and Other Business Activities	7	15,82	6%	3	14,66	9%	16	1,16	1%
c9-Chemicals and Chemical Products	8	13,40	5%	8	10,13	6%	13	3,27	3%
c27-Post and Telecommunications	9	11,95	4%	9	9,96	6%	15	1,99	2%
c13-Machinery, Nec	10	11,38	4%	15	1,42	1%	3	9,95	8%
Others		55,18	20%		20,05	13%		35,13	30%
Total		274,48	100%		156,33	100%		118,15	100%

Source: WIOD and own calculations

In 1999, c14-Electrical and Optical Equipment still ranked first (44.62 million US$). The second was c4-Textiles and Textile Products (33.59 million US$) and the third was c20-Wholesale Trade (33.52 million US$). The top 10 sectors had a weight of 80% of the total exports from China to Portugal. The total exports grew to 274.48 million US$ instead of 197.39 million US$ in the year 1995. Nevertheless, the exports for domestic production (156.33 million US$) exceeded the exports for final consumption (118.15 million US$). (see Table 16)

Table 17: Exports China/Portugal: weight of top 10 sectors -2004

Sector	EXCPT04			EXCPZ04			EXCPY04		
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c30-Renting of M&Eq and Other Business Activities	1	199,27	29%	1	184,65	40%	5	14,62	6%
c14-Electrical and Optical Equipment	2	114,86	17%	2	59,73	13%	1	55,12	24%
c4-Textiles and Textile Products	3	71,41	10%	3	37,08	8%	2	34,34	15%
c34-Other Community, Social and Personal Services	4	48,10	7%	5	31,51	7%	4	16,58	7%
c9-Chemicals and Chemical Products	5	41,49	6%	4	36,12	8%	12	5,36	2%
c13-Machinery, Nec	6	39,04	6%	12	4,84	1%	3	34,20	15%
c27-Post and Telecommunications	7	35,49	5%	6	29,59	6%	11	5,91	3%
c12-Basic Metals and Fabricated Metal	8	33,13	5%	7	26,46	6%	10	6,67	3%
c10-Rubber and Plastics	9	24,39	4%	8	15,27	3%	9	9,12	4%
c1-Agriculture, Hunting, Forestry and Fishing	10	12,47	2%	9	8,82	2%	13	3,65	2%
Others		75,90	11%		32,55	7%		43,35	19%
Total		695,56	100%		466,63	100%		228,92	100%

Source: WIOD and own calculations

In Table 17 for the year 2004, it was a big surprise that c30-Renting of M&Eq and Other Business Activities became the first industry (199.27 million US$) in the exports from China to Portugal. However, it was only 15.82 million US$ in the year of 1999.

And it was followed by c14-Electrical and Optical Equipment (114.86 million US$) and c4-Textiles and Textile Products (71.41 million US$). The other sectors continued growing. The top 10 sectors had a weight of 89% in the total exports from Portugal to China. The total exports were twice bigger than the total exports in 1999 (see in Table 16). What's more, the exports for domestic production (466.63 million US$) were much bigger than the ones for final consumption (228.92 million US$).

Table 18: Exports China/Portugal: weight of top 10 sectors -2008

Sector	EXCPT08			EXCPZ08			EXCPY08		
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	582,70	33%	1	285,82	30%	1	296,88	37%
c12-Basic Metals and Fabricated Metal	2	205,11	12%	2	190,76	20%	10	14,34	2%
c4-Textiles and Textile Products	3	172,31	10%	4	77,66	8%	3	94,65	12%
c13-Machinery, Nec	4	129,35	7%	6	34,05	4%	2	95,30	12%
c9-Chemicals and Chemical Products	5	122,19	7%	3	109,50	12%	11	12,70	2%
c15-Transport Equipment	6	105,54	6%	10	21,01	2%	4	84,53	10%
c3-Food, Beverages and Tobacco	7	65,00	4%	25	1,49	0%	5	63,51	8%
c10-Rubber and Plastics	8	51,82	3%	5	34,89	4%	8	16,93	2%
c34-Other Community, Social and Personal Services	9	49,08	3%	8	32,55	3%	9	16,53	2%
c5-Leather, Leather and Footwear	10	41,27	2%	21	2,69	0%	6	38,58	5%
Others		229,52	13%		154,87	16%		74,65	9%
Total		1753,88	100%		945,28	100%		808,60	100%

Source: WIOD and own calculations

In 2008, c14-Electrical and Optical Equipment (582.70 million US$) took the first place for another time. And the second was c12-Basic Metals and Fabricated Metal (205.11 million US$). The third was c14-Textiles and Textile Products (172.31 million US$). The top 10 sectors had a weight of 87% of the total exports from China to Portugal. Considering the value of total exports, it was a big jump. It was 695.56 million US$ in 2004, but it already reached 1753.88 million US$ in 2008. Moreover, the difference between the exports for domestic production and final consumption was smaller than before. The exports for domestic production were 945.28 million US$ and the exports for final consumption were 808.60 million US$. (see Table 18)

