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REM Working Paper 0416-2026

May 2026

REM – Research in Economics and Mathematics
Rua Miguel Lúpi 20,
1249-078 Lisboa,
Portugal

ISSN 2184-108X

Fundação para a Ciência e a Tecnologia
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Abstract.
The great recession of 2008/2009 and the subsequent sovereign debt crisis highlighted the existence of deep structural imbalances in the Eurozone: large differences of competitiveness and growth potential between its northern (core) and southern (peripheral) countries. In this paper, an input-output approach is used to study two important facets of this phenomenon, namely the nexus between current account (trade) imbalances and domestic (final) demand levels, as well as the sectoral specialization of tradable goods and services production. In the uncompetitive (current account deficit) economies of southern euro area, domestic final demand levels before the crisis were excessive and the opposite occurred in the strong, competitive economies of the north. These external imbalances were closely associated with a pattern of specialization favourable to the northern euro area countries (sectors with higher value added and more intensive technological activities). The empirical results of the paper for the period before the crisis, are based on input-output tables for several years: 1995, 2000, 2005 and 2011, available in the World Input Output Database. The northern euro area group is formed by Germany, Netherlands Finland and Ireland. The southern one is the so-called GIPS group (Greece, Italy, Portugal and Spain). After the (Troika) adjustment programs of 2011/2014, the external imbalances were overcome, by a strong demand compression initially and an export led orientation thereafter. This correction is shown for the Portuguese case, using 2013 and 2017 input-output tables for this country and a comparison is made with Germany, the reference country of the core Eurozone group.

Keywords: Trade imbalances; Domestic demand; Export composition; Input-output linkages; Eurozone; Portugal.

JEL classification codes: F40, C67, D57.

This work was supported by FCT, I.P., the Portuguese national funding agency for science, research and technology, under the Project UID/06522/2025 - https://doi.org/10.54499/UID/06522/2025.

1. Introduction

The great recession of 2008/2009 and the subsequent sovereign debt crisis highlighted the existence of deep structural imbalances in the Euro Area: the large differences of competitiveness and growth potential between its northern and southern countries. These differences always existed and are well documented in numerous papers (Schmitz and von Hagen, 2009; Eichengreen, 2010; Jaumotte and Sodsriwiboon, 2010; Berger and Nitsch, 2010;; Holinski et al, 2012; Lane and Pels, 2012; Gaulier and Vicard, 2012, Booman et al, 2022), but its macroeconomic consequences have been (more or less) mitigated by the existence of equilibrating mechanisms, namely the exchange rate and monetary policy instruments (Johnston and Regan, 2016). Since the start of the Economic and Monetary Union (EMU), these mechanisms are not available at the national level, and the "one size fits all" policy of the ECB was more of a kind "one size fits none", as it proved unable to prevent the accumulation of strong external imbalances across its member states (Arestis and Sawyer, 2011; Hall, 2012; Flassbeck and Lapavitzas, 2013; Storm and Naastepad, 2015a; Jones et al, 2016; Pusch, 2017).

According to the relevant literature, two main interpretations of current account imbalances emerge, not mutually exclusive, as the Eurozone crisis is in fact a multidimension event (Bofinger, 2016). Some authors emphasize the role of deteriorating cost (or price) competitiveness in Europe's periphery vis–à-vis its core (Brancaccio, 2012; Stockhammer and Onaran, 2012; Bibow, 2013; Chen et al, 2013).

Other authors highlight the unsustainable growth of domestic demand, led by capital flows from the (surplus) northern countries to the (deficit) southern countries (Wyplosz, 2013; Diaz Sanchez and Varoudakis, 2013; Hughes Hallett and Martinez Oliva, 2015; Podstawski, 2016; Kang and Shambaugh, 2016), as well as the weak domestic demand growth, due to wage moderation, in Germany (Cesaratto and Stirati, 2011; Horn et al, 2017).

Moreover, a few other related determinants have also been identified: declining private sector savings and unsustainable debt leverage (Atoyan et al, 2013; Storm and Naastepad, 2016); the sophistication of the banking sector (Nieminen, 2015); the large inflow of capital to the non-tradable sector in periphery countries (the *Dutch disease syndrome,* highlighted by Sy, 2016); differences in *non-price* competitiveness and 'structural' current account problems grounded in persistent weaknesses of periphery

countries' tradable sector (Storm and Naastepad, 2015b; Hanzl-Weiss and Landesmann, 2016).

Whatever their causes, large and persistent trade imbalances are undesirable, as they may ultimately lead to severe macroeconomic (balance of payments or financial) crises, but also because they may act, even in 'normal' times, "… as brakes of sustained output growth in *both* the persistent deficit and the persistent surplus countries" (Podkaminer, 2017, p. 193).

This paper adds value to this literature with an input-output based approach allowing to quantify the nexus between domestic final demand levels and the current account (trade) imbalances. Moreover, the sectoral specialization of tradable goods and services production, in the decade and a half before the Euro area sovereign debt crisis, is also investigated and quantitatively shown.

After the adjustment programs of 2011/2014 imposed by the Troika, the external imbalances in the EU southern countries were overcome (Monastiriotis and Tunali, 2020; Weise, 2020; Litsios and Pilbeam, 2024), by a strong demand compression initially and a (more) export led orientation thereafter (Reis, 2015; Pinho and Pinho, 2022; Barradas and Alcobia, 2024). This correction of trade imbalances is analysed in the paper, for the Portuguese case.

For the period before the sovereign debt crisis, the empirical application covers eight Euro area countries and is based on input-output tables for several years: 1995, 2000, 2005 and 2011, available from the World Input Output Database (WIOD). These countries were divided in two groups: a northern one formed by Germany, the Netherlands and Finland, and a southern one, formed by Greece, Portugal and Spain.