Table 19: Exports China/Portugal: weight of top 10 sectors -2009

Sector		EXCPT09			EXCPZ09			EXCPY09	
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	459,45	32%	1	255,61	34%	1	203,84	30%
c4-Textiles and Textile Products	2	172,74	12%	3	69,06	9%	2	103,68	15%
c13-Machinery, Nec	3	104,96	7%	9	24,86	3%	3	80,10	12%
c9-Chemicals and Chemical Products	4	87,90	6%	2	77,37	10%	11	10,52	2%
c3-Food, Beverages and Tobacco	5	80,76	6%	26	0,97	0%	4	79,79	12%
c12-Basic Metals and Fabricated Metal	6	76,13	5%	4	62,45	8%	10	13,68	2%
c15-Transport Equipment	7	64,21	4%	14	13,92	2%	5	50,29	7%
c27-Post and Telecommunications	8	55,61	4%	5	46,40	6%	12	9,22	1%
c10-Rubber and Plastics	9	47,76	3%	7	30,30	4%	8	17,46	3%
c34-Other Community, Social and Personal Services	10	43,19	3%	8	28,66	4%	9	14,54	2%
Others		256,57	18%		151,27	20%		105,30	15%
Total		1449,29	100%		760,86	100%		688,43	100%
Source: WIOD and own calculations									

In Table 19 of the year 2009, c14-Electrical and Optical Equipment occupied 32% of the total exports from China to Portugal, with the value of 459.45 million US$, ranking the first place. Then it came c4-Textiles and Textile Products (172.74 million US$), ranking the second place and c13-Machinery (104.96 million US$), ranking the third place. After the financial crisis in 2008, all sectors decreased a little comparing to the last year. The total exports decreased from 1753.88 million US$ in 2008 to 1449.29 million US$ in 2009. And the difference between the exports for domestic production and for final consumption remained small.

Table 20: Exports China/Portugal: weight of top 10 sectors -2011

Sector		EXCPT11			EXCPZ11			EXCPY11	
	Rank	Value	%	Rank	Value	%	Rank	Value	%
c14-Electrical and Optical Equipment	1	529,25	25%	1	246,64	24%	1	282,61	27%
c15-Transport Equipment	2	254,36	12%	6	53,12	5%	2	201,24	19%
c4-Textiles and Textile Products	3	195,95	9%	5	82,29	8%	5	113,67	11%
c13-Machinery, Nec	4	160,15	8%	8	45,01	4%	4	115,13	11%
c9-Chemicals and Chemical Products	5	159,59	8%	2	138,35	13%	8	21,25	2%
c12-Basic Metals and Fabricated Metal	6	121,44	6%	3	108,86	10%	12	12,58	1%
c3-Food, Beverages and Tobacco	7	120,00	6%	24	1,70	0%	3	118,30	11%
c20-Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	8	106,18	5%	4	91,65	9%	11	14,53	1%
c10-Rubber and Plastics	9	64,50	3%	9	41,02	4%	7	23,49	2%
c27-Post and Telecommunications	10	62,07	3%	7	51,73	5%	14	10,34	1%
Others		309,43	15%		177,08	17%		132,35	13%
Total		2082,94	100%		1037,44	100%		1045,49	100%
Source: WIOD and own calculations									

In 2011, c14-Electrical and Optical Equipment (529.25 million US$) still remained in the first place. And the second place was c15-Transporte Equipment (254.36 million

US$). The third place was c4-Textiles and Textile Products (195.95 million US$). The top 10 industries occupied 85% of the total exports from China to Portugal. And it was obvious that the exports have recovered from the financial crisis with the total amount of 2082.94 million US$. In terms of the destination of exports, the exports for final consumption (1045.49 million US) overpassed the ones for domestic production (1037.44 million US$). (see Table 20)

2.2.4 Weight of exports China/Portugal versus China/world in each sector

Table 21: Exports China/Portugal versus China/world in each sector -1995

Sector	Rank	EXCPT95/CW	Rank	EXCPZ95/CW	Rank	EXCPY95/CW
c27-Post and Telecommunications	1	1,61%	1	1,61%	1	1,63%
c22-Hotels and Restaurants	2	0,76%	2	0,92%	2	0,52%
c17-Electricity, Gas and Water Supply	3	0,55%	3	0,60%	3	0,45%
c30-Renting of M&Eq and Other Business Activities	4	0,38%	4	0,38%	4	0,38%
c34-Other Community, Social and Personal Services	5	0,17%	5	0,16%	8	0,19%
c1-Agriculture, Hunting, Forestry and Fishing	6	0,16%	12	0,10%	5	0,24%
c10-Rubber and Plastics	7	0,14%	7	0,12%	9	0,17%
c12-Basic Metals and Fabricated Metal	8	0,14%	11	0,11%	6	0,21%
c28-Financial Intermediation	9	0,13%	8	0,12%	10	0,13%
c11-Other Non-Metallic Mineral	10	0,12%	21	0,04%	7	0,21%
Source: WIOD and own calculations						

In 1995, in terms of weight in the total exports of certain sector, c27-Post and Telecommunications ranked the first place, which was 1.61%. The weights of others sectors were all under 1%. It meant that there was not an important sector in the exports from China to Portugal. (see Table 21)

Table 22: Exports China/Portugal versus China/world in each sector -1999

Sector	Rank	EXCPT99/CW	Rank	EXCPZ99/CW	Rank	EXCPY99/CW
c27-Post and Telecommunications	1	1,10%	1	0,99%	3	2,64%
c22-Hotels and Restaurants	2	0,85%	2	0,75%	5	1,30%
c17-Electricity, Gas and Water Supply	3	0,70%	3	0,61%	4	1,42%
c13-Machinery, Nec	4	0,38%	16	0,07%	8	1,17%
c1-Agriculture, Hunting, Forestry and Fishing	5	0,33%	8	0,15%	2	4,03%
c10-Rubber and Plastics	6	0,31%	6	0,20%	9	1,11%
c3-Food, Beverages and Tobacco	7	0,31%	24	0,03%	19	0,56%
c30-Renting of M&Eq and Other Business Activities	8	0,30%	4	0,28%	1	9,77%
c20-Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	9	0,30%	5	0,26%	7	1,18%
c16-Manufacturing, Nec; Recycling	10	0,27%	22	0,03%	17	0,66%
Source: WIOD and own calculations						

In Table 22 of the year 1999, comparing to the year 1995, it didn't change a lot. The first place was also c27-Post and Telecommunications. The second place was c22-Hotel and Restaurants. All the top 10 sectors had a weight less than 1% except c27 with 1.10%.

Table 23: Exports China/Portugal versus China/world in each sector -2004

Sector	Rank	EXCPT04/CW	Rank	EXCPZ04/CW	Rank	EXCPY04/CW
c30-Renting of M&Eq and Other Business Activities	1	1,02%	1	1,02%	1	1,04%
c27-Post and Telecommunications	2	1,00%	2	1,00%	2	1,01%
c34-Other Community, Social and Personal Services	3	0,44%	3	0,46%	3	0,42%
c28-Financial Intermediation	4	0,19%	5	0,19%	4	0,21%
c1-Agriculture, Hunting, Forestry and Fishing	5	0,19%	4	0,24%	8	0,13%
c9-Chemicals and Chemical Products	6	0,15%	6	0,18%	13	0,07%
c6-Wood and Products of Wood and Cork	7	0,15%	7	0,18%	15	0,07%
c22-Hotels and Restaurants	8	0,14%	9	0,14%	6	0,14%
c10-Rubber and Plastics	9	0,13%	10	0,13%	7	0,13%
c13-Machinery, Nec	10	0,12%	15	0,05%	5	0,15%
Source: WIOD and own calculations						

In 2004, c30 turned to be the first place with 1.02% of occupation. And c27-Post and Telecommunications became the second place with 1.00%. All the others had a weight less than 1%. From the 4th to the 10th, the weight was even less than 0.2% in the total exports of China in each sector. It is noted that c3-Food and Beverages and Tabaco was not in the top 10 anymore (see in Table 23).

Table 24: Exports China/Portugal versus China/world in each sector -2008

Sector	Rank	EXCPT08/CW	Rank	EXCPZ08/CW	Rank	EXCPY08/CW
c33-Health and Social Work	1	1,46%	1	1,46%	1	1,46%
c34-Other Community, Social and Personal Services	2	0,48%	3	0,46%	2	0,53%
c27-Post and Telecommunications	3	0,46%	2	0,46%	3	0,47%
c1-Agriculture, Hunting, Forestry and Fishing	4	0,25%	4	0,27%	5	0,22%
c3-Food, Beverages and Tobacco	5	0,19%	24	0,03%	6	0,22%
c6-Wood and Products of Wood and Cork	6	0,19%	5	0,22%	15	0,10%
c22-Hotels and Restaurants	7	0,18%	6	0,20%	8	0,15%
c12-Basic Metals and Fabricated Metal	8	0,17%	7	0,18%	17	0,09%
c11-Other Non-Metallic Mineral	9	0,16%	10	0,16%	7	0,17%
c17-Electricity, Gas and Water Supply	10	0,16%	8	0,17%	11	0,12%
Source: WIOD and own calculations						

In Table 24 of the year 2008, c33-Health and Social Work, which never was in the list, became the first with 1.46%. The second was c34-Other Community, Social and

Personal Services (0.48%). C27- Post and Telecommunications (0.46%) took the third place.