For the period after the eurozone sovereign debt crisis, the empirical results for the Portuguese case are based on 2013 and 2017 input-output (IO) tables, available from Statistics Portugal (INE). A comparison is made with Germany, the reference country of the core Eurozone group, using the corresponding IO tables available from Statistics Germany (*Statistisches Bundesamt*).

2. Trade imbalances, domestic demand and sectoral specialization: an input-output approach

2.1 Trade imbalances and domestic final demand excess or insufficiency

In this subsection a relation is made between the international trade imbalances and the levels of domestic final demands and exports. Countries with a trade deficit (surplus) have an excessive (insufficient) level of domestic final demand or, correspondently insufficient (excessive) level of goods and services' exports. This relation is based on an input-output modeling of production, value added (GDP), domestic (final) demand, exports and imports by sector, which improves the understanding and quantification of macroeconomic indicators, namely trade imbalances across countries, based on the productive structure of their economies. An interesting exercise along these lines, investigating the effects of domestic sources of final demand during the Eurozone crisis is Garbellini et al (2014).

In an "input-output based" economy, if va_D is the coefficient of value added content of domestic final demand (D) and va_E is the same coefficient for (goods and services) Exports (E) (the meaning of these coefficients and a brief synthesis of the input-output model are presented in Appendix 1), we can write:

$$Y = va_D D + va_E E \tag{1}$$

where Y is the Gross Domestic Product (GDP).

If the international trade relations are balanced (Exports = Imports), we must have:

$$E = (1 - va_D)D + (1 - va_E)E \tag{2}$$

where the right-hand member of (2) corresponds, of course, to (goods and services) imports. From which we can deduct that, in (external) "equilibrium" (with trade account balanced), the relation between exports and domestic final demand must be:

$$\frac{E^*}{D^*} = \frac{1 - va_D}{va_E} \tag{3}$$

If $\frac{E}{D}$ is the relation actually verified, then the difference $\frac{E^*}{D^*} - \frac{E}{D}$ gives, if positive, the excess of domestic final demand (or insufficiency of exports) relative to the situation of trade balance "equilibrium" (Exports = Imports), and gives, if negative, the insufficiency of domestic final demand (or 'excess' of exports), of course. These deviations can be expressed as percentages and calculated for each year or for an entire period average of length T as:

$$\frac{\sum_{t=1}^{T} \frac{E_t^*}{D_t^*} - \frac{E_t}{D_t}}{T}$$

Important as they are, macroeconomic indicators are not however the sole type of indicators that are needed for characterizing the foreign trade situation and development of an economy. That is why we go further and use a sectoral approach to get a better understanding of the subject, along the following lines.

2.2 Exports contribution to GDP: a sectoral analysis

In this subsection, the contribution of each tradable sector's exports to GDP (in relative terms) is quantified and decomposed into three sub-components, from which the export specialization of each country is determined. The main value added from this exercise is considering the direct, indirect and induced effects of exports through the sectoral interrelations of the economy's productive structure.

The contribution (direct + indirect) of sector *i* exports to *GDP*, EY_i can be calculated as follows:

$$EY_i = \mathbf{a}^{\mathbf{V}} \mathbf{B}_{\mathbf{i}} E_i \tag{4}$$

where:

$\mathbf{a}^{\mathbf{V}}$ is the (row) vector of value-added coefficients (*VA*/*GO*) of the *n* industries of the economy, and *GO* the gross output;

$\mathbf{B}_i$ is the vector of the output multipliers matrix (Leontief inverse) corresponding to column *i*, which gives the output of each sector needed to fulfill one additional unit of final demand directed to sector *i;*

E_i is the value of exports of sector *i*.

The contribution of sector *i* exports to *GDP* can be measured in relative terms, i.e., divided by the value of *GDP* (*Y*), through the following indicator:

$$EYR_i = \frac{EY_i}{Y} = \frac{\mathbf{a}^{\mathrm{V}}\mathbf{B}_{\mathbf{i}}E_i}{\mathbf{a}^{\mathrm{V}}\mathbf{x}} \tag{5}$$

where **x** is the (column) vector of gross output values of the *n* industries.

This indicator can be formulated (or decomposed) as follows:

$$EYR_i = \left(\mathbf{v}_{\mathbf{i}}^{*}\right)\left(\frac{E_i}{E}\right)\left(\frac{E}{Y}\right) \tag{6}$$

where *E* is the value of total exports of the economy and $\mathbf{v}_{\mathbf{i}}^{*} = \mathbf{a}^{\mathrm{V}}\mathbf{B}_{\mathbf{i}}$

The first factor of the product in (6) depends on meso-economic policies (for example, cluster policies) for reinforcement of the industrial network; the second depends on sectoral measures for improving the exports of each industry *i*; the third depends on macroeconomic policies for improving the exports of all sectors.

Each industry can be classified according to the value of EYR_i and, with more detail, by each one of the two first factors (as the third is equal for all of them). It is particularly interesting to assess and compare the "export specialization" of each country and its pattern of evolution over time.

3. Empirical results

In this section the methods and techniques described in section 2 are applied to a group of Euro Area countries, divided in two subgroups, named North-EA (Germany, Netherlands, Finland and Ireland) and South-EA (Greece, Italy, Portugal and Spain).

The main purpose is to show, from an input-output perspective, the different structural conditions of external competitiveness of both groups, a subject of major importance in all circumstances, but overwhelmingly so after the serious global economic crisis of 2008/2009 and the subsequent sovereign debt crisis of Eurozone periphery countries.

The main database used were the national input-output tables of these eight countries from WIOD and the period covered corresponds to all the years for which data was available: 1995-2011. For a detailed description of this database see Timmer (2012). The main results obtained are the following.