Table 25: Exports China/Portugal versus China/world in each sector -2009

Sector	Rank	EXCPT09/CW	Rank	EXCPZ09/CW	Rank	EXCPY09/CW
c33-Health and Social Work	1	1,17%	1	1,17%	1	1,17%
c27-Post and Telecommunications	2	0,79%	2	0,79%	2	0,79%
c34-Other Community, Social and Personal Services	3	0,51%	3	0,49%	3	0,55%
c22-Hotels and Restaurants	4	0,25%	4	0,38%	10	0,14%
c3-Food, Beverages and Tobacco	5	0,25%	25	0,02%	4	0,29%
c1-Agriculture, Hunting, Forestry and Fishing	6	0,19%	5	0,30%	14	0,10%
c28-Financial Intermediation	7	0,18%	7	0,18%	6	0,19%
c17-Electricity, Gas and Water Supply	8	0,18%	6	0,19%	7	0,16%
c26-Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	9	0,14%	11	0,15%	9	0,14%
c6-Wood and Products of Wood and Cork	10	0,14%	8	0,16%	16	0,10%
Source: WIOD and own calculations						

In 2009, c33-Healt and Social Work still occupied the first place, but the percentage dropped to 1.17%. And c27-Post and Telecommunication (0.79%), which was in the third place last year, became the second. C34-Other Community, Social and Personal Services (0.51%) nearly kept the same as to the occupation of the last year. (see Table 25)

Table 26: Exports China/Portugal versus China/world in each sector -2011

Sector	Rank	EXCPT11/CW	Rank	EXCPZ11/CW	Rank	EXCPY11/CW
c9-Chemicals and Chemical Products	1	0,11%	7	0,15%	8	0,04%
c25-Air Transport	2	0,09%	14	0,10%	2	0,07%
c10-Rubber and Plastics	3	0,07%	15	0,08%	3	0,06%
c12-Basic Metals and Fabricated Metal	4	0,07%	13	0,10%	15	0,02%
c15-Transport Equipment	5	0,06%	12	0,10%	4	0,06%
c11-Other Non-Metallic Mineral	6	0,06%	19	0,06%	1	0,07%
c4-Textiles and Textile Products	7	0,05%	11	0,10%	7	0,04%
c14-Electrical and Optical Equipment	8	0,05%	18	0,07%	6	0,04%
c6-Wood and Products of Wood and Cork	9	0,05%	17	0,08%	14	0,02%
c27-Post and Telecommunications	10	0,05%	1	0,55%	18	0,01%
Source: WIOD and own calculations						

In 2011 (Table 26), C9-Chemical and Chemical Products became the first with only 0.11%. The second place was c25-Air Transport (0.09%). 2011 was a year when a big decrease happened in the weight of the total exports in each sector. Because all the top 10 sectors had a weight near 0.10% or less than 0.10% which was really low.

3. Trade in value added and vertical specialization between Portugal and China

3.1 Theoretical and methodological framework

Since the 30s in the 20th century, input-output analysis has been used to study the economy in a sectoral perspective, by W. Leontief. He applied the IO model in US economy (Leontief, 1951) and later received the Nobel Prize because of his pioneering work, in 1973. In his theory, several coefficients are introduced, i.e., technological coefficient, import coefficient, etc. Since this paper is about imports and exports, we focus more in the import coefficient. Instead of calculate the coefficient in each sector, we do it in the total value but distinguish the origin of imports, namely, two certain countries Portugal and China or the rest of world, that are:

$$\text{Import coefficient of Portugal} = \frac{\sum_{j=1}^{n} imWP_j}{\sum_{j=1}^{n} xP_j} = A \qquad (1)$$

Where $\mathbf{im}WP_j$ means the imports from the rest of the world of sector j of Portugal and $\mathbf{x}P_j$ means the production of Portugal of sector j.

$$\text{Import coefficient of Portugal from China} = \frac{\sum_{j=1}^{n} imCP_j}{\sum_{j=1}^{n} xP_j} = B \qquad (2)$$

Where $\mathbf{im}CP_j$ means the imports from China of sector j of Portugal and $\mathbf{x}P_j$ means the production of Portugal of sector j.

$$\text{Import coefficient of China} = \frac{\sum_{j=1}^{n} imWC_j}{\sum_{j=1}^{n} xC_j} = C \qquad (3)$$

Where $\mathbf{im}WC_j$ means the imports from the rest of the world of sector j of China and $\mathbf{x}C_j$ means the production of China of sector j.

$$\text{Import coefficient of China from Portugal} = \frac{\sum_{j=1}^{n} imPC_j}{\sum_{j=1}^{n} xC_j} = D \qquad (4)$$

Where $imPC_j$ means the imports from Portugal of sector j of China and xC_j means the production of China of sector j.

All these four coefficients (equation 1, 2, 3 and 4) together can show us the direct foreign content of domestic production of Portugal and China.

And furthermore, one of the significant economic trends of the last decades is the strong growth of international trade flows (Amador et al., 2008). Globalization has been associated with the development of a new organizational paradigm of international production (Daudin et al., 2011). The production is divided in several countries and from there it came the concept of global value chains (GVC). To check out what is the positon of a country, vertical specialization (VS) was introduced in Hummels et al. (1998) and latterly perfected in Hummels et al. (2001). It can be written as:

$$VS_{kj} = \frac{imported\ inputs}{output} * \text{exports} = \sum_{i=1}^{n}\left(\frac{M_{ij}\,X_j}{Y_j}\right) = \sum_{i=1}^{n} a_{ij}^{M} X_j \quad (5)$$

Where **k** means the country and i, j = 1, 2,..., n. M_{ij} is the value of imported intermediate product i in sector j, X_j is the value of exports of sector j, Y_j is the total output of sector j, a_{ij}^{M} is the import coefficient.

Consequently, the vertical specialization of the country k is the sum of the VS_{ki} in all $sectors\ I, that\ is$:

$$VS_k = \sum_{i=1}^{n} VS_{ki} \qquad (6)$$

In order to facilitate the calculation and analysis, it is necessary to calculate the weight of VS_k in total exports of country k, presented in:

$$\frac{VS_k}{X_k} = \frac{\sum_{i=1}^{n} VS_{ki}}{\sum_{i=1}^{n} X_{ki}} \qquad (7)$$

According to Hummels et al. (2001), if we introduce the input-output matrices and the import coefficient, then we have the equation below:

$$\frac{VS_k}{X_k} = \frac{uA^M X}{X_k} \qquad (8)$$

Where u is a 1×n vector. A^M is a n×n matrix, representing the direct imports, in which every element is a_{ij}^M. And X is a n×1 vector representing the exports.

In this measurement, only the directly imported intermediate inputs for production are considered, so it is called the direct vertical specialization (DVS) of country k. And this measurement will be used in the section 3.2.2.

Back to the famous economist Leontief, his biggest contribution is the Leontief inverse which combines both direct and indirect inputs. In this case, if we apply the Leontief inverse to the Equation (8), both the direct and indirect inputs can be calculated, that is:

$$\frac{VS_k}{X_k} = \frac{uA^M[I- A^D]^{-1}X}{X_k} \tag{9}$$

Where $[I - A^D]^{-1}$ is the Leontief inverse, I is a n×n matrix, A^D is the n×n (domestic) technological coefficient matrix.

This measurement including both direct and indirect inputs is called total vertical specialization (TVS) which will be applied in section 3.2.3.

For an application of this methodology to the Portuguese Rubber and Plastics Industry, see Lopes and Santos (2015).

3.2 Empirical results

3.2.1 Direct foreign content of domestic production

Table 27: Direct foreign content of domestic production of Portugal

Index	1995	1999	2004	2008	2009	2011
A	10,4005%	10,5312%	10,8599%	12,7873%	10,1125%	10,3435%
B	0,0439%	0,0694%	0,1410%	0,2011%	0,1752%	0,2360%
Source: WIOD and own calculations						

In Table 27, the direct foreign content of domestic production of Portugal maintained almost the same level from 1995 to 2011. It started with 10.4005% in 1995, ended with 10.3435% in 2011 and reached the peak in 2008 with 12.7873%. On the other hand, the direct China's content of Portugal had a significant increase from 0.0439% in 1995 to

0.236% in 2011. It only decreased in 2009 because of the great recession. It means that the imported input from China was increasing in exports of Portugal. (see A and B in Equation (1), (2)).

Table 28: Direct foreign content of domestic production of China

Index	1995	1999	2004	2008	2009	2011
C	5,2477%	4,5707%	8,4962%	6,8906%	5,5314%	6,6300%
D	0,0119%	0,0135%	0,0269%	0,0035%	0,0029%	0,0023%
Source: WIOD and own calculations						

In Table 28 (see C and D in Equation (3), (4)), as we can see, the direct foreign content of China increased and reached the peak in 2004, and later started to decrease. In a total view, it expanded from 5.2477% in 1995 to 6.6300% in 2011.

The same thing happened to the direct Portugal's content of China, but the decrease after 2004 was much more dramatic. (I suspect that the dramatic decline was because of the possible error of the original data from WIOD, please check my explanation in chapter 4)

3.2.2 Direct foreign content of exports

From Table 29 to Table 30, **DVSpW** means the Portuguese direct vertical specialization (with imports from the world) of exports to the world; **DVSpC** means the Portuguese direct vertical specialization (with imports from the world) of exports to China; **DVScpW** means the Portuguese direct vertical specialization (with imports from China) of exports to the world; **DVScpC** means the Portuguese direct vertical specialization (with imports from China) of exports to China.

DVScW means the Chinese direct vertical specialization (with imports from the world) of exports to the world; **DVScP** means the Chinese direct vertical specialization (with imports from the world) of exports to Portugal; **DVSpcW** means the Chinese direct vertical specialization (with imports from Portugal) of exports to the world; **DVSpcP** means the Chinese direct vertical specialization (with imports from Portugal) of exports to Portugal.

Table 29: Direct foreign content of exports of Portugal

Index	1995	1999	2004	2008	2009	2011
DVSpW	19,1795%	20,1508%	21,7974%	24,1439%	18,6103%	18,9304%
DVSpC	9,7424%	8,3326%	9,1303%	26,5176%	19,8069%	20,9106%
DVScpW	0,0627%	0,1217%	0,2062%	0,4581%	0,3411%	0,4784%
DVScpC	0,0585%	0,0705%	0,2526%	0,9642%	0,6365%	0,6854%
Source: WIOD and own calculations						

From Table 29, **DVSpW** increased from 1995 to 2008, but after the great recession it dropped until 18.9304% in 2011, which was almost in the same level of 1995 (19.1795%). In another word, the Portuguese direct vertical specialization (with imports from the world) of exports to the world came back to its original point after 17 years.