3.1 *Trade imbalances and domestic final demand excess or insufficiency in Euro-Area northern and southern countries*

It is a fact well known that southern EA countries (particularly Greece and Portugal) have accumulated in several years before the great recession strong trade and current account imbalances. The other side of this coin is the corresponding large surplus of these accounts in the northern countries (particularly Germany). The numbers, in percentage of GDP, are illustrated in Table 1.

Table 1: Trade imbalances in % GDP, 1995/2011 – 8 Euro Area Countries

	Euro - South				**Euro - North**			
Year	**PRT**	**GRC**	**ESP**	**ITA**	**DEU**	**NDL**	**FIN**	**IRL**
1995	-6,69	-8,12	0,00	3,84	0,60	5,67	7,49	9,25
1996	-7,11	-8,83	0,51	4,72	0,96	5,28	6,96	11,26
1997	-8,11	-8,42	0,83	3,93	1,29	5,67	7,36	16,18
1998	-9,21	-10,17	-0,21	3,22	1,37	4,69	8,06	11,80
1999	-10,32	-10,32	-1,76	1,92	0,88	4,22	9,16	13,89
2000	-10,98	-13,75	-2,97	0,95	0,31	5,55	9,15	13,35
2001	-10,21	-13,51	-2,40	1,39	1,98	5,79	9,33	15,49
2002	-8,28	-13,98	-2,03	0,94	4,50	6,51	9,26	17,14
2003	-6,78	-12,58	-2,27	0,54	3,92	6,29	6,80	16,00
2004	-8,29	-10,29	-3,83	0,70	5,05	7,37	6,50	14,87
2005	-9,38	-9,27	-5,07	-0,06	5,21	8,53	4,07	11,66
2006	-8,49	-11,46	-6,13	-0,82	5,62	7,74	4,70	9,63
2007	-7,72	-14,11	-6,46	-0,25	7,00	8,22	5,12	9,01
2008	-9,69	-14,49	-5,54	-0,83	6,30	8,31	3,77	9,05
2009	-7,28	-11,47	-2,07	-0,53	4,92	7,00	1,63	16,02
2010	-7,28	-9,27	-2,41	-1,99	5,62	8,06	1,34	18,66
2011	-7,28	-8,11	-1,12	-1,42	5,20	8,58	-0,74	21,65
Average	**-8,42**	**-11,07**	**-2,53**	**0,96**	**3,57**	**6,68**	**5,88**	**13,82**

Source: AMECO

The contribution of our input-output based analysis to this subject is to quantify the connection between these negative or positive trade imbalances and the respective

excess or insufficiency of domestic final demand level, relative to the trade balanced situation. The suggestive results of Table 2 allow us to conclude that in Greece the average excess of domestic final demand is more than 14% of GDP and in Portugal it is almost 12%. This excess is much lower in Spain (4%) and it does not even exist in Italy, a country with no trade and current account problems. On the other side, Germany has had in this period a weak domestic final demand, around -5% of GDP relative to the value equilibrating its trade balance, and the situation is even more pronounced in the other northern countries (-10,3% in the Netherlands; -8,4% in Finland). Remarkable is the situation of one of the most punished countries by the sovereign debt crisis of 2010/2011, Ireland, with a large trade surplus of almost 14% of GDP, and a corresponding "insufficiency" of domestic final demand of 26%, showing that this country is in fact "northern" and not "southern" (or "peripheral") in efficiency and competitiveness matters, and recovered easily after its bank crisis was resolved.

Table 2: (E*/D*) - (E/D) (%), 1995/2011 – 8 Euro Area Countries

	Euro - South				Euro - North			
Year	**PRT**	**GRC**	**ESP**	**ITA**	**DEU**	**NDL**	**FIN**	**IRL**
1995	9,37	11,18	0,57	-4,38	-0,48	-8,26	-10,32	-19,97
1996	9,86	11,81	-0,05	-5,46	-1,01	-7,64	-9,66	-20,28
1997	11,16	12,69	-0,39	-4,42	-1,45	-8,36	-10,37	-22,73
1998	12,52	13,65	0,96	-3,44	-1,61	-6,64	-11,25	-19,94
1999	13,66	13,43	2,98	-1,94	-0,98	-5,90	-12,92	-25,70
2000	14,95	17,81	4,87	-0,76	-0,30	-8,31	-13,71	-26,46
2001	13,89	17,92	4,00	-1,34	-2,50	-8,52	-13,60	-32,00
2002	11,43	17,40	3,37	-0,86	-5,93	-9,53	-13,33	-34,30
2003	9,58	15,33	3,61	-0,38	-5,16	-9,13	-9,50	-30,97
2004	11,58	13,24	5,59	-0,58	-6,88	-11,16	-9,35	-28,88
2005	13,05	12,56	7,19	0,43	-7,31	-13,41	-5,90	-21,52
2006	12,22	13,94	8,73	1,46	-8,12	-12,28	-7,15	-16,53
2007	11,21	16,07	9,20	0,69	-10,44	-13,13	-7,78	-15,26
2008	14,02	17,31	8,05	1,28	-9,47	-13,69	-5,65	-15,62
2009	10,02	13,25	3,18	0,82	-6,76	-10,83	-2,12	-29,51
2010	10,02	13,21	3,84	2,72	-7,97	-13,42	-1,61	-38,63
2011	10,09	13,25	2,26	2,16	-7,35	-15,29	1,40	-45,72
Average	**11,69**	**14,36**	**4,00**	**-0,82**	**-4,92**	**-10,32**	**-8,40**	**-26,12**

Source: WIOD and author's calculations

3.2 Exports contribution to GDP: a sectoral analysis of Euro-Area northern and southern countries

According to the methodology proposed in subsection 2.2, the relative contribution of each sector's export to GDP is measured by $EYR_i = (\boldsymbol{v_i}^*) (E_i/E) (E/Y)$, depending on three factors: the value added associated with a unitary increase in sector's *i* exports, the weight of sector's *i* exports in total exports and the weight of total exports in GDP.

Starting by the last factor - the least interesting as it is common to all sectors in each country - the results of Table 3 show that the southern countries are considerably less open to international trade, as far as exports is concerned, particularly Greece, with a ratio of only 15%, and the other countries always under 30%, while the northern countries are very open, including Germany, a relatively large economy, mainly after 2000, but especially Ireland, with more than 100% in 2011.

Table 3: Exports in % GDP (E/Y), %

	1995	2000	2005	2011
PRT	26,25	28,20	27,14	25,97
GRE	14,46	15,23	16,18	15,06
ESP	19,21	25,61	23,02	26,89
ITA	24,73	26,22	25,46	28,61
DEU	24,32	34,29	41,60	46,42
NLD	54,84	58,68	56,62	66,80
FIN	38,44	45,37	43,44	42,91
IRL	77,50	98,29	85,11	103,81

Source: AMECO

The first indicator in the right-hand product, $\boldsymbol{v_i}^*$, tends to be similar in all countries, with service sectors at the top of the scale. This can be confirmed in the results presented on Table A2.1 (in Appendix 2), showing the top 10 sectors for each country (for economy of space, only the results for Portugal, Greece and Germany in 1995 and 2011 are presented here).

Let us look carefully, then, to the second right hand factor of the product, direct export specialization of the countries, and emphasize that the northern countries have an

advantage in this context, with a larger role played by technologically advanced sectors, particularly in Germany (Transport Equipment; Electrical and Optical Equipment; Machinery; Chemicals), while in southern, more peripheral countries (Greece and Portugal) the so-called traditional sectors prevail (Textiles, Food, Beverages and Tobacco, Pulp, Paper and Printing). However, particularly in Portugal, an upgrade along the "exports quality ladder" has been made between 1995 and 2011 (see Table A2.2).

Combining the three previous factors, everything converges with a worse export specialization in the southern countries, measured by the relative contribution of export sectors to GDP, EYR_i, as illustrated in the results of Table A2.3.

In this context, as the value-added multiplier tends to be larger in the case of traditional sectors, the predominant role of these sectors in the euro area southern countries is even clearer. For example, in Portugal the main exporting sector since 2005 is Transport Equipment, with Textiles in the second position, while in terms of export contribution to GDP Textiles comes first in all the years and Transport Equipment falls to fourth in 2011. This result illustrates the importance of considering the interindustry relations of productive sectors when assessing their export contribution to global value-added (GDP) and the pattern of export specialization, a contribution that only the input-output model (and corresponding data) allows.

3.3 The external imbalance correction after the sovereign debt crisis: the Portuguese case and a comparison with Germany

The adjustment programs of 2011/2014 imposed by the Troika (EU, ECB and IMF) to the southern countries of the Euro Area were based on a strong demand compression (fiscal austerity and wage cuts) which led to a rapid correction of the external imbalances of these countries.

The Portuguese case is well illustrative of these effects, as the numbers in Table 4 reveal. After 2012, Portugal has a surplus in the trade balance until the years affected by the Covid pandemics (2020,2021 and 2022), but in 2023 and 2024 the trade balance surpluses returned. The foreign trade surpluses in Germany remained large until 2021 (always above 5%), decreasing a little in the last 3 years of this period, particularly in 2022 (2,47%).

Table 4: Trade balance in % GDP, 2012/2024 – Portugal and Germany

Year	PRT	DEU
2012	-0,49	6,04
2013	1,10	5,77
2014	0,15	6,54
2015	0,74	7,41
2016	1,19	7,26
2017	1,08	6,95
2018	0,62	5,87
2019	0,54	5,61
2020	-2,00	5,31
2021	-2,78	5,12
2022	-2,40	2,47
2023	1,18	3,97
2024	1,85	3,78

Source: AMECO and author's calculations

Using now the relation between trade imbalances and domestic final demand excess or insufficiency, presented in sub-section 2.1, we can conclude that after a period of strong trade imbalances and excess of domestic final demand until 2011, around 11% (quantified in Table 2), the situation was inverted and Portugal has entered a phase of trade balance surpluses and domestic final demand below the level of trade balance equilibrium, of around 5% in 2013 and 2017 (see Table 5). In Germany, the situation of weak domestic final demand and corresponding strong trade surpluses persisted in 2013 (almost 23%) and 2017 (around 18%).

Table 5: (E*/D*) - (E/D) (%), 2013/2017 – Portugal and Germany

Year	PRT	DEU
2013	-5,06	-22,94
2017	-5,42	-18,33

Source: INE, Statistisches Bundesamt and author's calculations

The domestic final demand channel operated essentially through the reduction of imports. But another important factor explaining the correction of trade (and current

account) imbalances in Portugal after the sovereign debt crisis was the strong reinforcement of exports, from around 25% of GDP in 2011 to around 45% in 2024. As can be seen in Table 6, the weight of exports in Portugal's GDP has become similar to that of Germany, and even higher in the last 3 years.

Table 6: Exports in % GDP (E/Y%), 2012/2024 – Portugal and Germany

Year	PRT	DEU
2012	37,72	42,69
2013	39,56	41,68
2014	40,19	41,69
2015	40,69	42,59
2016	40,36	41,63
2017	42,94	42,20
2018	43,68	42,50
2019	43,65	42,34
2020	37,26	39,12
2021	41,55	42,52
2022	49,48	45,63
2023	47,16	42,97
2024	45,77	41,43

Source: AMECO and author's calculations

To better assess the sustainability of trade and current account balances and the strength of Portuguese competitiveness, it is useful to carefully look at each productive sectors's export contribution to GDP. As shown in section 2, this contribution depends on 2 factors: the value-added multiplier by sector and the weight of each sector's exports in total exports.