DVSpC also increased from 1995 to 2008, and decreased after the year 2008. But in 2011, the final year of this investigation, it (20.9106%) was more than twice of the initial value in 1995 (9.7424%). That means that exports from Portugal to China depended more and more on imported inputs. The biggest increase was in the year 2008 with 26.5176%. Before that, it was just 9.1303% in 2004.

Looking at **DVScpW**, it showed that the contribution of imports from China grew almost eight times in exports from Portugal to the world. The initial index was 0.0627%, and it ended with 0.4784%. This increase was very significant.

Finally, what we can see from **DVScpC** was a dramatic growth. In 17 years, it expanded from 0.0585% in 1995 to 0.6854% in 2011, which also can be considered to be a very big increase. And it was even bigger than **DVScpW** in 2011. This implies that the exports from Portugal to China had more imported input from China than the exports from Portugal to the world.

Table 30: Direct foreign content of exports of China

Index	1995	1999	2004	2008	2009	2011
DVScW	7,8192%	6,7039%	13,4996%	9,6829%	7,8933%	5,3448%
DVScP	7,0015%	6,1429%	11,3714%	9,7455%	7,4091%	7,9503%
DVSpcW	0,0112%	0,0139%	0,0277%	0,0066%	0,0041%	0,0023%
DVSpcP	0,0127%	0,0144%	0,0361%	0,0064%	0,0038%	0,0027%
Source: WIOD and own calculations						

In Table 30, **DVScW** started to increase from 1995 to 2004, and after that it decreased and ended with 5.3448% in 2011, which was quite lower than the initial value (7.8192%). It showed that exports of China depended less on imports form the world.

As to **DVScP** the evolution was almost the same, it grew from 1995 to 2004 and fell from 2004 to 2011. But in a longer view, as we can see, it still grew a little comparing the first year (7.0015%) and the last year (7.9503%). That means the exports from China to Portugal depended more on imported inputs.

DVSpcW and **DVSpcP** both increased from 1995 to 2004 and dropped a lot after. That means that the imported inputs from Portugal became more and more unimportant in exports of China. (Again, I suspect that the dramatic decline after 2004 was because of the possible error of the original data from WIOD, please check my explanation in chapter 4).

It is also very important to note that the peak of increase of direct foreign content of exports of Portugal was in 2008, but the peak of China was in 2004. It is very clear that the reversion of Portugal in 2008 was because of the great recession. But the reversion of China in 2004 means that maybe there was a great transformation in China between 2004 and 2008. And "made in China" became more and more really "made in China".

3.2.3 Total foreign content of exports

In Table 31, **VST-PW** means the total vertical specialization of exports from Portugal to the world; **VST-PC** means the total vertical specialization of exports from Portugal to China; **VST-CW** means the total vertical specialization of exports from China to the world; **VST-CP** means the total vertical specialization of exports from China to Portugal.

Table 31: The total foreign content of exports

| Year	VST-PW	VST-PC	VST-CW	VST-CP
1995	17,7577%	15,8734%	12,8292%	15,5760%
1996	17,6975%	14,8986%	11,5583%	14,3218%
1997	18,2969%	14,5779%	11,9999%	10,7911%
1998	18,1339%	14,4540%	10,4712%	13,5180%
1999	17,7584%	14,0687%	11,5685%	14,1754%
2000	19,6310%	16,1906%	14,0594%	17,8130%
2001	18,9816%	15,7819%	13,3362%	16,4810%
2002	18,2550%	15,0119%	14,3829%	18,1723%
2003	17,6975%	14,8756%	17,0845%	20,7822%
2004	18,4828%	15,2422%	20,0562%	24,1280%
2005	19,4340%	18,6735%	20,4901%	23,6469%
2006	20,3141%	16,8295%	20,8856%	24,8015%
2007	20,1494%	17,2632%	20,4213%	24,4451%
2008	21,3726%	36,5307%	19,2912%	25,2205%
2009	17,8698%	30,3753%	16,0849%	20,1114%
2010	17,8782%	31,8110%	18,1294%	21,9558%
2011	18,1237%	31,8393%	19,0311%	22,6840%
Medium	18,7888%	18,0431%	15,6346%	18,9323%

Source: WIOD and own calculations

According to Table 31, from 1995 to 2011, **VST-PW** remained almost the same level. While **VST-PC** increased a lot during these years and there was a big jump in the year 2008. On the other hand, **VST-CW** reached top in 2006 and later decreased a little in the next few years. And as to **VST-CP,** it also reached the top in 2006 and then began to drop.

During the 17 years, the total foreign content of exports from Portugal to the world did not change a lot and remained just the same level. But the total foreign content of exports from Portugal to China almost doubled itself which was an extraordinary growth. In terms of the foreign content of exports from China to the world, it also increased and reached the peak in 2006. And the same thing happened to the total foreign content of exports from China to Portugal.