The top ten value added multiplier sectors in Portugal after the sovereign debt crisis (2013 and 2017) were service activities, as expected, namely Real Estate Activities, Education, Public Administration and Defense, Financial Intermediation and Retail and Wholesale Trade (see Table 7).

In Germany, the service activities are also those with higher value-added multipliers, both in 2013 and 2017 (see Table 8).

Table 7: Value added multiplier by sector, v_i^* (top ten sectors) – Portugal

2013			2017		
c29	Real Estate Activities	0,9893	c29	Real Estate Activities	0,9791
c32	Education	0,9692	c32	Education	0,9717
c31	Public Admin and Defence	0,9446	c31	Public Admin and Defense	0,9489
c28	Financial Intermediation	0,9379	c28	Financial Intermediation	0,9368
c21	Retail Trade	0,9261	c21	Retail Trade	0,9148
c20	Wholesale Trade	0,9150	c34	Other Com, S. and P. Serv.	0,8974
c30	Other Business Act.	0,9035	c20	Wholesale Trade	0,8917
c34	Other Com, S. and P. Serv.	0,8966	c30	Other Business Activities	0,8828
c26	Other Supp. Transport Act.	0,8832	c22	Hotels and Restaurants	0,8655
c22	Hotels and Restaurants	0,8586	c26	Other Supp. Transport Act.	0,8504

Source: INE and author's calculations

Table 8: Value added multiplier by sector, v_i^* (top ten sectors) – Germany

2013			2017		
c29	Real Estate Activities	0,9687	c32	Education	0,9697
c32	Education	0,9675	c29	Real Estate Activities	0,9669
c34	Other Com, S. and P. Serv.	0,9474	c34	Other Com, S. and P. Serv.	0,9413
c33	Health and Social Work	0,9324	c31	Public Admin and Defense	0,9312
c31	Public Admin and Defence	0,9308	c33	Health and Social Work	0,9267
c30	Other Business Activities	0,9202	c21	Retail Trade	0,9117
c21	Retail Trade	0,9131	c28	Financial Intermediation	0,9025
c28	Financial Intermediation	0,9087	c30	Other Business Activities	0,8976
c20	Wholesale Trade	0,9034	c20	Wholesale Trade	0,8968
c19	Sale, Maint. R. Motor Vehi.	0,9001	c19	Sale, Maint. R. Motor Vehi.	0,8921

Source: Statistisches Bundesamt and author's calculations

Regarding the weight of each sector's exports in total exports, the improvement of the Portuguese production structure continued along the value chain ladder, with the reinforcement of medium or high value added sectors (Transport Equipment, Electrical and Optical Equipment, Chemicals) but the most significant change was the increase in the relative importance of tradable services, namely Air Transport and Other Business Activities, the second top sector in 2017 (see Table 9).

In Germany, the sectors with the greatest direct weight in total exports are the manufacturing sectors, above all the Transport Equipment sector (almost 20%), and also Machinery, Chemicals and Electrical and Optical Equipment (see Table 10).

Table 9: Weight of each sector's exports in total exports (E_i/E) (%) – Portugal

2013			2017		
c15	Transport Equipment	8,14	c15	Transport Equipment	11,22
c8	Coke, Refined Petroleum	7,08	c30	Other Business Activities	7,15
c3	Food, Beverages and Tobac.	6,72	c4	Textiles and Text. Products	6,96
c12	Basic Metals; Fabric. Met.	6,63	c3	Food, Beverages and Toboc.	6,93
c25	Air Transport	6,36	c12	Basic Metals; Fabric. Metals	6,89
c30	Other Business Activities	6,16	c14	Electrical and Opti. Equipm.	6,53
c4	Textiles and Text. Products	5,97	c25	Air Transport	5,32
c14	Electrical and Opti. Equipm.	5,46	c9	Chemicals and Chem. Prod.	5,24
c9	Chemicals and Chem. Prod.	5,20	c8	Coke, Refined Petroleum	5,22
c20	Wholesale Trade	3,87	c10	Rubber and Plastics	4,07

Source: INE and author's calculations

Table 10: Weight of each sector's exports in total exports (E_i/E) (%) – Germany

2013			2017		
c15	Transport Equipment	18,54	c15	Transport Equipment	19,03
c13	Machinery, Nec	12,80	c13	Machinery, Nec	11,82
c9	Chemicals and Chem. Pr.	11,56	c9	Chemicals and Chem. Pr.	11,24
c14	Electrical and Opt. Equip.	9,09	c14	Electrical and Opt. Equip.	9,31
c30	Other Business Activities	7,09	c30	Other Business Activities	8,79
c12	Basic Metals; Fabric. Met.	7,06	c12	Basic Metals; Fabric. Met.	6,39
c20	Wholesale Trade	5,59	c20	Wholesale Trade	6,26
c3	Food, Beverages and Tob.	4,44	c3	Food, Beverages and Tob.	4,08
c10	Rubber and Plastics	3,02	c10	Rubber and Plastics	2,86
c28	Financial Intermediation	2,51	c28	Financial Intermediation	2,52

Source: Statistisches Bundesamt and author's calculations

In Portugal, the role of Other Business Activities is even more significant in terms of its export contribution to GDP (see Table 11), occupying the top place in 2013 and 2017, with almost double the value of the second-placed sector in this last year (Food, Beverages and Tobacco). In the third place in 2017, Wholesale Trade deserves a special reference, above the traditional Textiles sector. It is also worth mentioning that the sector with the greatest direct weight in total exports is only ranked seventh in terms of exports contribution to GDP, due to the low value of its value-added multiplier. And the

same occurs with Coke and Refined Petroleum, a significant direct exports sector that does not even appear in the top 10 sectors, according to the exports contribution to GDP criterium. These last two results emphasize once again the importance of the input-output methodology for the analysis of the productive structure of an economy, because it considers not only the direct connections between sectors and the direct contents of crucial macroeconomic variables (domestic demand, exports, imports, GDP), but also the indirect and induced relations and effects.