If we look at the medium value, **VST-PW**, **VST-PC** and **VST-CP** were almost the same but **VST-CW** was smaller than the others.

So in average, the total foreign content of exports from Portugal to the world, the one from Portugal to China and the one from China to Portugal were just the same with the value around 18%. But the total foreign content of exports from China to the world was smaller with only nearly 15%.

Figure 3: The total foreign content of exports

The total foreign content of exports
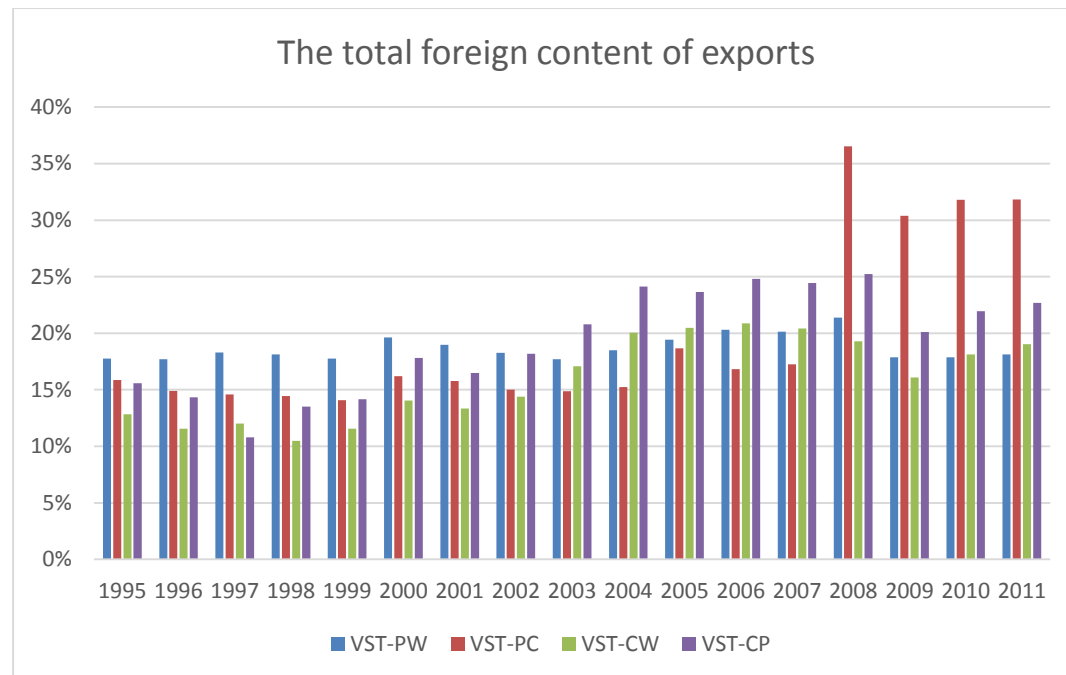
Source: WIOD and won calculations

According to the Figure 3, **VST-PC** (red) is really attractive, because it grew a lot and became the biggest in all the four indexes. **VST-PW** (blue) remained the same. **VST-CW** and **VST-CP** grew and reached the top in around 2006 and then decreased. But **VST-CP** was almost always bigger than **VST-CW**.

As we can see, in terms of exports to the world, the total vertical specialization of Portugal and China were in the same level in the final years. They were both between 15% and 20%. Therefore, in certain meaning, Portugal and China were in the same positon. But we also need to see what part of the global value chains that two countries participated. Because profits can be very different if the participation in global value chains are in different sectors as in different phase of production.

On the other hand, in terms of exports between two countries, the total vertical specialization of Portugal was much bigger than the one of China in the final years. It implies that the exports from Portugal to China had more participation in the global value chains.

In addition, the vertical specifications of exports between the two countries were bigger than the one to the world. For example, in 2011, the red and purple were bigger than blue and green.

4. Explanation of the possible error of the original data from WIOT

Table 32: The exports of Portugal to China in 7 services (million US$)