In Germany, the sectors with grater sectoral export contribution to GDP are the manufacturing activities already mentioned (see Table 12).

Table 11: Sectoral export contribution to GDP, EYR_i (%) - Portugal

2013			2017		
c30	Other Business Activities	2,14	c30	Other Business Activities	3,20
c3	Food, Beverages and Tobac.	1,67	c3	Food, Beverages and Tobac.	1,62
c4	Textiles and Text. Produc.	1,46	c20	Wholesale Trade	1,61
c12	Basic Metals; Fabric. Metals	1,42	c4	Textiles and Text. Produc.	1,59
c25	Air Transport	1,37	c12	Basic Metals; Fabric. Metals	1,37
c20	Wholesale Trade	1,36	c25	Air Transport	1,36
c15	Transport Equipment	1,03	c15	Transport Equipment	1,21
c14	Electrical and Opti. Equipm.	0,91	c14	Electrical and Opti. Equipm.	1,06
c9	Chemicals and Chem. Prod.	0,91	c23	Inland Transport	0,96
c26	Other Supp. Transport Act.	0,78	c9	Chemicals and Chem. Prod.	0,93

Source: INE and author's calculation

Table 12: Sectoral export contribution to GDP, EYR_i (%) - Germany

2013			2017		
c15	Transport Equipment	4,46	c15	Transport Equipment	4,97
c13	Machinery, Nec	3,48	c13	Machinery, Nec	3,34
c9	Chemicals and Chem. Pr.	2,60	c30	Other Business Activities	3,06
c14	Electrical and Opt. Equip.	2,47	c9	Chemicals and Chem. Pr.	2,64
c30	Other Business Activities	2,45	c14	Electrical and Opt. Equip.	2,59
c20	Wholesale Trade	1,89	c20	Wholesale Trade	2,17
c12	Basic Metals; Fabric. Met.	1,73	c12	Basic Metals; Fabric. Met.	1,60
c3	Food, Beverages and Tob.	1,19	c3	Food, Beverages and Tob.	1,13
c28	Financial Intermediation	0,86	c28	Financial Intermediation	0,88
c10	Rubber and Plastics	0,70	c27	Post and Telecommunicatio.	0,73

Source: Statistisches Bundesamt and author's calculations

Unfortunately, the latest Input-Output table now available for Portugal is from the year 2020, and this was a very atypical year due to the Covid-19 pandemic. It was for this reason that we decided to limit the analysis of the effects of the sovereign debt crisis and the corresponding Portuguese adjustment program to the years 2013 and 2017. But it is well known that structural changes in economies are slow, cumulative and progressive. It will therefore be interesting to supplement this analysis with more recent IO tables, when they become available.

4. Concluding remarks

In this paper, an input-output approach was used to study the large differences of competitiveness and growth potential between several northern and southern countries of the euro area, namely the relation between current account (trade) imbalances and domestic final demand levels, as well as the sectoral specialization of tradable goods and services production.

The empirical results of the paper were based on input-output tables for several years: 1995, 2000, 2005 and 2008, available in the World Input Output Database. The northern euro-area group is formed by Germany, Netherlands, Finland and Ireland. The southern is the so-called GIPS group (Greece, Italy, Portugal and Spain).

In the less competitive (current account deficit) economies of southern euro area, domestic final demand levels were in excess of its equilibrium values and the opposite occurs in the strong, competitive economies of the north, since the mid 1990's until the recent macroeconomic crises of 2008/2009 and 2010/2011. Particularly serious imbalances were found, and quantified, in Greece and Portugal, in the (deficit) southern side, and in The Netherlands, Finland and Germany, in the (surplus) northern side.

These external imbalances were accompanied and explained by a different geographic pattern of specialization favorable to the northern euro area countries, in which the export pattern is based on sectors with higher value added and more intensive technological activities. The southern countries, Portugal and above all Greece, but not so much Spain and Italy, have the bulk of their exports made by traditional, lower value added, sectors.

After the sovereign debt crisis, a significant correction of trade imbalances was made in the euro area peripheral countries, mainly through a large domestic demand and imports compression, but also through a more export led orientation. The quantification of this correction was shown for the Portuguese case, at the macroeconomic level and the sectoral dimension.

The Portuguese economy appears to become more similar to the German one, in terms of trade balances, weight of exports in GDP and sectoral specialization, but traditional sectors and service activities (namely those related to tourism) still prevail, and it remains to be seen whether the positive external indicators of this economy can withstand a severe macroeconomic recession.

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Appendix 1. Input-output model and the coefficients of value-added content of domestic demand and exports

If an economy is modeled according to the well-known Leontief model (for a detailed exposition of this model see Miller and Blair (2009) and Amaral and Lopes, 2018), the basic equation is:

$$\mathbf{x} = \mathbf{A}\,\mathbf{x} + \mathbf{y}, \tag{A1}$$

Where **x** is the column vector of gross output values of the *n* sectors of the economy; **y** is the final demand vector and **A** is the technical coefficients matrix.

The solution of this system is:

$$\mathbf{x} = (\mathbf{I}-\mathbf{A})^{-1}\,\mathbf{y}, \tag{A2}$$

Where $(\mathbf{I}-\mathbf{A})^{-1}$ is the so-called Leontief inverse matrix of output multipliers (hereinafter represented by **B**), whose generic element, b_{ij}, gives the increase of setors' *j* production caused by an additional unitary final demand directed to sector *i.*

The vector of (total) final demand can be decomposed in two vectors: one corresponding to domestic final demand, $\mathbf{y^D}$ (D = Private Consumption + Public Consumption + Gross Capital Formation), and the other corresponding to external final demand, $\mathbf{y^E}$ (E = Exports):

$$\mathbf{y} = \mathbf{y^D} + \mathbf{y^E} \tag{A3}$$

In this case, the solution of the Leontief system is given by:

$$\mathbf{x} = \mathbf{B}\,(\mathbf{y^D} + \mathbf{y^E}). \tag{A4}$$

The next step is to calculate the primary factors' incomes (wages and profits, including also, for simplicity, net indirect taxes) necessary for sectoral production, $\mathbf{x}$, and for final demand.

$$VA = \mathbf{a^V}\,\mathbf{B}\,\mathbf{a^D}\,D + \mathbf{a^V}\,\mathbf{B}\,\mathbf{a^E}\,E + a^t{}_D\,D \tag{A5}$$

where: VA is the total amount of wages and profits (plus net indirect taxes) of the economy, i.e. Gross Value Added (VA), corresponding to GDP at market prices; $\mathbf{a^V}$ is the vector of value added coefficients of the n sectors ($a^v{}_j = VA_j/X_j$); $\mathbf{a^D}$ and $\mathbf{a^E}$ are the vertical coefficients of domestic and external demand components directed to the productive sectors; $a^t{}_D$ is the vertical coefficient of net indirect taxes on final demand components (consumption and investment only, as this coefficient is null in the case of public consumption, as well as exports); D and E are the values of the final demand components.

From (A5) the coefficients of value added content of domestic demand and exports can be deducted as:

$va_D = \mathbf{a^V}\,\mathbf{B}\,\mathbf{a^D} + a^t{}_D$

$va_E = \mathbf{a^V}\,\mathbf{B}\,\mathbf{a^E}$

As the sum of value added coefficients and import coefficients must sum one (as the equilibrium condition of the input-output model imposes that total value added plus imports equal total final demand), the coefficients of import content of domestic demand and exports are (1 - va_D) and (1 - va_E), respectively.

APPENDIX 2 - Tables

Table A2.1: Value added multiplier by sector, vi* (top ten sectors)

PORTUGAL - 1995			PORTUGAL - 2011		
c28	Financial Intermediation	0,941	c28	Financial Intermediation	0,940
c26	Other Supporting and Auxiliary Transport Activit	0,937	c20	Wholesale Trade	0,881
c27	Post and Telecommunications	0,901	c30	Renting of M&Eq and Other Business Activities	0,877
c1	Agriculture, Hunting, Forestry and Fishing	0,889	c26	Other Supporting and Auxiliary Transport Activit	0,868
c23	Inland Transport	0,874	c27	Post and Telecommunic.	0,865
c20	Wholesale Trade	0,873	c22	Hotels and Restaurants	0,858
c2	Mining and Quarrying	0,872	c34	Oth. Community, S. P. Ser.	0,843
c30	Renting of M&Eq and Other Business Activities	0,869	c2	Mining and Quarrying	0,839
c17	Electricity, Gas and Water	0,865	c1	Agriculture, Hunting, Forestry and Fishing	0,816
c22	Hotels and Restaurants	0,849	c23	Inland Transport	0,807
GREECE - 1995			**GREECE - 2011**		
c27	Post and Telecommunications	0,971	c27	Post and Telecommunications	0,956
c28	Financial Intermediation	0,968	c28	Financial Intermediation	0,942
c34	Other Community, Social and Personal Services	0,939	c34	Other Community, Social and Personal Services	0,911
c30	Renting of M&Eq and Other Business Activities	0,927	c22	Hotels and Restaurants	0,900
c20	Wholesale Trade and Commission Trade, Except	0,920	c26	Other Supporting and Auxiliary Transport Activit	0,897
c17	Electricity, Gas and Water Supply	0,919	c20	Wholesale Trade and Commission Trade, Except	0,896
c1	Agriculture, Hunting, Forestry and Fishing	0,910	c17	Electricity, Gas and Water Supply	0,889
c2	Mining and Quarrying	0,907	c30	Renting of M&Eq and Other Business Activities	0,882
c22	Hotels and Restaurants	0,903	c2	Mining and Quarrying	0,851
c11	Other Non-Metallic Mineral	0,861	c5	Leather, Leather and Footwear	0,843
GERMANY 1995			**GERMANY 2011**		
c30	Renting of M&Eq and Other Business Activities	0,962	c30	Renting of M&Eq and Other Business Activities	0,944
c27	Post and Telecommunications	0,956	c34	Other Community, Social and Personal Services	0,917
c34	Other Community, Social and Personal Services	0,947	c20	Wholesale Trade	0,903
c20	Wholesale Trade	0,946	c28	Financial Intermediation	0,893
c28	Financial Intermediation	0,939	c22	Hotels and Restaurants	0,879
c23	Inland Transport	0,919	c27	Post and Telecommunications	0,858
c17	Electricity, Gas and Water	0,910	c23	Inland Transport	0,856
c22	Hotels and Restaurants	0,907	c26	Other Supporting and Auxiliary Transport Activit	0,848
c2	Mining and Quarrying	0,892	c17	Electricity, Gas and Water	0,846
c26	Other Supporting and Auxiliary Transport Activit	0,890	c2	Mining and Quarrying	0,805

Source: WIOD and author's calculations

Table A2.2: Weight of each sector's exports in total exports (Ei/E) (%)