	Financial Intermediation	Real Estate Activities	Renting of M&Eq and Other Business Activities	Public Admin and Defence; Compulsory Social	Education	Health and Social Work	Other Community, Social and Personal Services	Total 7 services	Total exports from Portugal to China	Total 7 services/ Total exports
	c28	c29	c30	c31	c32	c33	c34			
1995	76,2	0,4	78,7	7,7	0,3	0,1	36,3	199,78	284,48	70,23%
1996	95,1	0,2	57,9	6,1	0,3	0,0	18,6	178,27	253,58	70,30%
1997	84,9	0,2	56,7	6,4	0,3	0,0	12,8	161,29	236,48	68,21%
1998	125,1	0,5	147,5	18,8	0,8	0,1	49,1	341,85	424,71	80,49%
1999	128,0	0,5	167,2	21,5	0,9	0,1	45,9	364,26	463,78	78,54%
2000	87,9	0,5	165,3	24,0	1,1	4,2	49,2	332,20	450,41	73,76%
2001	100,1	0,7	234,4	30,6	1,6	10,5	90,4	468,21	631,20	74,18%
2002	125,2	1,0	343,7	46,7	2,6	0,3	90,0	609,65	810,59	75,21%
2003	145,2	1,3	523,0	68,0	5,3	0,5	123,1	866,31	1162,00	74,55%
2004	207,9	1,9	818,0	105,4	7,5	0,7	155,4	1296,70	1726,28	75,12%
2005	151,2	1,0	481,9	55,0	5,5	0,5	237,0	932,06	1352,61	68,91%
2006	198,2	2,0	1086,3	97,1	8,2	0,7	237,8	1630,42	2118,67	76,95%
2007	272,1	2,8	1465,8	126,9	10,6	7,9	376,6	2262,77	2929,66	77,24%
2008	0,0	0,0	0,3	0,1	0,0	0,0	0,0	0,41	690,88	0,06%
2009	0,0	0,0	0,5	0,2	0,0	0,0	0,0	0,73	643,67	0,11%
2010	0,0	0,0	0,6	0,1	0,0	0,0	0,0	0,76	674,07	0,11%
2011	0,0	0,0	0,7	0,4	0,0	0,0	0,0	1,10	907,77	0,12%

Source: WIOD and own calculations

After all the calculations, I found that there are some strange results that I have made. If you look at Table 6, Table 7 and Table 8, you may wonder why the exports from Portugal to China dropped such a lot. And the data is very different from the data from COMTRADE (see Table 1). Another thing is that the Portuguese content of exports of China decreased dramatically after 2008 which is also very wear (see Table 30). With a few analysis, it is found that there may be some mistake in the data of WIOD, particularly in the service industries of exports from Portugal to China.

As we can see from Table 32, it is pointed out 7 services, from 1995 to 2007, represented more or less 75% of the total exports from Portugal to China. But suddenly the weight of 7 services decreased until less than 0.1% in 2008 and stayed around 0.1% in the next three years. So, it appears that there is probably something wrong in the data of WIOD after 2007.

We have already contacted by email the authors of this database (through Professor M. Timmer) and finally we got his answer "*From 2007 to 2008 there is a sharp drop in the trade volume which can be explained by the global economic crisis and the decline of trade as a result thereof. Perhaps there is also a specific story for Portuguese bilateral trade with China, that I'm not aware of. I have also calculated your indicators using the data from the new WIOTs, that are due to be released by the end of October. It shows that the trade volume is much lower for the whole period in the new tables,*

which may reflect the changes in the SNA, or other revisions of the trade statistics, so the tables are not really comparable in this respect."

But I still have some doubts about the data of WIOD. There are three hypotheses. Firstly, it could be the change of the methods of statistics from 2008. Secondly, it also could be a wrong statistic in the period from 1995 to 2007 or in the period after 2007. And thirdly, it was possible that the dramatic drop of exports of service from Portugal to China really happened. And to find it out, it is very important to know how the data was collected.

5. Conclusions

Nowadays, the world seems to become smaller and smaller because of the international trade. The development of communications and the decrease of the cost of transportation boomed the international trade. A lot of products are produced in several different countries, making a certain country just focus on his part of participation in the global value chains (GVC).

In this paper, the purpose is to find out the nature, law and characteristic of the trade between Portugal and China in today's new and modern world environment.

In order to research, firstly, we took a quick look at the trade between the two countries and the weight in total exports along the last two decades. It is found that the trade between Portugal and China was not in balance, i. e., Portugal had a huge trade deficit against China. The exports from China to Portugal were nearly three times the exports from Portugal to China in the last few years. Nevertheless, in terms of weight in total exports in each country, the weight of exports from Portugal to China in total exports was 10 times more than the weight from China to Portugal.

Secondly, we studied all the trade flows by sectors. From 1995 to 2008, the majority of exports from Portugal to China were in some service sectors and accounted for a big proportion in the total exports. But from 2008 on, these services suddenly disappeared and then electrical and optical equipment became the biggest industry in exports. However, in the exports from China to Portugal, the Electrical and Optical Equipment was always in the top from 1995 to 2011. By the way, the exports from China to Portugal for domestic production were more or less the same as the exports for the final consumption in the final years.

In terms of the position in the global value chains (GVC) of the two countries, we analyzed in three steps which are direct foreign content in domestic production, direct foreign content of exports and total foreign content of exports.

The direct foreign content in domestic production of Portugal (10.3435% in the year 2011) was bigger than China (6.6300% in the year 2011). In addition, the direct Chinese content in domestic production of Portugal (0.2360% in the year 2011) was also quite bigger than China (0.0023% in the year 2011).

For the direct foreign content in exports, Portugal had more vertical specialization than China in all four indexes.

Finally, in terms of total (direct and indirect) vertical specialization in exports to the world, Portugal had more than China. Nevertheless, in terms of total vertical specialization in exports between the two countries, China had a little bit more than Portugal.

Furthermore, in the end of this paper, I point out that there may be some errors in the data from WIOD and because of that, there are some strange results in my calculations. I hope to clear this point in future research, after studying how the data was collected.

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