PORTUGAL - 1995			PORTUGAL - 2011		
c4	Textiles and Textile Products	18,881	c15	Transport Equipment	8,860
c14	Electrical and Optical Equipment	10,078	c4	Textiles and Textile Products	7,327
c15	Transport Equipment	9,571	c14	Electrical and Optical Equipment	7,083
c5	Leather and Footware	6,416	c3	Food, Beverages and Tobacco	6,850
c25	Air Transport	5,129	c7	Pulp, Paper, Printing	6,614
c3	Food, Beverages and Tobacco	4,985	c12	Basic Metals and Fabricated Metal	6,115
c7	Pulp, Paper, Printing	4,946	c25	Air Transport	5,261
c9	Chemicals and Chemical Products	3,802	c30	Renting of M&Eq and Other Business Activ	4,827
c6	Wood and Cork	3,524	c13	Machinery, Nec	4,364
c11	Other Non-Metallic Mineral Products	3,402	c23	Inland Transport	4,271
GREECE - 1995			**GREECE - 2011**		
c24	Water Transport	16,040	c24	Water Transport	42,070
c4	Textiles and Textile Products	12,788	c20	Wholesale Trade and Commission Trade, E	5,425
c3	Food, Beverages and Tobacco	12,670	c12	Basic Metals and Fabricated Metal	5,362
c1	Agriculture, Hunting, Forestry and Fishing	12,543	c8	Coke, Refined Petroleum and Nuclear Fuel	4,956
c12	Basic Metals and Fabricated Metal	8,591	c26	Other Supporting and Auxiliary Transport A	4,414
c20	Wholesale Trade and Commission Trade, E	6,780	c3	Food, Beverages and Tobacco	4,239
c9	Chemicals and Chemical Products	2,842	c30	Renting of M&Eq and Other Business Activ	3,656
c11	Other Non-Metallic Mineral	2,490	c9	Chemicals and Chemical Products	3,571
c8	Coke, Refined Petroleum and Nuclear Fuel	2,239	c1	Agriculture, Hunting, Forestry and Fishing	3,549
c26	Other Supporting and Auxiliary Transport A	2,195	c25	Air Transport	3,466
GERMANY - 1995			**GERMANY - 2011**		
c15	Transport Equipment	18,612	c15	Transport Equipment	19,494
c13	Machinery, Nec	14,759	c14	Electrical and Optical Equipment	12,793
c14	Electrical and Optical Equipment	13,804	c13	Machinery, Nec	12,711
c9	Chemicals and Chemical Products	12,510	c9	Chemicals and Chemical Products	11,541
c12	Basic Metals and Fabricated Metal	9,485	c12	Basic Metals and Fabricated Metal	10,460
c3	Food, Beverages and Tobacco	4,191	c3	Food, Beverages and Tobacco	4,746
c7	Pulp, Paper, Printing	3,556	c30	Renting of M&Eq and Other Business Activ	3,921
c4	Textiles and Textile Prod.	3,464	c10	Rubber and Plastics	3,426
c10	Rubber and Plastics	3,249	c7	Pulp, Paper, Printing	3,063
c30	Renting of M&Eq and Other Business Activ	2,548	c24	Water Transport	1,937

Source: WIOD and author’s calculations

Table A2.3: Sectoral export contribution to GDP, EYRi

PORTUGAL - 1995			PORTUGAL - 2011		
c4	Textiles and Textile Products	3,569	c4	Textiles and Textile Products	1,450
c14	Electrical and Optical Equipment	1,524	c7	Pulp, Paper, Printing	1,316
c15	Transport Equipment	1,348	c3	Food, Beverages and Tobacco	1,305
c5	Leather and Footware	1,191	c15	Transport Equipment	1,257
c7	Pulp, Paper, Printing	1,042	c14	Electrical and Optical Equipment	1,113
c3	Food, Beverages and Tobacco	1,010	c30	Renting of M&Eq and Other Business Activ	1,099
c25	Air Transport	0,959	c12	Basic Metals, Fabr Metal	0,997
c11	Other Non-Metallic Mineral	0,731	c25	Air Transport	0,986
c9	Chemicals	0,706	c23	Inland Transport	0,895
c6	Wood and Cork	0,706	c13	Machinery, Nec	0,733
GREECE - 1995			**GREECE - 2011**		
c1	Agriculture, Hunting, Forestry and Fishing	0,887	c24	Water Transport	5,551
c24	Water Transport	0,871	c20	Wholesale Trade and Commission Trade, E	4,147
c3	Food, Beverages and Tobacco	0,827	c26	Other Supporting and Auxiliary Transport A	4,034
c4	Textiles and Textile Products	0,719	c12	Basic Metals and Fabricated Metal	3,780
c20	Wholesale Trade and Commission Trade, E	0,485	c3	Food, Beverages and Tobacco	2,998
c12	Basic Metals and Fabricated Metal	0,449	c30	Renting of M&Eq and Other Business Activ	1,719
c11	Other Non-Metallic Mineral	0,167	c1	Agriculture, Hunting, Forestry and Fishing	1,593
c9	Chemicals and Chemical Products	0,157	c9	Chemicals and Chemical Products	1,094
c26	Other Supporting and Auxiliary Transport A	0,142	c25	Air Transport	1,092
c30	Renting of M&Eq and Other Business Activ	0,133	c4	Textiles and Textile Products	0,721
GERMANY - 1995			**GERMANY - 2011**		
c15	Transport Equipment	3,461	c15	Transport Equipment	5,551
c13	Machinery, Nec	2,943	c13	Machinery, Nec	4,147
c14	Electrical and Optical Equipment	2,681	c14	Electrical and Optical Equipment	4,034
c9	Chemicals and Chemical Products	2,483	c9	Chemicals and Chemical Products	3,780
c12	Basic Metals, Fabr Metal	1,785	c12	Basic Metals, Fabr Metal	2,998
c3	Food, Beverages and Tobacco	0,860	c30	Renting of M&Eq and Other Business Activ	1,719
c7	Pulp, Paper, Printing	0,733	c3	Food, Beverages and Tobacco	1,593
c10	Rubber and Plastics	0,634	c7	Pulp, Paper, Printing	1,094
c4	Textiles and Textile Products	0,625	c10	Rubber and Plastics	1,092
c30	Renting of M&Eq and Other Business Activ	0,596	c24	Water Transport	0,721

Source: WIOD and author's calculations